



**AFRICAN DEVELOPMENT BANK
AFRICAN DEVELOPMENT FUND**



Athi Water Works Development Agency

BIDDING DOCUMENT FOR PROCUREMENT OF WORKS

Procurement of

NAIROBI RIVERS BASIN REHABILITATION AND RESTORATION PROGRAM: SEWERAGE IMPROVEMENT PROJECT (PHASE II)

Lot 3-Construction of Mwiki & Clay Works Reticulation Sewer

IFB No: AWWDA/NaRSIP II/W-03/2020

Issued on: August, 2020

Kenya

Preface

This Bidding Document for Procurement of Works has been prepared by Athi Water Works Development Agency and is based on the Standard Bidding Document for Procurement of Works issued by the African Development Bank,¹ dated June 2010.

The Standard Bidding Document for Procurement of Works reflects the structure and the provisions of the Master Document for Procurement of Works issued by the Multilateral Development Banks, except where specific considerations within the African Development Bank have required a change.

¹ "Bank" shall mean the African Development Bank, the African Development Fund, the Nigeria Trust Fund, as well as any other funds administered by the African Development Bank, and any or all of these entities, as the context may require.

Standard Bidding Document

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PART 1 – Bidding Procedures

Section I. Instructions to Bidders

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Section I. Instructions to Bidders

A. GENERAL

- 1. Scope of Bid** 1.1 The Employer indicated in Section II, Bid Data Sheet (BDS) issues this Bidding Document for the procurement of Works, as specified in Section VI, Requirements. The name, identification, and number of lots are provided in the BDS.
- 1.2 Unless otherwise stated, throughout this Bidding Document definitions and interpretations shall be as prescribed in Section VII, General Conditions.
- 2. Source of Funds** 2.1 The Borrower or Recipient (hereinafter called “Borrower”) indicated in the BDS has applied for or received financing (hereinafter called “funds”) from the African Development Bank² (hereinafter called “the Bank”) toward the cost of the project named in the BDS. The Borrower intends to apply a portion of the funds to eligible payments under the contract(s) for which this Bidding Document is issued.
- 2.2 Payments by the Bank will be made only at the request of the Borrower and upon approval by the Bank in accordance with the terms and conditions of the financing agreement between the Borrower and the Bank (hereinafter called the Loan Agreement), and will be subject in all respects to the terms and conditions of that Loan Agreement. No party other than the Borrower shall derive any rights from the Loan Agreement or have any claim to the funds.
- 3. Fraud and Corruption** 3.1 It is the Bank’s policy to require that Borrowers (including beneficiaries of Bank Financing), as well as Bidders, Suppliers, and contractors, and their agents (whether declared or not), subcontractors, sub-consultants, service providers or suppliers, and any personnel thereof, under Bank-financed contracts, observe the highest standard of ethics during the procurement and execution of such contracts³. In pursuance of this policy, the Bank:
- (a) defines, for the purposes of this provision, the terms set forth below as follows:
- (i) “Corrupt Practice” is the offering, giving, receiving, or soliciting, directly or indirectly, of anything of value to influence improperly the actions of another party⁴;
- (ii) “Fraudulent practice” is any act or omission, including a misrepresentation that knowingly or recklessly misleads, or attempts to

² The specific financing institution shall be as stipulated in the **BDS**.

³ In this context, any action to influence the procurement process or contract execution for undue advantage is improper.

⁴ For the purpose of this sub-paragraph, “another party” refers to a public official acting in relation to the procurement process or contract execution. In this context, “public official” includes Bank staff and employees of other organizations taking or reviewing procurement decisions.

mislead, a party to obtain financial or other benefit or to avoid an obligation;

(iii) “Collusive Practice” is an arrangement between two or more parties⁵, designed to achieve an improper purpose, including to influence improperly the actions of another party; and

(iv) “Coercive practice” is impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party⁶;

(v) “Obstructive practice” is

(aa) deliberately destroying, falsifying, altering, or concealing of evidence material to the investigation or making false statements to investigators in order to materially impede a Bank investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; and/or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation, or

(bb) acts intended to materially impede the exercise of the Bank’s inspection and audit rights provided for under paragraph 3.1(e) below.

(b) will reject a proposal for award if it determines that the Bidder recommended for award, or any of its personnel, or its agents, or its sub-consultants, sub-contractors, service providers, suppliers and/or their employees has, directly or indirectly engaged in corrupt, fraudulent, collusive, coercive or obstructive practices in competing for the Contract in question;

(c) will declare misprocurement and cancel the portion of the Financing allocated to a contract if it determines at any time that representatives of the Borrower or of a recipient of any part of the proceeds of such Financing engaged in corrupt, fraudulent, collusive, coercive or obstructive practices during the procurement or the implementation of that contract, without the Borrower having taken timely and appropriate action satisfactory to the Bank to address such practices when they occur, including by failing to inform the Bank in a timely manner at the time they knew of the practices;

(d) will sanction a firm or individual, at any time, in accordance with the prevailing Bank’s sanctions procedures⁷ including by publicly declaring

⁵ For the purpose of this sub-paragraph, “parties” refers to participants in the procurement process (including public officials) attempting either themselves, or through another person or entity not participating in the procurement or selection process, to simulate competition or to establish bid prices at artificial, non-competitive levels, or are privy to each other’s bid prices or other conditions.

⁶ For the purpose of this sub-paragraph, “party” refers to a participant in the procurement process or contract execution.

⁷ A firm or an individual may be declared ineligible to be awarded a Bank financed contract: (i) upon completion of the Bank’s sanctions proceedings as per its sanctions procedures, including, inter alia, cross-debarment as agreed with other International Financial Institutions, including Multilateral Development Banks, or otherwise decided by the Bank; and through the application of the Proposal for the Implementation of a Sanctions Process within the African Development Bank Group; and (ii) as a result

such firm or individual ineligible to bid for, or to be awarded Bank-financed contracts either indefinitely or for a stated period of time, (i) to be awarded a Bank-financed contract; (ii) to be a nominated⁸ sub-contractor, consultant, supplier, or service provider of an otherwise eligible firm being awarded a Bank-financed contract ; and

(e) will require that a clause be included in Bidding Documents and in contracts financed by the Bank, requiring bidders, suppliers and contractors and their sub-contractors, agents, personnel, consultants, service providers, or suppliers, to permit the Bank to inspect all accounts and records and other documents relating to the submission of bids and contract performance and to have them audited by auditors appointed by the Bank.

3.2 Furthermore, Bidders shall be aware of the provisions stated in Section VII, General Conditions.

4. Eligible Bidders

4.1 A Bidder may be a natural person, private entity, government-owned entity—subject to ITB 4.5—or any combination of such entities supported by a letter of intent to enter into an agreement or under an existing agreement in the form of a joint venture, consortium, or association (JVCA). In the case of a joint venture, consortium, or association:

a) unless otherwise specified in the BDS, all partners shall be jointly and severally liable, and

b) the JVCA shall nominate a Representative who shall have the authority to conduct all businesses for and on behalf of any and all the partners of the JVCA during the bidding process and, in the event the JVCA is awarded the Contract, during contract execution.

4.2 A Bidder, and all parties constituting the Bidder, shall have the nationality of an eligible country, in accordance with the Bank's **Rules and Procedures for Procurement of Goods and Works**, and as listed in Section V, Eligible Countries.⁹ A Bidder shall be deemed to have the nationality of a country if the Bidder is a citizen or is constituted, incorporated, or registered and operates in conformity with the provisions of the laws of that country. This criterion shall also apply to the determination of the nationality of proposed subcontractors or suppliers for any part of the Contract including Related Services.

4.3 A Bidder shall not have a conflict of interest. All Bidders found to have a conflict of interest shall be disqualified. A Bidder may be considered to have a conflict of interest with one or more parties in this

of temporary suspension or early temporary suspension in connection with an on-going sanction proceeding. See footnote 18 and paragraph 9 of Appendix 1 of the Rules and Procedures for Procurement of Goods and Works.

⁸ A nominated sub-contractor, consultant, manufacturer or supplier, or service provider (different names are used depending on the particular bidding documents) is one which has either been: (i) included by the bidder in its pre-qualification application or bid because it brings specific and critical experience and know-how that allow the bidder to meet the qualification requirement for the particular bid; or (ii) appointed by the Borrower."

⁹ Including eligibility criteria for participation in the supply of goods, works and related services.

bidding process, if:

- (a) they have controlling partners in common; or
- (b) they receive or have received any direct or indirect subsidy from any of them; or
- (c) they have the same legal representative for purposes of this bid; or
- (d) they have a relationship with each other, directly or through common third parties, that puts them in a position to have access to information about or influence on the bid of another Bidder, or influence the decisions of the Employer regarding this bidding process; or
- (e) A Bidder participates in more than one bid in this bidding process. Participation by a Bidder in more than one Bid will result in the disqualification of all Bids in which it is involved. However, this does not limit the inclusion of the same subcontractor, not otherwise participating as a Bidder, in more than one bid; or
- (f) a Bidder participated as a consultant in the preparation of Section VI, Requirements that are the subject of the bid; or
- (g) A Bidder or any of its affiliates has been hired, or is proposed to be hired, by the Employer or the Borrower for the supervision of the contract.

4.4 A Bidder that is under a declaration of ineligibility by the Bank in accordance with ITB Clause 3, at the date of the deadline for bid submission or thereafter, shall be disqualified.

4.5 Government-owned entities in the Borrower's country shall be eligible only if they can establish that they (i) are legally and financially autonomous, (ii) operate under the principles of commercial law, and (iii) are not dependent agencies of the Employer or the Borrower.

4.6 Bidders shall not be under execution of a Bid-Securing Declaration in the Employer's Country.

4.7 Bidders shall provide such evidence of their continued eligibility satisfactory to the Employer, as the Employer shall reasonably request.

4.8 Firms from an eligible country shall be excluded if:

- (a) as a matter of law or official regulation, the Borrower's country prohibits commercial relations with that country; or
- (b) by an act of compliance with a decision of the United Nations Security Council taken under Chapter VII of the Charter of the United Nations, the Borrower's country prohibits any import of Goods from that country or any payments to persons or entities in that country.

4.9 In case a prequalification process has been conducted prior to the

bidding process, this bidding is open only to prequalified Bidders.

4.10 A firm sanctioned by the Bank in accordance with the above ITB Clause 3.1 (d), or in accordance with the Bank's policies on anti-corruption and fraud and Bank's sanctions procedures¹⁰, shall be ineligible to be awarded a Bank-financed contract, or to benefit from a Bank-financed contract, financially or in any other manner, during the period of time determined by the Bank.

5. Eligible Goods and Related Services

5.1 All goods and Related services to be supplied under the Contract and financed by the Bank, shall have as their country of origin an eligible country of the Bank in accordance with the Bank's **Rules and Procedures for Procurement of Goods and Works**, and as listed in Section V, Eligible Countries.

5.2 For purposes of this Clause, the term "Goods" includes commodities, raw material, machinery, equipment, and industrial plants; and "Related Services" includes services such as insurance, transportation, installation, commissioning, training, and initial maintenance.

5.3 The term "country of origin" means the country where the Goods have been mined, grown, cultivated, produced, manufactured, or processed; or through manufacture, processing, or assembly, another commercially recognised article results that differs substantially in its basic characteristics from its imported components.

5.4 The nationality of the firm that produces, assembles, distributes, or sells the Goods shall not determine their origin.

B. CONTENTS OF BIDDING DOCUMENT

6. Sections of Bidding Document

6.1 The Bidding Document consists of Parts 1, 2, and 3, which include all the Sections indicated below, and should be read in conjunction with any Addenda issued in accordance with ITB 8.

PART 1 Bidding Procedures

Section I. Instructions to Bidders (ITB)

Section II. Bid Data Sheet (BDS)

Section III. Evaluation and Qualification Criteria

Section IV. Bidding Forms

Section V. Eligible Countries

PART 2 Employer's Requirements

Section VI. Requirements

PART 3 Conditions of Contract and Contract Forms

Section VII. General Conditions (GC)

¹⁰ See the Proposal for the Implementation of a Sanctions Process within the African Development Bank Group and the Bank's Whistleblowing and Complaints Handling Policy. The Bank's sanctions procedures are publicly disclosed on the Bank's external website."

Section VIII. Particular Conditions (PC)**Section IX. Contract Forms**

6.2 The Invitation for Bids issued by the Employer is not part of the Bidding Document.

6.3 The Bidder shall obtain the Bidding Document from the source stated by the Employer in the Invitation for Bids; otherwise the Employer is not responsible for the completeness of the Bidding Document.

6.4 The Bidder is expected to examine all instructions, forms, terms, and specifications in the Bidding Document. Failure to furnish all information or documentation required by the Bidding Document may result in the rejection of the bid.

**7. Clarification
of Bidding
Document, Site
Visit, Pre-Bid
Meeting**

7.1 A prospective Bidder requiring any clarification of the Bidding Document shall contact the Employer in writing at the Employer's address indicated in the BDS or raise his enquiries during the pre-bid meeting if provided for in accordance with ITB 7.4. The Employer will respond to any request for clarification, provided that such request is received prior to the deadline for submission of bids, within the number of days specified in the BDS. The Employer's response shall be in writing with copies to all Bidders who have acquired the Bidding Document in accordance with ITB 6.3, including a description of the inquiry but without identifying its source. Should the Employer deem it necessary to amend the Bidding Document as a result of a request for clarification, it shall do so following the procedure under ITB 8 and ITB 22.2.

7.2 Where applicable, the Bidder is advised to visit and examine the project site and obtain for itself on its own responsibility all information that may be necessary for preparing the bid and entering into a contract for the provision of the Requirements. The costs of visiting the site shall be at the Bidder's own expense.

7.3 Pursuant to ITB 7.2, where the Bidder and any of its personnel or agents have been granted permission by the Employer to enter upon its premises and lands for the purpose of such visit, the Bidder, its personnel, and agents will release and indemnify the Employer and its personnel and agents from and against all liability in respect thereof, and will be responsible for death or personal injury, loss of or damage to property, and any other loss, damage, costs, and expenses incurred as a result of the visit.

7.4 The Bidder's designated representative is invited to attend a pre-bid meeting, if provided for in the BDS. The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage. If so provided for in the BDS, the Employer will organise a site visit.

7.5 The Bidder is requested, as far as possible, to submit any questions in writing, to reach the Employer not later than one week before the

meeting.

7.6 Minutes of the pre-bid meeting, including the text of the questions raised without identifying the source, and the responses given, together with any responses prepared after the meeting, will be transmitted promptly to all Bidders who have acquired the Bidding Document in accordance with ITB 6.3. Any modification to the Bidding Document that may become necessary as a result of the pre-bid meeting shall be made by the Employer exclusively through the issue of an Addendum pursuant to ITB 8 and not through the minutes of the pre-bid meeting.

7.7 Non-attendance at the pre-bid meeting will not be a cause for disqualification of a Bidder.

8. Amendment of Bidding Document

8.1 At any time prior to the deadline for submission of bids, the Employer may amend the Bidding Document by issuing addenda.

8.2 Any addendum issued shall be part of the Bidding Document and shall be communicated in writing to all who have obtained the Bidding Document from the Employer in accordance with ITB 6.3.

8.3 To give prospective Bidders reasonable time in which to take an addendum into account in preparing their bids, the Employer may, at its discretion, extend the deadline for the submission of bids, pursuant to ITB 22.2

C.PREPARATION OF BIDS

9. Cost of Bidding

9.1 The Bidder shall bear all costs associated with the preparation and submission of its Bid, and the Employer shall not be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

10. Language of Bid

10.1 The Bid, as well as all correspondence and documents relating to the bid exchanged by the Bidder and the Employer, shall be written in the language specified in the BDS. Supporting documents and printed literature that are part of the Bid may be in another language provided they are accompanied by an accurate translation of the relevant passages in that language, in which case, for purposes of interpretation of the Bid, such translation shall govern.

11. Documents Comprising the Bid

11.1 The Bid shall comprise the following:

- a) Letter of Bid
- b) Completed Schedules as provided in Section IV, Bidding Forms;
- c) Bid Security or Bid -Securing Declaration, in accordance

with ITB 19;

d) at the Bidder's option, alternative proposals, if permissible, in accordance with ITB 13;

e) written confirmation authorising the signatory of the Bid to commit the Bidder, in accordance with ITB 20.2;

f) documentary evidence establishing the eligibility of the Goods and Related Services offered by the Bidder, in accordance with ITB 17.1;

g) documentary evidence establishing the Bidder's qualifications in accordance with the requirements of Section III, Evaluation and Qualification Criteria, using the relevant forms furnished in Section IV, Bidding Forms;

h) documentary evidence as specified in the BDS, establishing the conformity of the Technical Proposal offered by the Bidder with the Bidding Document, using the relevant forms furnished in Section IV, Bidding Forms;

i) in the case of a bid submitted by a JVCA, JVCA agreement, or letter of intent to enter into a JVCA including a draft agreement, indicating at least the parts of the Requirements to be executed by the respective partners;

j) any other document required in the BDS.

**12. Letter of Bid
and Price
Schedules**

12.1 The Bidder shall submit the Letter of Bid using the form furnished in Section IV, Bidding Forms. This form must be completed without any alterations to its format, and no substitutes shall be accepted. All blank spaces shall be filled in with the information requested.

**13. Alternative
Bids**

13.1 Unless otherwise indicated in the BDS, alternative proposals shall not be considered. If alternative proposals are permitted, their method of evaluation shall be as stipulated in Section III, Evaluation and Qualification Criteria.

13.2 When alternative times for completion are explicitly invited, a statement to that effect will be included in the BDS, as will the method of evaluating different times for completion.

13.3 Except as provided under ITB 13.4 below, Bidders wishing to offer technical alternatives to the requirements of the bidding document must first price the Employer's requirements as described in the bidding document and shall further provide all information necessary for a complete evaluation of the alternative by the Employer, including drawings, design calculations, technical specifications, breakdown of prices, and proposed construction methodology and other relevant details. Only the technical alternatives, if any, of the lowest evaluated

Bidder conforming to the basic technical requirements shall be considered by the Employer.

13.4 When specified in the BDS, Bidders are permitted to submit alternative technical solutions for specified parts of the requirements, and such parts shall be identified in the BDS, as will the method for their evaluation, and described in Section VI, Requirements.

14. Bid Prices and Discounts

14.1 The prices and discounts quoted by the Bidder in the Letter of Bid and in the Price Schedules shall conform to the requirements specified in ITB 14.2.

14.2 Unless otherwise provided in the BDS and the General Conditions (GC), the prices quoted by the Bidder shall be fixed.

14.3 The Bidder shall fill in rates and prices for all items of the Works described in the Bill of Quantities. Items against which no rate or price is entered by the Bidder will not be paid for by the Employer when executed and shall be deemed covered by the rates for other items and prices in the Bill of Quantities.

14.4 The price to be quoted in the Letter of Bid, in accordance with ITB 12.1, shall be the total price of the Bid, excluding any discounts offered.

14.5 The Bidder shall quote any unconditional discounts and the methodology for their application in the Letter of Bid, in accordance with ITB 12.1.

14.6 If, pursuant to ITB 14.2, prices are adjustable, the Bidder shall furnish the indices and weightings for the price adjustment formulae in the Schedule of Adjustment Data provided in Section IV, Bidding Forms and the Employer may require the Bidder to justify its proposed indices and weightings.

14.7 If so indicated in ITB 1.1, bids are being invited for individual lots (contracts) or for any combination of lots (packages). Bidders wishing to offer any price reduction for the award of more than one Contract shall specify in their bid the price reductions applicable to each package, or alternatively, to individual Contracts within the package. Price reductions or discounts shall be submitted in accordance with ITB 14.5, provided the bids for all lots (contracts) are submitted and opened at the same time.

14.8 All duties, taxes, and other levies payable by the Contractor under the Contract, or for any other cause, as of the date 28 days prior to the deadline for submission of bids, shall be included in the rates and prices and the total Bid Price submitted by the Bidder.

15. Currencies of Bid and Payment

15.1 The currency(ies) of the bid and the currency(ies) for payment shall be as specified in the BDS.

16. Documents Establishing the

16.1 To establish its qualifications to perform the Contract in accordance with Section III, Evaluation and Qualification Criteria, the Bidder shall

Qualifications of the Bidder	provide the information requested in Section IV, Bidding Forms.
17. Documents Establishing the Eligibility of the Goods and Related Services	17.1 To establish the eligibility of the Goods and Related Services in accordance with ITB Clause 5, Bidders shall complete the forms, included in Section IV, Bidding Forms.
18. Period of Validity of Bids	<p>18.1 Bids shall remain valid for the period specified in the BDS after the bid submission deadline date prescribed by the Employer, pursuant to ITB 22. A bid valid for a shorter period shall be rejected by the Employer as non-responsive.</p> <p>18.2 In exceptional circumstances, prior to the expiration of the bid validity period, the Employer may request Bidders to extend the period of validity of their bids. The request and the responses shall be made in writing. If a bid security is requested in accordance with ITB 19, the Bidder granting the request shall also extend the bid security for twenty-eight (28) days beyond the deadline of the extended validity period. A Bidder may refuse the request without forfeiting its bid security. A Bidder granting the request shall not be required or permitted to modify its bid, except as provided in ITB 18.3.</p> <p>18.3 In the case of fixed price contracts, if the award is delayed by a period exceeding fifty-six (56) days beyond the expiry of the initial bid validity, the Contract price shall be adjusted as specified in the request for extension. Bid evaluation shall be based on the Bid Price without taking into consideration the above correction.</p>
19. Bid Security	<p>19.1 The Bidder shall furnish as part of its bid, at the option of the Employer, and as stipulated in the BDS, the original of either a Bid-Securing Declaration or a bid security using the relevant form included in Section IV, Bidding Forms. In the case of a bid security, the bid security amount and currency shall be as specified in the BDS.</p> <p>19.2 A Bid-Securing Declaration shall use the form included in Section IV, Bidding Forms.</p> <p>19.3 If a bid security is specified pursuant to ITB 19.1, the bid security shall be a demand guarantee in any of the following forms at the Bidder's option:</p> <ul style="list-style-type: none"> (a) an unconditional guarantee issued by a bank or surety; (b) an irrevocable letter of credit; or (c) a cashier's or certified check; <p>from a reputable source from an eligible country. If the unconditional guarantee is issued by an insurance company or a bonding company located outside the Employer's Country, the issuer shall have a correspondent financial institution located in the Employer's Country to make it enforceable. In the case of a bank guarantee, the bid security shall be submitted either using the Bid Security Form included in Section</p>

IV, Bidding Forms or in another substantially similar format approved by the Employer prior to bid submission. In either case, the form must include the complete name of the Bidder. The bid security shall be valid for twenty-eight days (28) beyond the original validity period of the bid, or beyond any period of extension if requested under ITB 18.2.

19.4 Pursuant to the option stipulated at ITB 19.1, any bid not accompanied by a substantially responsive bid security or Bid-Securing Declaration shall be rejected by the Employer as non-responsive.

19.5 If a bid security is specified pursuant to ITB 19.1, the bid security of unsuccessful Bidders shall be returned as promptly as possible upon the successful Bidder's furnishing of the performance security pursuant to ITB 38.

19.6 The bid security of the successful Bidder shall be returned as promptly as possible once the successful Bidder has signed the Contract and furnished the required performance security.

19.7 The bid security may be forfeited or the Bid-Securing Declaration executed:

- (a) if a Bidder withdraws its bid during the period of bid validity specified by the Bidder in the Letter of Bid or
- (b) if the successful Bidder fails to:
 - (i) sign the Contract in accordance with ITB 37; or
 - (ii) furnish a performance security in accordance with ITB 38.

19.8 The Bid Security or the Bid Securing Declaration of a JVCA shall be in the name of the JVCA that submits the bid. If the JVCA has not been legally constituted into a legally enforceable JVCA at the time of bidding, the Bid Security or the Bid Securing Declaration shall be in the names of all future partners as named in the letter of intent referred to in ITB 4.1.

19.9 If a Bid-Securing Declaration is executed in accordance with ITB 19.7, the Employer will declare the Bidder ineligible to be awarded a contract by the Employer for the period of time stated in the Form of Bid-Securing Declaration.

**20. Format and
Signing of Bid**

20.1 The Bidder shall prepare one original of the documents comprising the bid as described in ITB 11 and clearly mark it "ORIGINAL." In addition, the Bidder shall submit copies of the bid, in the number specified in the BDS and clearly mark them "COPY." In the event of any discrepancy between the original and the copies, the original shall prevail.

20.2 The original and all copies of the bid shall be typed or written in indelible ink and shall be signed by a person duly authorised to sign on behalf of the Bidder. This authorisation shall consist of a written confirmation as specified in the BDS and shall be attached to the bid. The

name and position held by each person signing the authorisation must be typed or printed below the signature. All pages of the bid where entries have been made shall be signed or initialled by the person signing the bid.

20.3 A bid submitted by a JVCA shall comply with the following requirements:

(a) Unless not required in accordance with ITB 4.1 (a), be signed so as to be legally binding on all partners; and

(b) Include the Representative's authorisation referred to in ITB 4.1 (b), consisting of a power of attorney signed by those legally authorised to sign on behalf of the JVCA.

20.4 Any amendments, interlineations, erasures, or overwriting shall be valid only if they are signed or initialled by the person signing the bid.

D.Submission and Opening of Bids

21. Submission, Sealing and Marking of Bids

21.1 Bidders may always submit their bids by mail or by hand. If so specified in the BDS, bidders shall have the option of submitting their bids electronically. Procedures for submission, sealing and marking are as follows:

(a) Bidders submitting bids by mail or by hand shall enclose the original and copies of the Bid in separate sealed envelopes. If so permitted in accordance with ITB 13 alternative proposals, and copies thereof, shall also be placed in separate envelopes. The envelopes shall be duly marked as "ORIGINAL," "ALTERNATIVE," "ORIGINAL COPY," and "ALTERNATIVE COPY". These envelopes shall then be enclosed in one single package. The rest of the procedure shall be in accordance with ITB 21.2 and 21.3.

(b) Bidders submitting bids electronically shall follow the electronic bid submission procedures specified in the BDS.

21.2 The inner and outer envelopes shall:

(a) bear the name and address of the Bidder;

(b) be addressed to the Employer in accordance with ITB 22.1;

(c) bear the specific identification of this bidding process pursuant to ITB 1.1; and

(d) bear a warning not to open before the time and date for bid opening

21.3 If envelopes and packages are not sealed and marked as required, the Employer will assume no responsibility for the misplacement or premature opening of the bid.

- 22. Deadline for Submission of Bids** 22.1 Bids must be received by the Employer at the address and no later than the date and time indicated in the BDS.
- 22.2 The Employer may, at its discretion, extend the deadline for the submission of bids by amending the Bidding Document in accordance with ITB 8, in which case all rights and obligations of the Employer and Bidders previously subject to the deadline shall thereafter be subject to the deadline as extended.
- 23. Late Bids** 23.1 The Employer shall not consider any bid that arrives after the deadline for submission of bids, in accordance with ITB 22. Any bid received by the Employer after the deadline for submission of bids shall be declared late, rejected, and returned unopened to the Bidder.
- 24. Withdrawal, Substitution, and Modification of Bids** 24.1 A Bidder may withdraw, substitute, or modify its bid after it has been submitted by sending a written notice, duly signed by an authorised representative, and shall include a copy of the authorisation in accordance with ITB 20.2, (except that withdrawal notices do not require copies). The corresponding substitution or modification of the bid must accompany the respective written notice. All notices must be:
- (a) Prepared and submitted in accordance with ITB 20 and ITB 21 (except that withdrawals notices do not require copies), and in addition, the respective envelopes shall be clearly marked “Withdrawal,” “Substitution,” “Modification;” and
 - (b) Received by the Employer prior to the deadline prescribed for submission of bids, in accordance with ITB 22.
- 24.2 Bids requested to be withdrawn in accordance with ITB 24.1 shall be returned unopened to the Bidders.
- 24.3 No bid may be withdrawn, substituted, or modified in the interval between the deadline for submission of bids and the expiration of the period of bid validity specified by the Bidder on the Letter of Bid or any extension thereof.
- 25. Bid Opening** 25.1 The Employer shall conduct the bid opening in public, in the presence of Bidders` designated representatives and anyone who choose to attend, and at the address, date and time specified in the BDS. Any specific electronic bid opening procedures required if electronic bidding is permitted in accordance with ITB 21.1, shall be as specified in the BDS.
- 25.2 First, envelopes marked “Withdrawal” shall be opened and read out and the envelope with the corresponding bid shall not be opened, but returned to the Bidder. No bid withdrawal shall be permitted unless the corresponding withdrawal notice contains a valid authorisation to request the withdrawal and is read out at bid opening. Next, envelopes marked “Substitution” shall be opened and read out and exchanged with the corresponding bid being substituted, and the substituted bid shall not be opened, but returned to the Bidder. No bid substitution shall be permitted unless the corresponding substitution notice contains a valid

authorisation to request the substitution and is read out at bid opening. Envelopes marked “Modification” shall be opened and read out with the corresponding bid. No bid modification shall be permitted unless the corresponding modification notice contains a valid authorisation to request the modification and is read out at bid opening. Only bids that are opened and read out at bid opening shall be considered further.

25.3 The Employer shall open all other envelopes one at a time and read out: the name of the Bidder, the Bid Price(s), any discounts and their application methodology, alternative bids, the presence or absence of a bid security or Bid-Securing Declaration; and any other details as the Employer may consider appropriate. Only discounts and alternative bids read out at bid opening shall be considered for evaluation. No bid shall be rejected at bid opening except for late bids, in accordance with ITB 23.1.

25.4 The Employer shall prepare a record of the bid opening that shall include, as a minimum: the name of the Bidder and whether there is a withdrawal, substitution, or modification; the Bid Price, per lot if applicable, including any discounts and alternative proposals; and the presence or absence of a bid security or a Bid-Securing Declaration. The Bidders’ representatives who are present shall be requested to sign the record. The omission of a Bidder’s signature on the record shall not invalidate the contents and effect of the record. A copy of the record shall be distributed to all Bidders who submitted bids in time, and posted online when electronic bidding is permitted.

E. Examination of Bids

- 26. Confidentiality** 26.1 Information relating to the evaluation of bids shall not be disclosed to Bidders or any other persons not officially concerned with such process until information on Contract award is communicated to all Bidders.
- 26.2 Any attempt by a Bidder to influence improperly the Employer in the evaluation of the bids or Contract award decisions may result in the rejection of its bid.
- 26.3 Notwithstanding ITB 26.1, from the time of bid opening to the time of Contract award, if any Bidder wishes to contact the Employer on any matter related to the bidding process, it should do so in writing.

27. Clarification of Bids

27.1 To assist in the examination, evaluation, and comparison of the bids, and qualification of the Bidders, the Employer may, at its discretion, ask any Bidder for a clarification of its bid, allowing a reasonable time for response. Any clarification submitted by a Bidder that is not in response to a request by the Employer shall not be considered. The Employer's request for clarification and the response shall be in writing. No change in the prices or substance of the bid shall be sought, offered, or permitted, except to confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the bids, in accordance with ITB 29.

27.2 If a Bidder does not provide clarifications of its bid by the date and time set in the Employer's request for clarification, its bid may be rejected.

28. Determination of Responsiveness

28.1 The Employer's determination of a bid's responsiveness is to be based on the contents of the bid itself, as defined in ITB 11.

28.2 A substantially responsive bid is one that meets the requirements of the Bidding Document without material deviation, reservation, or omission.

(a) "Deviation" is a departure from the requirements specified in the Bidding Document;

(b) "Reservation" is the setting of limiting conditions or withholding from complete acceptance of the requirements specified in the Bidding Document; and

(c) "Omission" is the failure to submit part or all of the information or documentation required in the Bidding Document.

28.3 A material deviation, reservation, or omission is one that,

(a) if accepted, would:

(i) affect in any substantial way the scope, quality, or performance of the Requirements as specified in Section VI; or

(ii) limit in any substantial way, inconsistent with the Bidding Document, the Employer's rights or the Bidder's obligations under the proposed Contract; or

(b) if rectified, would unfairly affect the competitive position of other Bidders presenting substantially responsive bids.

28.4 The Employer shall examine the technical aspects of the bid in particular, to confirm that all requirements of Section VI have been met without any material deviation, reservation, or omission.

28.5 If a bid is not substantially responsive to the requirements of the Bidding Document, it shall be rejected by the Employer and may not subsequently be made responsive by correction of the material deviation, reservation, or omission.

28.6 Provided that a bid is substantially responsive, the Employer may waive any quantifiable nonconformity in the bid that does not constitute a material deviation, reservation or omission.

28.7 Provided that a bid is substantially responsive, the Employer may request that the Bidder submit the necessary information or documentation, within a reasonable period of time, to rectify nonmaterial nonconformities in the bid related to documentation requirements. Requesting information or documentation on such nonconformities shall not be related to any aspect of the price of the bid. Failure of the Bidder to comply with the request may result in the rejection of its bid.

28.8 Provided that a bid is substantially responsive, the Employer shall rectify quantifiable nonmaterial nonconformities related to the Bid Price. To this effect, the Bid Price shall be adjusted, for comparison purposes only, to reflect the price of the non-conforming item or component. The adjustment shall be made using the methodology indicated in Section III, Evaluation and Qualification Criteria.

F. Bid Evaluation and Comparison

29. Correction of Arithmetical Errors

29.1 The Employer shall use the criteria and methodologies indicated in Section III, Evaluation and Qualification Criteria. No other evaluation criteria or methodologies shall be permitted.

29.2 Provided that the bid is substantially responsive, the Employer shall correct arithmetical errors as indicated in Section III, Evaluation and Qualification Criteria.

29.3 If a Bidder does not accept the correction of errors, its bid shall be declared non-responsive and its Bid Security shall be forfeited or the Bid -Securing Declaration executed.

30. Conversion to Single Currency

30.1 For evaluation and comparison purposes, the currency (ies) of the bid shall be converted into a single currency as specified in Section III, Evaluation and Qualification Criteria.

31. Bid Adjustments

32.1 For the evaluation and comparison purposes the Employer shall adjust the bid prices using the criteria and methodology specified in Section III. Evaluation and Qualification Criteria.

32.2 Unless otherwise specified in the BDS, no margin of domestic or regional preference shall apply. If a margin of preference applies, the application methodology shall be as specified in Section III, Evaluation and Qualification Criteria, and in accordance with the provisions stipulated in the Bank's Rules and Procedures for Procurement of Goods and Works.

32.3 If in the opinion of the Employer the bid which results in the lowest Evaluated Bid, is seriously unbalanced or front loaded or substantially below the Employer's estimates, the Employer may require the Bidder to produce detailed price analyses for any or all items of the Bill of Quantities, to demonstrate the internal consistency of those prices with the methods and schedule proposed. After evaluation of the price analyses, taking into consideration the schedule of estimated Contract payments, the Employer may require that the amount of the performance

security be increased at the expense of the Bidder to a level sufficient to protect the Employer against financial loss in the event of default of the successful Bidder under the Contract.

32. Qualification of the Bidder

32.4 The Employer shall determine to its satisfaction whether the Bidder that is selected as having submitted the lowest evaluated and substantially responsive bid meets the qualifying criteria specified in Section III, Evaluation and Qualification Criteria.

33.1 The determination shall be based upon an examination of the documentary evidence of the Bidder's qualifications submitted by the Bidder, pursuant to ITB 16.

33.2 An affirmative determination shall be a prerequisite for award of the Contract to the Bidder. A negative determination shall result in disqualification of the bid, in which event the Employer shall proceed to the next lowest evaluated bid to make a similar determination of that Bidder's qualifications to perform satisfactorily.

33.3 The capabilities of the manufacturers and subcontractors proposed in its Bid to be used by the lowest evaluated Bidder for identified major items of the Requirements will also be evaluated for acceptability in accordance with the criteria and methodologies defined in Section III, Evaluation and Qualification Criteria. Their participation should be confirmed with a letter of intent between the parties, as needed. Should a manufacturer or subcontractor be determined to be unacceptable, the Bid will not be rejected, but the Bidder will be required to substitute an acceptable manufacturer or subcontractor without any change to the bid price.

33. Comparison of Bids

33.1 Subject to ITB 29, 30 and 31, the Employer shall compare all substantially responsive bids to determine the lowest evaluated bid.

34. Employer's Right to Accept Any Bid, and to Reject Any or All Bids

34.1 The Employer reserves the right to accept or reject any bid, and to annul the bidding process and reject all bids at any time prior to contract award, without thereby incurring any liability to Bidders. In case of annulment, all bids submitted and specifically, bid securities, shall be promptly returned to the Bidders.

G. Award of Contract

35. Award Criteria

35.1 Subject to ITB 34.1, the Employer shall award the Contract to the Bidder whose offer has been determined to be the lowest evaluated bid and is substantially responsive to the Bidding Document, provided further that the Bidder is determined to be qualified to perform the Contract satisfactorily.

36. Notification of Award

36.1 Prior to the expiration of the period of bid validity, the Employer shall notify the successful Bidder, in writing, that its bid has been accepted. The notification letter (hereinafter and in the Conditions of Contract and Contract Forms called the "Letter of Acceptance") shall specify the sum that the Employer will pay the Contractor in

consideration of the execution and completion of the Works (hereinafter and in the Contract Forms called “the Contract Price”).

36.2 Until a formal contract is prepared and executed, the notification of award shall constitute a binding Contract.

36.3 At the same time, the Employer shall also notify all other Bidders of the results of the bidding, and shall publish in UNDB online and at the Bank’s website (www.afdb.org), the results identifying the bid and lot numbers and the following information: (i) name of each Bidder who submitted a Bid; (ii) bid prices as read out at bid opening; (iii) name and evaluated prices of each Bid that was evaluated; (iv) name of bidders whose bids were rejected and the reasons for their rejection; and (v) name of the winning Bidder, and the price it offered, as well as the duration and summary scope of the contract awarded. After publication of the award, unsuccessful bidders may request in writing to the Employer for a debriefing seeking explanations on the grounds on which their bids were not selected. The Employer shall promptly respond in writing to any unsuccessful Bidder who, after Publication of contract award, requests a debriefing.

37. Signing Contract

of 37.1 Promptly upon notification, the Employer shall send the successful Bidder the Contract Agreement.

37.2 Within twenty-eight (28) days of receipt of the Contract Agreement, the successful Bidder shall sign, date, and return it to the Employer.

37.3 Upon the successful Bidder’s furnishing of the signed Contract Agreement and Performance Security pursuant to ITB 38, the Employer will discharge its Bid Security, pursuant to ITB 19.

37.4 Notwithstanding ITB 37.2 above, in case signing of the Contract Agreement is prevented by any export restrictions attributable to the Employer, to the country of the Employer, or to the use of the products/goods, systems or services to be supplied, where such export restrictions arise from trade regulations from a country supplying those products/goods, systems or services, the Bidder shall not be bound by its bid, always provided, however, that the Bidder can demonstrate to the satisfaction of the Employer and of the Bank that signing of the Contract Agreement has not been prevented by any lack of diligence on the part of the Bidder in completing any formalities, including applying for permits, authorisations and licenses necessary for the export of the products/goods, systems or services under the terms of the Contract Agreement.

38. Performance Security

38.1 Within twenty-eight (28) days of the receipt of notification of award from the Employer, the successful Bidder shall furnish the performance security in accordance with the conditions of contract, subject to ITB 31.3, using for that purpose the Performance Security Form included in Section IX, Contract Forms, or another form acceptable to the Employer. If the performance security furnished by the successful Bidder is in the form of a bond, it shall be issued by a bonding or insurance company that

has been determined by the successful Bidder to be acceptable to the Employer. A foreign institution providing a bond shall have a correspondent financial institution located in the Employer's Country.

38.2 Failure of the successful Bidder to submit the above-mentioned Performance Security or sign the Contract shall constitute sufficient grounds for the annulment of the award and forfeiture of the bid security, or execution of the Bid-Securing Declaration. In that event the Employer may award the Contract to the next lowest evaluated Bidder whose offer is substantially responsive and is determined by the Employer to be qualified to perform the Contract satisfactorily.

Section II. Bid Data Sheet

A. General	
ITB 1.1	The number of the Invitation for Bids is : AWWDA/NaRSIP II/W-03/2020
ITB 1.1	The Employer is: ATHI WATER WORKS DEVELOPMENT AGENCY
ITB 1.1	<p>The name of the bidding process is: International Competitive Bidding</p> <p>The identification number of the bidding process is: AWWDA/NaRSIP II/W-03/2019</p> <p>The number and identification of lots comprising this bidding process is: N/A</p>
ITB 2.1	The Borrower is: Government of Kenya
ITB 2.1	The specific Bank financing institution is: African Development Bank (AfDB)
ITB 2.1	<p>The name of the Project is:</p> <p style="text-align: center;">NAIROBI RIVERS BASIN REHABILITATION AND RESTORATION PROGRAM: SEWERAGE IMPROVEMENT PROJECT PHASE II</p> <p>Lot 3- Construction of Mwiki & Clay Works Reticulation Sewers</p>
ITB 4.1 (a)	The individuals or firms in a joint venture, consortium or association shall be jointly and severally liable.
ITB 4.4	A list of debarred firms is available at http://www.afdb.org/debarred
B. Contents of Bidding Document	
ITB 7.1	<p>For <u>clarification purposes</u> only, the Employer's address is:</p> <p>Athi Water Works Development Agency. 3rd floor, Africa-Re Centre, Hospital Road, Upper Hill, P.O Box 45283 - 00100 Nairobi, Kenya Tel: +254-20-2724292/3,2711342 Fax: +254-20-2724295 Email: info@awwda.go.ke Website: www.awwda.go.ke</p> <p>Requests for clarifications should be received by the Employer no later than 14 DAYS prior to the deadline for submission of Bids.</p>
ITB 7.4	A Pre-Bid meeting shall NOT take place.

C. Preparation of Bids	
ITB 10.1	The language of the bid is: English
ITB 11.1 (h)	The Bidder must provide the following Documentary Evidence to establish the conformity of the Technical Proposal with the Bidding Document: As per Section IV
ITB 11.1 (j)	The Bidder shall submit with its bid the following additional documents: As per Section IV
ITB 13.1	Alternative bids are NOT permitted.
ITB 13.2	Alternatives to the Times for Completion shall NOT be permitted.
ITB 13.4	Alternative technical solutions shall be permitted for the following parts of the Works, as further detailed in the Specification: None
ITB 14.2	Prices shall be fixed.
ITB 14.6	The prices quoted by the Bidder shall not be subject to adjustment during the performance of the Contract.
ITB 15.1	<p>The currency(ies) of the bid and the payment currency(ies) shall be as described below:</p> <p>Bidders to quote entirely in local currency</p> <p>(a) The unit rates and the prices shall be quoted by the Bidder in the Bill of Quantities, entirely in Kenya Shillings, further referred to as “the local currency”. A Bidder expecting to incur expenditures in other currencies for inputs to the Requirements supplied from outside the Employer’s country (referred to as “the foreign currency (ies) requirements”) shall indicate, in the Summary of Payment Currencies, furnished in Section IV. Bidding Forms, the percentage(s) of the Bid Price (excluding Provisional Sums), needed by him for the payment of such foreign currency requirements, limited to no more than three foreign currencies of any eligible country.</p> <p>(b) The rates of exchange to be used by the Bidder in arriving at the local currency equivalent and the percentage(s) mentioned in (a) above shall be specified by the Bidder in the Summary of Payment Currencies, furnished in Section IV. Bidding Forms, shall apply for all payments under the Contract so that no exchange risk will be borne by the successful Bidder.</p> <p>(c) Bidders may be required by the Employer to justify, to the Employer’s satisfaction, their local and foreign currency requirements, and to substantiate that the amounts included in the unit rates and prices and shown in the Schedule of Adjustment Data, furnished in Section IV. Bidding Forms, are reasonable, in which case a detailed breakdown of the foreign currency requirements shall be provided by Bidders.</p>
ITB 18.1	The bid validity period shall be: 120 days.
ITB 19.1	The Bidder shall furnish a bid security (in the form of unconditional Bank

	Guarantee), in the amount of KShs. 2,000,000.00 or its equivalent in a freely convertible currency;
ITB 20.1	In addition to the original of the bid, the number of copies is: 3 (Three)
ITB 20.2	<p>The written confirmation of authorisation to sign on behalf of the Bidder shall indicate:</p> <p>(a) The name and description of the documentation required to demonstrate the authority of the signatory to sign the Bid such as a Power of Attorney; and</p> <p>In the case of Bids submitted by an existing or intended JVCA an undertaking signed by all parties (i) stating that all parties shall be jointly and severally liable, if so required in accordance with ITB 4.1(a), and (ii) nominating a Representative who shall have the authority to conduct all business for and on behalf of any and all the parties of the JVCA during the bidding process and, in the event the JVCA is awarded the Contract, during contract execution.”]</p>
D. Submission and Opening of Bids	
ITB 21.1	Bidders shall not have the option of submitting their bids electronically.
ITB 21.1 (b)	the electronic bidding submission procedures shall be: N/A
ITB 22.1	<p>For <u>bid submission purposes</u> only, the Employer’s address is :</p> <p>The Chief Executive Officer Athi Water Works Development Agency 3rd floor, Africa-Re Centre, Hospital Road, Upper Hill, P.O Box 45283 - 00100 Nairobi, Kenya</p> <p>The deadline for bid submission is: Date: 22nd September, 2020 Time: 12:00 pm East African Time</p>
ITB 25.1	<p>The bid opening shall take place at: Athi Water Works Development Agency Africa-Re Centre, Hospital Road, Upper Hill, P.O Box 45283 - 00100 Nairobi, Kenya Date: 22nd September, 2020 Time: 12:05 pm East African Time</p>
ITB 25.1	The electronic bid opening procedures shall be: N/A
F. Bid Evaluation and Comparison	
ITB 31.2	A 10% Total Bid Amount margin of domestic preference shall apply.

Section III. Evaluation and Qualification Criteria

This Section contains all the criteria that the Employer shall use to evaluate bids and qualify Bidders. In accordance with ITB 28 and ITB 32, no other factors, methods or criteria shall be used. The Bidder shall provide all the information requested in the forms included in Section IV, Bidding Forms.

1 Evaluation Criteria and Methodology

1.1 Alternative Proposal (If permitted in accordance with ITB 13.1)

Technical Alternative: N/A

Alternative Time for Completion: N/A

1.2 Correction of Arithmetical Errors (In accordance with ITB 29.1)

- (a) Where there are errors between the total of the amounts given under the column for the price breakdown and the amount given under the Total Price, the former shall prevail and the latter will be corrected accordingly
- (b) If there is a discrepancy between the unit price and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail and the total price shall be corrected, unless in the opinion of the Employer there is an obvious misplacement of the decimal point in the unit price, in which case the total price as quoted shall govern and the unit price shall be corrected;
- (c) **If there is an error in a total corresponding to the addition or subtraction of subtotals, the subtotals shall prevail and the total shall be corrected; and**
- (d) **If there is a discrepancy between words and figures, the amount in words shall prevail, unless the amount expressed in words is related to an arithmetic error, in which case the amount in figures shall prevail subject to (a) and (b) above.**

1.3 Conversion to a Single Currency (In accordance with ITB 30)

The currency that shall be used for bid evaluation and comparison purposes to convert all bid prices expressed in various currencies into a single currency is:

Kenya Shillings

The source of exchange rate shall be: **Central Bank of Kenya Selling Rate**

The date for the exchange rate shall be: **Bid submission deadline**

1.4 Discounts (In accordance with ITB 14.5)

The Employer will adjust the Bid Price, using the methodology prescribed by the Bidder in its Letter of Bid, to take account of the Discounts offered by the Bidder in its Letter of Bid, as read out at the Bid Opening.

1.5 Quantifiable Nonmaterial Nonconformities (In accordance with ITB 28.8)

The adjustment shall be made using the following methodology: N/A

1.6 Margin of Domestic Preference 10% of Bid price

1.7 Any other Criteria or Methodology: N/A

2	Qualification (Without Prequalification)
2.1	Eligibility (TABLE)
2.2	Historical Contract Non-Performance (TABLE)
2.3	Financial Situation (TABLE)
2.4	Experience (TABLE)
2.5	Personnel (TABLE)
2.6	Equipment (TABLE)

2. Qualification Tables (Without Prequalification)

TABLES

Factor	2.1 Eligibility					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture, Consortium or Association			
			All partners combined	Each partner	At least one partner	
2.1.1 Nationality	Nationality in accordance with ITB 4.2.	Must meet requirement	Existing or intended JVCA must meet requirement	Must meet requirement	N / A	Form ELI –1.1 and 1.2, with attachments
2.1.2 Conflict of Interest	No- conflicts of interests as described in ITB 4.3.	Must meet requirement	Existing or intended JVCA must meet requirement	Must meet requirement	N / A	Letter of Bid

Factor	2.1 Eligibility					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture, Consortium or Association			
			All partners combined	Each partner	At least one partner	
2.1.3 Bank Ineligibility	Not having been declared ineligible by the Bank as described in ITB 4.4.	Must meet requirement	Existing JVCA must meet requirement	Must meet requirement	N / A	Letter of Bid
2.1.4 Government Owned Entity	Compliance with conditions of ITB 4.5	Must meet requirement	Must meet requirement	Must meet requirement	N / A	Form ELI –1.1 and 1.2, with attachments
2.1.5 Ineligibility based on a United Nations resolution or Borrower’s country law	Not having been excluded as a result of the Borrower’s country laws or official regulations, or by an act of compliance with UN Security Council resolution, in accordance with ITB 4.8	Must meet requirement	Existing JVCA must meet requirement	Must meet requirement	N / A	Letter of Bid

Factor	2.2 Historical Contract Non-Performance					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture, Consortium or Association			
			All partners combined	Each partner	At least one partner	
2.2.1 History of non-performing contracts	Non-performance of a contract did not occur within the last FIVE (5) years prior to the deadline for application submission, based on all information on fully settled disputes or litigation. A fully settled dispute or litigation is one that has been resolved in accordance with the Dispute Resolution Mechanism under the respective contract, and where all appeal instances available to the bidder have been exhausted.	Must meet requirement by itself or as partner to past or existing JVCA	N / A	Must meet requirement by itself or as partner to past or existing JVCA	N / A	Form CON - 2

Factor	2.2 Historical Contract Non-Performance					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture, Consortium or Association			
			All partners combined	Each partner	At least one partner	
2.2.2 Failure to Sign Contract	Not being under execution of a Bid-Securing Declaration pursuant to ITB 4.6 for THREE (3) years	Must meet requirement	N / A	Must meet the requirement by itself or as partner to a JVCA	N / A	Letter of Bid
2.2.3 Pending Litigation	All pending litigation shall in total not represent more than FIFTY percent (50%) of the Bidder’s net worth and shall be treated as resolved against the Bidder.	Must meet requirement by itself or as partner to past or existing JVCA	N / A	Must meet requirement by itself or as partner to past or existing JVCA	N / A	Form CON – 2

Factor	2.3 Financial Situation					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture, Consortium or Association			
			All partners combined	Each partner	At least one partner	
2.3.1 Historical Financial Performance	Submission of audited balance sheets or if not required by the law of the bidder’s country, other financial statements acceptable to the Employer, for the last FIVE [5] years from 1 st January, 2020 to demonstrate the current soundness of the bidders financial position and its prospective long term profitability. Criterion 1: $\frac{\text{Current Assets}}{\text{Current Liabilities}} > 1$ Criterion 2: $\frac{\text{Total Debt}}{\text{Total Assets}} < 1$	Must meet requirement	N / A	Must meet requirement	N / A	Form FIN – 3.1 with attachments

Factor	2.3 Financial Situation					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture, Consortium or Association			
			All partners combined	Each partner	At least one partner	
2.3.2. Average Annual Turnover	Minimum average annual turnover of Kenya Shillings One Billion, Eight Hundred Million (KShs 1,800,000,000), or equivalent amount in freely convertible currency calculated as total certified payments received for contracts in progress or completed, within the last FIVE (5) years	Must meet requirement	Must meet requirement	Must meet TWENTY FIVE percent (25%) of the requirement	Must meet ONE HUNDRED percent (100%) of the requirement	Form FIN –3.2
2.3.3. Financial Resources	The Bidder must demonstrate access to, or availability of, financial resources such as liquid assets, unencumbered real assets, lines of credit, and other financial means, other than any contractual advance	Must meet requirement	Must meet requirement	Must meet TWENTY FIVE percent (25%) of the requirement	Must meet ONE HUNDRED percent (100%) of the requirement	Form FIN –3.3 + Form CCC

Factor	2.3 Financial Situation					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture, Consortium or Association			
			All partners combined	Each partner	At least one partner	
	payments to meet: (i) the following cash-flow requirement: KES 300,000,000 or equivalent amount in freely convertible currency with adequate proof provided by letter from a reputable bank acceptable to the Employer and (ii) the overall cash flow requirements for this contract and its current commitments.			t	t	

Factor	2.4 Experience					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture, Consortium or Association			
			All partners combined	Each partner	At least one partner	
2.4.1General Experience	Experience under contracts in the role of contractor, subcontractor, or management contractor for at least the last FIVE [5] years prior to the applications submission deadline, and with activity in at least nine (9) months in each year.	Must meet requirement	N / A	Must meet requirement	N / A	Form EXP-2.4.1
2.4.2Specific Experience	(a)Participation as contractor, management contractor, or subcontractor, in at least TWO (2) contracts within the last FIVE (5) years, each with a value of at least Kenya Shillings One Billion and Four Hundred	Must meet requirement	Must meet requirements for all characteristics	N / A	Must meet requirement for one characteristic	Form EXP 2.4.2(a)

Factor	2.4 Experience					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture, Consortium or Association			
			All partners combined	Each partner	At least one partner	
	Million Only (KES 1,400,000,000) that have been successfully and substantially completed and that are similar to the proposed Works. The similarity shall be based on the physical size, complexity, methods/technology or other characteristics as described in Section IV, Bidding Forms.					

Factor	2.4 Experience					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture, Consortium or Association			
			All partners combined	Each partner	At least one partner	
2.4.2 Specific Experience	b) For the above or other contracts executed during the period stipulated in 2.4.2(a) above, a minimum experience in the following key activities: i. Must have undertaken at least one Sewerage project of minimum amount of KES. 1,400,000,000 within the last 5 years ii. Sewer pipework greater than DN 225mm at 6.0 km per month;	Must meet requirements	Must meet requirements	N / A	Must meet requirements	Form EXP-2.4.2(b)

2.5 Personnel

The Bidder must demonstrate that it has the personnel for the **key positions** that meet the following requirements:

No.	Position	Total Similar Work Experience (years)	In Similar Works Experience (years)
1	One (1) Site Agent (registered Civil Engineer or equivalent)	15	7
2	One (1) Deputy Site Agent (Civil Engineer or equivalent)	10	5
3	One (1) Contract Manager (Civil engineer or equivalent)	7	4
4	Two (2) Engineers (university graduate) (Sewers Works)	7	4
5	Two (2) Site Engineering surveyors (Minimum Degree in surveying or Equivalent)	5	5
6.	Environmentalist (University Graduate in Environmental Science or equivalent) – Registered with NEMA	5	4
7.	Two (2) Sociologists (University Graduate in Sociology or equivalent) – Registered with NEMA (or Equivalent)	5	4
8.	2 No Site Works Inspectors/Foremen (Diploma or equivalent in Civil Engineering)	10	5
9.	1 No. Health and Safety Officer (Degree in Engineering, Environmental or Health Sciences/ + training and certification in Occupational Health and Safety Course	7	3

The Bidder shall provide details of the proposed personnel and their experience records using Forms PER-1 and PER-2 included in Section IV, Bidding Forms.

Personnel for the listed positions should either:

- Be fluent in written and spoken English or
- at least one interpreter who is fluent in written and spoken English shall be provided by the contractor for every four personnel who are themselves not fluent in written and spoken English.

2.6 Equipment

The Bidder must demonstrate that it has the key equipment listed hereafter:

No.	Equipment Type and Characteristics	Minimum Number required
(1)	1.5m ³ or 20ton Excavators	3
(2)	Backhoe loader	3
(3)	7-10 ton lorries	2
(4)	15 ton tippers	2
(5)	Motor Graders (3.6m blade)	2
(6)	Concrete Mixers (> 2m ³ /hr)	4
(7)	Concrete dumpers(> 0.75m ³)	4
(8)	Concrete Poker vibrators (35-40mm)	8
(9)	Air compressor (with > 8 Jack hammers)	5
(10)	Mobile rubber tyred Crane (5 ton)	1
(11)	Storm water drainage pumps (> 3m ³ /min.)	2
(12)	Pick up vehicles – 4 Wheel drive	2
(13)	Survey Total Station Equipment	2
(14)	Generators - >15kVA;	1
(15)	12t Compactor Roller	1

The Bidder shall provide further details of proposed items of equipment using the Form EQU in Section IV.

Section IV. Bidding Forms

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Letter of Bid

The Bidder must prepare the Letter of Bid on stationery with its letterhead clearly showing the Bidder's complete name and address.

Date: _____
 Bidding No.: _____
 Invitation for Bid No.: _____

To:

We, the undersigned, declare that:

- (a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (ITB) Clause 8 _____;
- (b) We offer to execute in conformity with the Bidding Documents the following Works:
 _____;
- (c) The total price of our Bid, excluding any discounts offered in item (d) below is: [amount of foreign currency in words], [amount in figures], and [amount of local currency in words], [amount in figures];
- (d) The discounts offered and the methodology for their application are:
 _____;
- (e) Our bid shall be valid for a period of _____ [insert validity period as specified in ITB 18.1.] days from the date fixed for the bid submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;
- (f) If price adjustment provisions apply, the Table(s) of Adjustment Data shall be considered part of this Bid;¹¹
- (g) If our bid is accepted, we commit to obtain a performance security in accordance with ITB 38 and GC 4.2, for the due performance of the Contract;
- (h) Our firm, including any subcontractors or suppliers for any part of the Contract, have nationalities from eligible countries, in accordance with ITB 4.2;

¹¹ Include if price adjustment provisions apply in the Contract in accordance with PC Clause 13.8: Adjustments for Changes in Cost.

- (i) We, including any subcontractors or suppliers for any part of the contract, do not have any conflict of interest in accordance with ITB 4.3;
- (j) We are not participating, as a Bidder or as a subcontractor, in more than one bid in this bidding process in accordance with ITB 4.3, other than alternative offers submitted in accordance with ITB 13;
- (k) Our firm, its affiliates or subsidiaries (including any Subcontractors or Suppliers for any part of the contract), has not been declared ineligible by the Bank, or under execution of a Bid-Securing Declaration in the Employer's country, or under the Employer's country laws or official regulations, or by an act of compliance with a decision of the United Nations Security Council, in accordance with ITB 4.4, 4.6 and 4.8, respectively;
- (l) We are not a government owned entity / We are a government owned entity but meet the requirements of ITB 4.5;¹²
- (m) We are / are not under sanction by the World Bank, the IADB, EBRD or the AsDB for any action of corruption and fraud in accordance with ITB 3. [If under sanction, please provide details including date of start of sanction and duration].
- (n) We have paid, or will pay the following commissions, gratuities, or fees with respect to the bidding process or execution of the Contract: ¹³

Name of Recipient	Address	Reason	Amount
.....
.....

- (o) We undertake that, in competing for (and, if the award is made to us, in executing) the above contract, we will strictly observe the laws against fraud and corruption in force in the country of the Employer, as such laws have been listed by the Employer in the bidding documents for this contract.¹⁴
- (p) We understand that this bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed;
- (q) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive; and
- (r) If awarded the contract, the person named below shall act as Contractor's Representative: _____

Name: _____

¹² Use one of the two options as appropriate.

¹³ If none has been paid or is to be paid, indicate "none".

¹⁴ The Bank will accept the introduction of such undertaking at the request of the Borrowing country, provided the arrangements governing such undertaking are satisfactory to the Bank.

In the capacity of:

Signed:

Duly authorised to
sign the Bid for and
on behalf of:

Date:

Bill of Quantities/Schedules of Prices

PREAMBLE TO BILL OF QUANTITIES

1. The Bills of Quantities forms part of the Contract Documents and are to be read in conjunction with the Instructions to Bidders, Conditions of Contract, Specifications and Drawings.
2. The brief description of the items in the Bills of Quantities is purely for the purpose of identification, and in no way modifies or supersedes the detailed descriptions given in the Conditions of Contract and Specifications for the full direction and description of work and materials.
3. The Quantities given in the Bills of Quantities are estimated, representing substantially the work to be carried out, and are given to provide a common basis for bidding and comparing of Bids. There is no guarantee to the Contractor that he will be required to carry out all the quantities of work indicated under any one particular item or group of items in the Bill of Quantities. The basis of payment shall be the Contractor's rates and the quantities of work actually done in fulfillment of his obligation under the Contract.
4. The prices and rates inserted in the Bills of Quantities will be used for valuing the work executed, and the Engineer will only measure the whole of the works executed in accordance with this Contract.
5. A price or rate shall be entered in ink against every item in the Bills of Quantities with the exception of items that already have Provisional sums affixed thereto. The bidders are reminded that no "nil" or "included" rates or "lump-sum" discounts will be accepted. The rates for various items should include discounts if any. Bidders who fail to comply will be disqualified.
6. Provisional sums (including Dayworks) in the Bills of Quantities shall be expended in whole or in part at the discretion of the Engineer in accordance with the relevant Clauses of the Conditions of Contract.
7. The price and rates entered in the Bills of Quantities shall, except insofar as it is otherwise provided under the Contract, include all Construction plant to be used, labour, insurance, supervision, compliance testing, materials, erection, maintenance of works, overheads and profits, taxes and duties (excluding VAT) together with all general risks, liabilities and obligations set out or implied in the Contract, transport, electricity and telephones, water, use and replenishment of all consumables, including those required under the contract by the Engineer and his staff.
8. Errors in the pricing of the Bills of Quantities will be corrected in accordance with the relevant Clause of the instructions to bidders.

9. The whole cost of complying with the provisions of the Contract shall be included in the Items provided in the priced Bill of Quantities, and where no Items are provided, the cost shall be deemed to be distributed among the rates and prices entered for the related Items of Work.
10. General directions and descriptions of work and materials are not necessarily repeated or summarized in the Bill of Quantities. References to the relevant sections of the Contract documentation shall be made before entering prices against each item in the priced Bill of Quantities.
11. The method of measurement of completed work for payment shall be in accordance with the *Civil Engineering Standard Method of Measurement* Version 3.
12. "Authorised" "Directed" or "Approved" shall mean the authority, direction or approval of the Engineer.
13. Unless otherwise stated, all measurements shall be net taken on the finished work carried out in accordance with the details shown on the drawings or instructed, with no allowance for extra cuts or fills, waste or additional thickness necessary to obtain the minimum finished thickness or dimensions required in this contract. Any work performed in excess of the requirements of the plans and specifications will not be paid for, unless ordered in writing by the Engineer.
14. Units of Measurement and abbreviations used herein shall have the following meanings:

Unit	Abbreviation	Unit	Abbreviation
cubic meter	m ³ or cu m	millimeter	mm
hectare	ha	month	month
hour	hr	number	No.
kilogram	kg	provisional sum	P.S.
kilometre	km	square meter	m ² or sq m
lump sum	L.S.	square millimeter	mm ² or sq mm
meter	m	vehicle	veh
metric ton (1,000 kg)	t	week	wk
months	mths		

Schedule of Adjustment Data

Table A - Local Currency

Index Code	Index Description	Source Index	of	Base Value and Date	Bidder's Local Currency Amount	Bidder's Proposed Weighting
	Nonadjustable	—		—	—	A: _____ B: _____ C: _____ D: _____ E: _____
Total						1.00

Table B - Foreign Currency

Name of Currency: _____

If the Bidder wishes to quote in more than one foreign currency, this table should be repeated for each foreign currency.

Index Code	Index Description	Source Index	of	Base Value and Date	Bidder's Currency in Type/Amount	Equivalent in FC1	Bidder's Proposed Weighting
	Nonadjustable	—		—	—		A: _____ B: _____ C: _____ D: _____ E: _____
Total							1.00

Summary of Payment Currencies

Table: Alternative A

Forinsert name of Section of the Works.

Separate tables may be required if the various sections of the Works (or of the Bill of Quantities) will have substantially different foreign and local currency requirements. The Employer should insert the names of each Section of the Works.

	A	B	C	D
Name of Payment Currency	Amount of Currency	Rate of Exchange to Local Currency	Local Currency Equivalent $C = A \times B$	Percentage of Net Bid Price (NBP) $\frac{100 \times C}{NBP}$
Local currency _____		1.00		
Foreign Currency #1 _____				
Foreign Currency #2 _____				
Foreign Currency #3 _____				
Net Bid Price				100.00
Provisional Sums Expressed in Local Currency		1.00		
BID PRICE				

DAYWORK SCHEDULE					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KSh.)
	<p>CLASS A - GENERAL ITEMS</p> <p>The rates entered in the following schedules will be used in assessing the cost of any extra work ordered by the Engineer for execution on a Dayworks basis.</p> <p>If any rate is found to be grossly in excess of prevailing market rates the Engineer shall use the market rate for this purpose. The rates indicated are to include for Contractor's profit, administration, tools, supervision, overheads and all other costs in relation to the provision of labour, materials or plant indicated.</p> <p>Labour</p>				
A411.1	Unskilled labourer	h	2,000.00		
A411.2	Foreman	h	500.00		
A411.3	Assistant foreman	h	500.00		
A411.4	Plant operator	h	500.00		
A411.5	Vehicle driver	h	1,000.00		
A411.6	Mason	h	500.00		
A411.7	Concretor	h	500.00		
A411.8	Carpenter	h	1,000.00		
A411.9	Plumber/welder	h	1,000.00		
A411.10	Pipelaye	h	500.00		
A411.11	Electrician	h	500.00		
A411.12	Surveyor	h	500.00		
A411.13	Painter	h	500.00		
A411.14	Technician	h	500.00		
A411.15	Watchman	h	2,000.00		
Total C/F to Next Page					

DAYWORK SCHEDULE					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	Total B/F From Previous Page				
	Materials				
	All materials as per specifications. The rate to include for delivery to site, storage and handling.				
A413.1	Coarse aggregates for concrete	m3	300.00		
A413.2	Fine aggregates (sand) for concrete	m3	300.00		
A413.3	Ordinary portland cement	t	25.00		
A413.4	150mm thick building stone/concrete blocks	nr	500.00		
A413.5	225mm thick building stone/concrete blocks	nr	1,000.00		
A413.6	Hardcore	m3	50.00		
A413.7	Murram/gravel	m3	50.00		
A413.8	Spigot and socket concrete pipes 150mm dia.	m	100.00		
A413.9	Spigot and socket concrete pipes 225mm dia.	m	100.00		
A413.10	Spigot and socket concrete pipes 300mm dia.	m	100.00		
A413.11	Spigot and socket concrete pipes 375mm dia.	m	100.00		
A413.12	Spigot and socket concrete pipes 450mm dia.	m	100.00		
A413.13	Spigot and socket concrete pipes 525mm dia.	m	100.00		
A413.14	Spigot and socket concrete pipes 600mm dia.	m	100.00		
A413.15	Spigot and socket concrete pipes 675mm dia.	m	100.00		
A413.16	Spigot and socket concrete pipes 760mm dia.	m	100.00		
A413.17	Spigot and socket concrete pipes 825mm dia.	m	100.00		
A413.18	Spigot and socket concrete pipes 900mm dia.	m	100.00		
A413.19	uPVC Class 34 pipe 160mm dia	m	50.00		
A413.20	uPVC Class 34 pipe 200mm dia	m	50.00		
A413.21	uPVC Class 34 pipe 225mm dia	m	50.00		
A413.22	uPVC Class 34 pipe 250mm dia	m	50.00		
A413.23	uPVC Class 34 pipe 315mm dia	m	50.00		
A413.24	uPVC Class 34 pipe 355mm dia	m	50.00		
A413.25	uPVC Class 34 pipe 400mm dia	m	50.00		
A413.26	Concrete Class 10/20	m3	50.00		
A413.27	Concrete Grade 15/20	m3	50.00		
A413.28	Concrete Grade 20/20	m3	50.00		
A413.29	Concrete Grade 25/20	m3	50.00		
A413.30	Concrete Grade 30/20	m3	50.00		
A413.31	BRC mesh No. A142	m2	50.00		
A413.32	BRC mesh No. A193	m3	50.00		
A413.33	12mm and under mild steel round bars	t	1.00		
A413.34	16mm and over mild steel round bars	t	1.00		
A413.35	12mm and under high yield steel bars	t	1.00		
A413.36	16mm and over high yield steel bars	t	1.00		
A413.37	Shuttering timber	m2	50.00		
A413.38	Petrol	l	1,000.00		
A413.39	Diesel	l	1,000.00		
A413.40	Lubricants	l	250.00		
A413.41	Road marking paint	l	50.00		
A413.42	Emulsion paint	l	50.00		
A413.43	Gross paint	m2	50.00		
A413.44	Rubber rings	nr	1.00		
A413.45	Steel louvered Door for the power House	sum	1.00		
A413.46	Gabion boxes (2x1x1)	nr	1.00		
	Total C/F to Next Page				

DAYWORK SCHEDULE					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	Total B/F From Previous Page				-
	Plant				
	Rate to include for all operation and maintenance costs, fuel, oil, grease, operators etc.				
A415.1	1 tonne pickup	h	200.00		
A415.2	7 tonne lorry (tipper)	h	100.00		
A415.3	10 tonne lorry (tipper)	h	100.00		
A415.4	15 tonne lorry (tipper)	h	100.00		
A415.5	20 tonne lorry (tipper)	h	100.00		
A415.6	D6 bulldozer	h	50.00		
A415.7	D7 bulldozer	h	50.00		
A415.8	Hydraulic excavator/shovel (1.0m3)	h	50.00		
A415.9	Backhoe tractor (1.0m3)	h	50.00		
A415.10	Wheel loader	h	50.00		
A415.11	Mobile crane (5tonne)	h	50.00		
A415.12	Concrete mixer 1.0m3	h	50.00		
A415.13	Mobile concrete mixer	h	50.00		
A415.14	Dumper, 0.76m3	h	50.00		
A415.15	Dumper, 2.0m3	h	50.00		
A415.16	Dumper, 3.0m3	h	50.00		
A415.17	Dumper, 4.5m3	h	50.00		
A415.18	Concrete vibrator (petrol or diesel) with drive, flex and 40mm poker	h	50.00		
A415.19	Concrete vibrator (petrol or diesel) with drive, flex and 75mm poker	h	50.00		
A415.20	Water bowser (5,000 l)	h	50.00		
A415.21	Portable dewatering pump (50mm dia)	h	50.00		
A415.22	Portable dewatering pump (75mm dia)	h	50.00		
A415.23	Portable dewatering pump (100mm dia)	h	50.00		
A415.24	Portable dewatering pump (150mm dia)	h	50.00		
A415.25	Compaction roller 1 tonne	h	50.00		
A415.26	Compaction roller 3 tonne	h	50.00		
A415.27	Vibrating plate compactor	h	50.00		
A415.28	Air compressor machine (5000 l/min)	h	100.00		
A415.29	Jack hammer (25kg)	h	200.00		
A415.30	Generator (15kVA)	h	100.00		
A415.31	Generator (150kVA)	h	100.00		
A415.32	Electric welding set including electrodes	h	50.00		
A415.33	Cutting and welding set including oxygen and acetylene	h	50.00		
A415.34	Lowbed	trips	1.00		
A415.34	Iron mongers quotation for the pipe works and fittings and contractor's adjustment	ls	1.00		
A415.35	Grinder c/w accessories	ls	1.00		
	Total Dayworks (Plant) C/F to Item No. 1A42*7				

BILL NO. 1 - PRELIMINARIES AND GENERAL ITEMS					
ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT
	CLASS A - GENERAL ITEMS				
	Contractual Requirements				
	<i>Allow for Provision of:</i>				
11A110	Performance Security	Item	L.S		
11A120.1	Insurance for Works and Contractor's Equipment	Item	L.S		
11A120.3	Insurance against Injury to Third Party Persons and Damage Contractor's Equipment as	Item	L.S		
	Specified Requirements				
	<i>Offices and Accommodation for the Engineer's Staff</i>				
1A211.1	Provide Engineer's offices as specified or instructed by the Engineer	sum		1	5,000,000
1A211.2	Provisional sum for rented accommodation for Engineer's Staff (5 No.)	month	24	150,000	3,600,000
1A211.4	% Adjustment to the provisional sum for Items A211.1 to A211.2	%	8,600,000		
	<i>Services for Engineer's Staff</i>				
1A221.1	Provisional sum for purchase of three Double Cabin Vehicles (2400cc) for use by Engineer's Staff as instructed. Vehicles to revert to	No.	3	6,000,000	18,000,000
1A221.2	Provisional sum for purchase of two Station Wagon Vehicle (2800cc) for use by Engineer's Staff as instructed. Vehicles to revert to the	No.	2	7,000,000	14,000,000
1A221.3	Provisional Sum for maintenance, running, servicing and insurance costs of the vehicles on items A221.1 and A221.2 as directed by the	km	500,000	30	15,000,000
1A221.4	Allow a provisional sum for final repairs and rehabilitation of the vehicles (Item A221.1 and A221.2) before they revert to Employer at the end of the contract.	PS			2,500,000
1A221.5	% Adjustment to the provisional sum for Items A221.1 to A221.4	%	49,500,000		
1A221.6	Provide alternative transport of equivalent and equal specifications to Engineers staff before the acquisition of Item A221.1 and A221.2	km	50,000		
	<i>Equipment for Engineer's Staff</i>				
1A231.1	Provisional sum for furnishing and equipping the R.E's offices. To include furniture, laptop computers, digital cameras, printers e.t.c	PS			2,500,000
1A231.2	Provisional Sum for monthly maintenance of office equipment (printers, cameras etc) for use by the Engineer's Staff	month	24	100,000	2,400,000
1A231.3	% Adjustment to the provisional sum for Items A231.1 to A231.2	%	4,900,000		
	<i>Attendance Upon Engineer's Staff</i>				
1A241	Sum for attendance upon Engineer's Staff by drivers (5No.)	month	90		
1A242	Sum for attendance upon Engineer's staff by office administrative assistants and chain men (4no.)	month	72		
PAGE TOTAL TAKEN TO P&G COLLECTION PAGE					

BILL NO. 1 - PRELIMINARIES AND GENERAL ITEMS					
ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT
	Total B/F From Previous Page				-
	Testing of Materials and Works				
1A250.1	Provisional sum for testing of materials as specified or directed by the Engineer	sum			1,000,000
1A250.2	% Adjustment to the provisional sum for Item A250.1	%	1,000,000.00		
1A260.1	Provisional sum for testing of the Works as specified or directed by the Engineer	sum			1,000,000
1A260.2	% Adjustment to the provisional sum for Item A260.1	%	1,000,000.00		
A277	Allow for de-watering of all works, trench strutting, unclogging and flushing of existing sewer lines in the vicinity of the works to allow loading of the new sewerlines, including management of effluents	sum			
A278	Traffic regulation (including signages, warning tapes and warning signs); establishment, operation and removal	sum			
	Project Signboards and Plaque				
1A279.1	Provision, fixing, maintaining and removal of site signboards	nr	4		
	Other Provisional sums				
1A279.4	Provisional Sum for fees requested by various authorities and agencies including TELKOM, CABLE companies, NCWSC, road authorities	sum			8,000,000
1A279.5	% Adjustment to the provisional sum for Item A279.4	%	8,000,000		
	Method Related Charges				
	In addition to the items listed hereunder, a tenderer is to insert such items as he may decide to cover, items of work relating to his intended method of executing the works, costs of which are not to be considered as allowed in the rates and prices for the other items				
	Accommodation, Buildings and Services				
1A310	Establish, maintain and remove Contractor's camp including offices, stores, laboratories, cabins, canteens etc and services including electricitv. water. securitv. transport. staff welfare etc	sum			
1A41*.3	Allow a provisional sum of Kshs. 20,000,000 to cover cost for capacity building, training and internship to be expended by the	PS			20,000,000
1A41*.4	Allow a Provisional sum of Kshs. 5,000,000 to cater for monthly site meetings, as directed by the project manager	PS			5,000,000
1A42.2	Allow a Provisional sum for implementing safeguards/ESMP while undertaking the work. Item to be used in conjunction with other water service providers.	P.S			1,000,000
1A42*.3	Allow a Provisional sum of KES 500,000/-, to be spent in whole or part, for HIV/AIDS prevention activities and campaigns to be spent as directed by the Engineer	PS			500,000
1A42*.5	Allow a Provisional sum of KES 1,000,000/-, to be spent in whole or part, for Environmental Conservation and Water Resiliance Program activities and campaigns as well as community mobilization to be spent as directed by the Engineer	PS			1,000,000
1A42*.6	Include Percentage addition to item (A41*.3 to A42*.5) for overheads and profits	%	27,500,000		
1A42*7	Provisional sum for undertaking works under the day works bill as instructed by the Engineer. (summary of Dayworks carried here)	PS	1		
1A42*8	P.C. Sum for Inspection and Witness Testing of Pipes, Fittings and Equipment at manufacturer's premises by the Employer, Engineer and their representatives to be expended as directed by the Engineer	Item	L.S		
1A42*9	P.C. Sum for Third Party Inspection of Pipes, Fittings, Equipment, etc. during Manufacture and Construction Works to be expended as directed by the Engineer	Item	L.S		
	Provision sum of kshs. 5,000,000 for procuring laboratory equipments for the wastewater treatment plant as directed by the	PS			5,000,000
A640	Provision for preparation and submission to the employer 2No. Sets of blue print copies (A1 Size) and in AutoCAD format and hard copy of as built drawings (geo-referenced to the national grid)	Item	1		
BILL 1 P&G TOTAL TAKEN TO GRAND COLLECTION PAGE					

BILL NO. 2: 450mm PRIMARY SEWERS - MWIKI					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	CLASS A - GENERAL ITEMS				
	Testing of the Works				
A260	Carrying out test on 450mm pipeline as specified or directed by the Engineer. Include provision of all equipment and materials	m	950.00		
	CLASS B - SITE INVESTIGATION				
B111	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth ne 1m (Provisional)	nr	5.00		
B112	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 1-2m (Provisional)	nr	5.00		
B113	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 2-3m (Provisional)	nr	5.00		
B114	construction size etc, of pipelines, services or Trial holes where ordered to prove location, existing structures, max depth 3-5m (Provisional)	nr	5.00		
	CLASS D - DEMOLITION AND SITE CLEARANCE				
D100	General site clearance through undeveloped land over the wayleave, include for any additional clearance required	ha	0.31		
D210	Removal of trees, girth 0.5-1m	nr	5.00		
D220	Removal of trees, girth 1-2m	nr	5.00		
D230	Removal of trees, girth 2-3m	nr	5.00		
D310	Removal of stump, diameter 0.5-1m	nr	5.00		
D461	Buildings of indeterminate construction Volume not exceeding 50m3	nr	5.00		
D462	Buildings of indeterminate construction Volume not exceeding 50-100m3	nr	7.00		
D561	Other structures of indeterminate construction Volume not exceeding 50m3	nr	7.00		
D562	Other structures of indeterminate construction Volume not exceeding 50-100m3	nr	7.00		
	CLASS I: PIPEWORK - PIPES				
	PRECAST CONCRETE PIPES TO BS 5911 WITH SPIGOT AND SOCKET FLEXIBLE JOINTS				
	The rates entered against the items in this section shall include for stripping top soil, laying aside and subsequently replacing over refilled trench, excavation in trench in material other than rock, shuttering where necessary, refilling and compacting, spreading surplus soil evenly over and alongside pipe trench compacting, supply lay and joint pipes to correct line and level. Depths are stated from ground level to invert level.				
I 232	Nominal bore 450mm in trenches Depth n.e. 1.5m	m	166.00		
I 233	Depth 1.5m - 2.0m	m	111.00		
I 234	Depth 2.0m - 2.5m	m	160.00		
I 235	Depth 2.5m - 3.0m	m	171.00		
I 236	Depth 3.0m - 3.5m	m	160.00		
I 237	Depth 3.5m - 4.0m	m	121.00		
I 238	Depth >4.0m	m	61.00		
I431	Steel pipes nominal internal diameter 450mm for aerial crossings complete with fittings	m	20.00		
	CLASS K: PIPEWORK - MANHOLES AND PIPEWORK ANCILLARIES				
	Excavation quantities are given net. The rates entered are to include for manhole concrete slabs and covers, step irons or ladder, excavation, working room, trimming the base of the excavation, shuttering where necessary, refilling and compacting around the finished manholes, and disposing of surplus spoil local to the trench. Surplus spoil is to be evenly spread.				
	Manholes				
	Manhole type B, size 1200mm, reinforced concrete manhole slab and cover.				
K 151	Depth n.e 1.5m	nr	4.00		
K 152	Ditto- but depth 1.5m - 2.0m	nr	3.00		
K 153	Ditto- but depth 2.0m - 2.5m	nr	4.00		
K 154	Ditto- but depth 2.5m - 3.0m	nr	4.00		
K 155	Ditto- but depth 3.0m - 3.5m	nr	4.00		
K 156	Ditto- but depth 3.5m - 4.0m	nr	3.00		
K 157	Ditto- but depth >4.0m	nr	2.00		
	Manhole type B, size 1200mm, reinforced concrete manhole slab and cover with				
K 166	Ditto- but depth 3.5m - 4.0m	nr	3.00		
K 167	Ditto- but depth >4.0m	nr	1.00		
	Total C/F to Next Page				

BILL NO. 2: 450mm PRIMARY SEWERS - MWIKI					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	Total B/F From Previous Page				
	Crossings Include for all work associated with the crossings Pipe nominal bore 450mm				
K 631	River, stream and valley crossing and reinstatement;	nr	2.00		
K 642	Hedge crossing and reinstatement;	nr	2.00		
K 652	Wall crossing and reinstatement;	nr	2.00		
K 662	Fence crossing and reinstatement;	nr	2.00		
K682	Underground water mains crossing	nr	8.00		
	Reinstatement <i>Pipe nominal bore 450mm</i>				
K 731	Breaking up, temporary and permanent reinstatement of murrum roads	m	200.00		
K 741	Breaking up, temporary and permanent reinstatement of footpaths with slabs	m	250.00		
K 751	Reinstatement of land	m	300.00		
	CLASS L: SUPPORTS AND PROTECTION ANCILLARIES TO LAYING AND EXCAVATION Extras to Excavation and Backfilling (Note: Blasting not allowed for any rock excavation) In Pipe Trenches				
L111	Excavation of rock (Provisional)	m3	2,333.00		
L117	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	300.00		
L118	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	475.00		
	In manholes and Other Chambers (Note: Blasting not allowed for any rock excavation)				
L121	Excavation of rock (Provisional)	m3	255.00		
L127	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	350.00		
L128	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	280.00		
	Bed, Haunches and Surrounds Granular Material				
L312	Pipeline nominal bore 450mm Sand as per specifications Beds 150 mm thick	m	575.20		
L322	Selected excavated granular material as per specifications Beds 150 mm thick	m	431.40		
L332	Imported granular material as per specifications Beds 150 mm thick	m	431.40		
	Mass Concrete Grade 15/20 in 150mm Thick Beds, Haunches and Surrounds 450mm nominal bore pipeline				
L442.1	Bed and haunch Type A (Concrete 0.1689m3/m)	m	60.00		
L442.2	Bed and haunch Type B (Concrete 0.2645m3/m)	m	126.00		
L442.3	Bed and haunch Type C (Concrete 0.4059m3/m)	m	114.00		
L442.4	Bed and haunch Type D (Concrete 0.4818m3/m)	m	650.00		
	Total C/F to Summary Sheet				

BILL NO. 2: 375mm PRIMARY SEWERS - MWIKI					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	CLASS A - GENERAL ITEMS				
	Testing of the Works				
A260	Carrying out test on 375mm pipeline as specified or directed by the Engineer. Include provision of all equipment and materials	m	1,438.00		
	CLASS B - SITE INVESTIGATION				
B111	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth ne 1m (Provisional)	nr	3.00		
B112	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 1-2m (Provisional)	nr	3.00		
B113	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 2-3m (Provisional)	nr	3.00		
B114	construction size etc, of pipelines, services or Trial holes where ordered to prove location, existing structures, max depth 3-5m (Provisional)	nr	3.00		
	CLASS D - DEMOLITION AND SITE CLEARANCE				
D100	General site clearance through undeveloped land over the wayleave, include for any additional clearance required	ha	0.47		
D210	Removal of trees, girth 0.5-1m	nr	3.00		
D220	Removal of trees, girth 1-2m	nr	3.00		
D230	Removal of trees, girth 2-3m	nr	3.00		
D310	Removal of stump, diameter 0.5-1m	nr	3.00		
D461	Buildings of indeterminate construction Volume not exceeding 50m3	nr	5.00		
D462	Buildings of indeterminate construction Volume not exceeding 50-100m3	nr	3.00		
D561	Other structures of indeterminate construction Volume not exceeding 50m3	nr	5.00		
D562	Other structures of indeterminate construction Volume not exceeding 50-100m3	nr	5.00		
	CLASS I: PIPEWORK - PIPES				
	PRECAST CONCRETE PIPES TO BS 5911 WITH SPIGOT AND SOCKET FLEXIBLE JOINTS				
	The rates entered against the items in this section shall include for stripping top soil, laying aside and subsequently replacing over refilled trench, excavation in trench in material other than rock, shuttering where necessary, refilling and compacting, spreading surplus soil evenly over and alongside pipe trench compacting, supply lay and joint pipes to correct line and level. Depths are stated from ground level to invert level.				
	Nominal bore 375mm in trenches				
I 232	Depth n.e. 1.5m	m	114.00		
I 233	Depth 1.5m - 2.0m	m	55.00		
I 234	Depth 2.0m - 2.5m	m	471.00		
I 235	Depth 2.5m - 3.0m	m	227.00		
I 236	Depth 3.0m - 3.5m	m	109.00		
I 237	Depth 3.5m - 4.0m	m	186.00		
I 238	Depth >4.0m	m	256.00		
I431	Steel pipes nominal internal diameter 375mm for aerial crossings complete with fittings	m	20.00		
	CLASS K: PIPEWORK - MANHOLES AND PIPEWORK ANCILLARIES				
	Excavation quantities are given net. The rates entered are to include for manhole concrete slabs and covers, step irons or ladder, excavation, working room, trimming the base of the excavation, shuttering where necessary, refilling and compacting around the finished manholes, and disposing of surplus spoil local to the trench. Surplus spoil is to be evenly spread.				
	Manholes				
	Manhole type B, size 1050mm, reinforced concrete manhole slab and cover.				
K 151	Depth n.e 1.5m	nr	4.00		
K 152	Ditto- but depth 1.5m - 2.0m	nr	2.00		
K 153	Ditto- but depth 2.0m - 2.5m	nr	11.00		
K 154	Ditto- but depth 2.5m - 3.0m	nr	8.00		
K 155	Ditto- but depth 3.0m - 3.5m	nr	4.00		
K 156	Ditto- but depth 3.5m - 4.0m	nr	5.00		
K 157	Ditto- but depth >4.0m	nr	6.00		
	Manhole type B, size 1050mm, reinforced concrete manhole slab and cover with				
K 166	Ditto- but depth 3.5m - 4.0m	nr	2.00		
K 167	Ditto- but depth >4.0m	nr	8.00		
Total C/F to Next Page					

BILL NO. 2: 375mm PRIMARY SEWERS - MWIKI					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	Total B/F From Previous Page				
	Crossings				
	Include for all work associated with the crossings				
	Pipe nominal bore 375mm				
K 631	River, stream and valley crossing and reinstatement;	nr	3.00		
K 642	Hedge crossing and reinstatement;	nr	3.00		
K 652	Wall crossing and reinstatement;	nr	3.00		
K 662	Fence crossing and reinstatement;	nr	3.00		
K682	Underground water mains crossing	nr	15.00		
	Reinstatement				
	<i>Pipe nominal bore 375mm</i>				
K 731	Breaking up, temporary and permanent reinstatement of murrum roads	m	120.00		
K 741	Breaking up, temporary and permanent reinstatement of footpaths with slabs	m	240.00		
K 751	Reinstatement of land	m	240.00		
	CLASS L: SUPPORTS AND PROTECTION ANCILLARIES TO LAYING AND EXCAVATION				
	Extras to Excavation and Backfilling				
	(Note: Blasting not allowed for any rock excavation)				
	In Pipe Trenches				
L111	Excavation of rock (Provisional)	m3	4,660.00		
L117	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	50.00		
L118	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	346.00		
	In manholes and Other Chambers				
	(Note: Blasting not allowed for any rock excavation)				
L121	Excavation of rock (Provisional)	m3	780.00		
L127	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	200.00		
L128	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	180.00		
	Bed, Haunches and Surrounds				
	Granular Material				
	<u>Pipeline nominal bore 375mm</u>				
L312	Sand as per specifications Beds 150 mm thick	m	575.20		
L322	Selected excavated granular material as per specifications	m	431.40		
L332	Beds 150 mm thick	m	431.40		
	Mass Concrete Grade 15/20 in 150mm Thick Beds, Haunches and Surrounds				
	<u>375mm nominal bore pipeline</u>				
L442.1	Bed and haunch Type A (Concrete 0.1471m3/m)	m	1,048.00		
L442.2	Bed and haunch Type B (Concrete 0.2256m3/m)	m	256.00		
L442.3	Bed and haunch Type C (Concrete 0.3458m3/m)	m	114.00		
L442.4	Bed and haunch Type D (Concrete 0.4093m3/m)	m	1.00		
	Total C/F to Summary Sheet				
BILL NO. 2: 300mm PRIMARY SEWERS - MWIKI					

Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	CLASS A - GENERAL ITEMS				
	Testing of the Works Carrying out test on 300mm pipeline as specified or directed by the Engineer. Include provision of all equipment and materials	m	4,823.00		
	CLASS B - SITE INVESTIGATION				
B111	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth ne 1m (Provisional)	nr	10.00		
B112	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 1-2m (Provisional)	nr	10.00		
B113	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 2-3m (Provisional)	nr	10.00		
B114	construction size etc, of pipelines, services or Trial holes where ordered to prove location, existing structures, max depth 3-5m (Provisional)	nr	10.00		
	CLASS D - DEMOLITION AND SITE CLEARANCE				
D100	General site clearance through undeveloped land over the wayleave, include for any additional clearance required	ha	1.59		
D210	Removal of trees, girth 0.5-1m	nr	10.00		
D220	Removal of trees, girth 1-2m	nr	10.00		
D230	Removal of trees, girth 2-3m	nr	10.00		
D310	Removal of stump, diameter 0.5-1m	nr	10.00		
D461	Buildings of indeterminate construction Volume not exceeding 50m3	nr	16.00		
D462	Buildings of indeterminate construction Volume not exceeding 50-100m3	nr	10.00		
D561	Other structures of indeterminate construction Volume not exceeding 50m3	nr	16.00		
D562	Other structures of indeterminate construction Volume not exceeding 50-100m3	nr	16.00		
	CLASS I: PIPEWORK - PIPES				
	PRECAST CONCRETE PIPES TO BS 5911 WITH SPIGOT AND SOCKET				
	FLEXIBLE JOINTS The rates entered against the items in this section shall include for stripping top soil, laying aside and subsequently replacing over refilled trench, excavation in trench in material other than rock, shuttering where necessary, refilling and compacting, spreading surplus soil evenly over and alongside pipe trench compacting, supply lay and joint pipes to correct line and level.				
	Nominal bore 300mm in trenches				
I 222	Depth n.e. 1.5m	m	627.00		
I 223	Depth 1.5m - 2.0m	m	1,175.00		
I 224	Depth 2.0m - 2.5m	m	1,063.00		
I 225	Depth 2.5m - 3.0m	m	1,061.00		
I 226	Depth 3.0m - 3.5m	m	726.00		
I 227	Depth 3.5m - 4.0m	m	48.00		
I 228	Depth >4.0m	m	123.00		
I421	Steel pipes nominal internal diameter 300mm for aerial crossings complete with fittings	m	20.00		
	CLASS K: PIPEWORK - MANHOLES AND PIPEWORK ANCILLARIES				
	Excavation quantities are given net. The rates entered are to include for manhole concrete slabs and covers, step irons or ladder, excavation, working room, trimming the base of the excavation, shuttering where necessary, refilling and compacting around the finished manholes, and disposing of surplus spoil local to the trench. Surplus spoil is to be evenly spread. Manholes				
	Manhole type B, size 1050mm, reinforced concrete manhole slab and cover.				
K 151	Depth n.e 1.5m	nr	12.00		
K 152	Ditto- but depth 1.5m - 2.0m	nr	23.00		
K 153	Ditto- but depth 2.0m - 2.5m	nr	21.00		
K 154	Ditto- but depth 2.5m - 3.0m	nr	23.00		
K 155	Ditto- but depth 3.0m - 3.5m	nr	15.00		
K 156	Ditto- but depth 3.5m - 4.0m	nr	3.00		
K 157	Ditto- but depth >4.0m	nr	4.00		
	Manhole type B, size 1050mm, reinforced concrete manhole slab and cover with				
K 166	Ditto- but depth 3.5m - 4.0m	nr	2.00		
K 167	Ditto- but depth >4.0m	nr	8.00		
	Total C/F to Next Page				

BILL NO. 2: 300mm PRIMARY SEWERS - MWIKI					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	Total B/F From Previous Page				
	Crossings Include for all work associated with the crossings Pipe nominal bore 300mm				
K 631	River, stream and valley crossing and reinstatement;	nr	10.00		
K 642	Hedge crossing and reinstatement;	nr	10.00		
K 652	Wall crossing and reinstatement;	nr	10.00		
K 662	Fence crossing and reinstatement;	nr	10.00		
K 682	Underground water mains crossing	nr	47.00		
	Reinstatement <i>Pipe nominal bore 300mm</i>				
K 731	Breaking up, temporary and permanent reinstatement of murram roads	m	386.00		
K 741	Breaking up, temporary and permanent reinstatement of footpaths with slabs	m	771.00		
K 751	Reinstatement of land	m	771.00		
	CLASS L: SUPPORTS AND PROTECTION ANCILLARIES TO LAYING AND EXCAVATION				
	Extras to Excavation and Backfilling (Note: Blasting not allowed for any rock excavation)				
	In Pipe Trenches				
L111	Excavation of rock (Provisional)	m3	3,000.00		
L117	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	111.00		
L118	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	1,110.00		
	In manholes and Other Chambers (Note: Blasting not allowed for any rock excavation)				
L121	Excavation of rock (Provisional)	m3	664.00		
L127	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	20.00		
L128	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	194.00		
	Bed, Haunches and Surrounds Granular Material				
	<u>Pipeline nominal bore 300mm</u>				
L312	Sand as per specifications Beds 150 mm thick	m	1,849.20		
L322	Selected excavated granular material as per specifications	m	1,386.90		
L332	Beds 150 mm thick Imported granular material as per specifications Beds 150 mm thick	m	1,386.90		
	Mass Concrete Grade 15/20 in 150mm Thick Beds, Haunches and Surrounds <u>300mm nominal bore pipeline</u>				
L442.1	Bed and haunch Type A (Concrete 0.1278m3/m)	m	3,973.00		
L442.2	Bed and haunch Type B (Concrete 0.1906m3/m)	m	133.00		
L442.3	Bed and haunch Type C (Concrete 0.2966m3/m)	m	697.00		
L442.4	Bed and haunch Type D (Concrete 0.3449m3/m)	m	1.00		
	Total C/F to Summary Sheet				

BILL NO. 2: 225mm SECONDARY SEWERS - MWIKI					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	CLASS A - GENERAL ITEMS				
	Testing of the Works Carrying out test on 225mm pipeline as specified or directed by the Engineer. Include provision of all equipment and materials	m	32,818.00		
	CLASS B - SITE INVESTIGATION				
B111	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth ne 1m (Provisional)	nr	55.00		
B112	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 1-2m (Provisional)	nr	55.00		
B113	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 2-3m (Provisional)	nr	55.00		
B114	construction size etc, of pipelines, services or Trial holes where ordered to prove location, existing structures, max depth 3-5m (Provisional)	nr	55.00		
	CLASS D - DEMOLITION AND SITE CLEARANCE				
D100	General site clearance through undeveloped land over the wayleave, include for any additional clearance required	ha	10.83		
D210	Removal of trees, girth 0.5-1m	nr	25.00		
D220	Removal of trees, girth 1-2m	nr	25.00		
D230	Removal of trees, girth 2-3m	nr	25.00		
D310	Removal of stump, diameter 0.5-1m	nr	25.00		
D461	Buildings of indeterminate construction Volume not exceeding 50m3	nr	25.00		
D462	Buildings of indeterminate construction Volume not exceeding 50-100m3	nr	50.00		
D561	Other structures of indeterminate construction Volume not exceeding 50m3	nr	50.00		
D562	Other structures of indeterminate construction Volume not exceeding 50-100m3	nr	50.00		
	CLASS I: PIPEWORK - PIPES				
	PRECAST CONCRETE PIPES TO BS 5911 WITH SPIGOT AND SOCKET FLEXIBLE JOINTS				
	The rates entered against the items in this section shall include for stripping top soil, laying aside and subsequently replacing over refilled trench, excavation in trench in material other than rock, shuttering where necessary, refilling and compacting, spreading surplus soil evenly over and alongside pipe trench compacting, supply lay and joint pipes to correct line and level. Depths are stated from ground level to invert level.				
	Nominal bore 225mm in trenches				
I 222	Depth n.e. 1.5m	m	6,897.00		
I 223	Depth 1.5m - 2.0m	m	7,205.00		
I 224	Depth 2.0m - 2.5m	m	6,864.00		
I 225	Depth 2.5m - 3.0m	m	4,925.00		
I 226	Depth 3.0m - 3.5m	m	4,507.00		
I 227	Depth 3.5m - 4.0m	m	1,922.00		
I 228	Depth >4.0m	m	398.00		
#####	Steel pipes nominal internal diameter 225mm for aerial crossings complete with fittings	m	100.00		
	CLASS K: PIPEWORK - MANHOLES AND PIPEWORK ANCILLARIES				
	Excavation quantities are given net. The rates entered are to include for manhole concrete slabs and covers, step irons or ladder, excavation, working room, trimming the base of the excavation, shuttering where necessary, refilling and compacting around the finished manholes, and disposing of surplus spoil local to the trench. Surplus spoil is to be evenly spread.				
	Manholes				
	Manhole type B, size 1050mm, reinforced concrete manhole slab and cover.				
K 151	Depth n.e 1.5m	nr	152.00		
K 152	Depth 1.5m - 2.0m	nr	154.00		
K 153	Depth 2.0m - 2.5m	nr	162.00		
K 154	Depth 2.5m - 3.0m	nr	111.00		
K 155	Depth 3.0m - 3.5m	nr	98.00		
K 156	Depth 3.5m - 4.0m	nr	41.00		
K 157	Depth >4.0m	nr	10.00		
	Manhole type B, size 1050mm, reinforced concrete manhole slab and cover with				
K 144	Ditto- but depth 2.5m - 3.0m	nr	27.00		
K 145	Ditto- but depth 3.0m - 3.5m	nr	17.00		
K 146	Ditto- but depth 3.5m - 4.0m	nr	18.00		
K 147	Ditto- but depth >4.0m	nr	13.00		
Total C/F to Next Page					

BILL NO. 2: 225mm PRIMARY SEWERS - MWIKI					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	Total B/F From Previous Page				
	Crossings Include for all work associated with the crossings Pipe nominal bore 225mm				
K 631	River, stream and valley crossing and reinstatement;	nr	6.00		
K 642	Hedge crossing and reinstatement;	nr	10.00		
K 652	Wall crossing and reinstatement;	nr	10.00		
K 662	Fence crossing and reinstatement;	nr	10.00		
K682	Underground water mains crossing	nr	59.00		
	Reinstatement <i>Pipe nominal bore 225mm</i>				
K 731	Breaking up, temporary and permanent reinstatement of murram roads	m	2,735.00		
K 741	Breaking up, temporary and permanent reinstatement of footpaths with slabs	m	1,470.00		
K 751	Reinstatement of land	m	5,470.00		
	CLASS L: SUPPORTS AND PROTECTION ANCILLARIES TO LAYING AND EXCAVATION Extras to Excavation and Backfilling (Note: Blasting not allowed for any rock excavation)				
	In Pipe Trenches				
L111	Excavation of rock (Provisional)	m3	2,000.00		
L117	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	788.00		
L118	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	1,877.00		
	In manholes and Other Chambers (Note: Blasting not allowed for any rock excavation) Excavation of rock				
L121	Excavation of rock (Provisional)	m3	2,736.00		
L127	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	146.00		
L128	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	1,456.00		
	Bed, Haunches and Surrounds Granular Material				
	<u>Pipeline nominal bore 225mm</u>				
L312	Sand as per specifications Beds 150 mm thick	m	13,127.20		
L322	Selected excavated granular material as per specifications	m	9,845.40		
L332	Beds 150 mm thick	m	9,845.40		
	Mass Concrete Grade 15/20 in 150mm Thick Beds, Haunches and Surrounds 225mm nominal bore pipeline				
L442.1	Bed and haunch Type A (Concrete 0.1078m3/m)	m	15,423.00		
L442.2	Bed and haunch Type B (Concrete 0.1558m3/m)	m	398.00		
L442.3	Bed and haunch Type C (Concrete 0.2450m3/m)	m	3,897.00		
L442.4	Bed and haunch Type D (Concrete 0.2821m3/m)	m	1.00		
	Total C/F to Summary Sheet				

BILL NO. 3: 300mm PRIMARY SEWERS - CLAY WORKS					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	CLASS A - GENERAL ITEMS				
	Testing of the Works				
A260	Carrying out test on 300mm pipeline as specified or directed by the Engineer. Include provision of all equipment and materials	m	3,765.00		
	CLASS B - SITE INVESTIGATION				
B111	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth ne 1m (Provisional)	nr	8.00		
B112	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 1-2m (Provisional)	nr	8.00		
B113	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 2-3m (Provisional)	nr	8.00		
B114	construction size etc, of pipelines, services or Trial holes where ordered to prove location, existing structures, max depth 3-5m (Provisional)	nr	8.00		
	CLASS D - DEMOLITION AND SITE CLEARANCE				
D100	General site clearance through undeveloped land over the wayleave, include for any additional clearance required	ha	1.07		
D210	Removal of trees, girth 0.5-1m	nr	8.00		
D220	Removal of trees, girth 1-2m	nr	8.00		
D230	Removal of trees, girth 2-3m	nr	8.00		
D310	Removal of stump, diameter 0.5-1m	nr	8.00		
D461	Buildings of indeterminate construction Volume not exceeding 50m3	nr	12.00		
D462	Buildings of indeterminate construction Volume not exceeding 50-100m3	nr	8.00		
D561	Other structures of indeterminate construction Volume not exceeding 50m3	nr	12.00		
D562	Other structures of indeterminate construction Volume not exceeding 50-100m3	nr	12.00		
	CLASS I: PIPEWORK - PIPES				
	PRECAST CONCRETE PIPES TO BS 5911 WITH SPIGOT AND SOCKET				
	FLEXIBLE JOINTS				
	The rates entered against the items in this section shall include for stripping top soil, laying aside and subsequently replacing over refilled trench, excavation in trench in material other than rock, shuttering where necessary, refilling and compacting, spreading surplus soil evenly over and alongside pipe trench compacting, supply lay and joint pipes to correct line and level. Depths are stated from ground level to invert level.				
	Nominal bore 300mm in trenches				
I 222	Depth n.e. 1.5m	m	465.00		
I 223	Depth 1.5m - 2.0m	m	552.00		
I 224	Depth 2.0m - 2.5m	m	529.00		
I 225	Depth 2.5m - 3.0m	m	889.00		
I 226	Depth 3.0m - 3.5m	m	695.00		
I 227	Depth 3.5m - 4.0m	m	422.00		
I 228	Depth >4.0m	m	213.00		
I431	Steel pipes nominal internal diameter 300mm for aerial crossings complete with fittings	m	20.00		
	CLASS K: PIPEWORK - MANHOLES AND PIPEWORK ANCILLARIES				
	Excavation quantities are given net. The rates entered are to include for manhole concrete slabs and covers, step irons or ladder, excavation, working room, trimming the base of the excavation, shuttering where necessary, refilling and compacting around the finished manholes, and disposing of surplus spoil local to the trench. Surplus spoil is to be evenly spread.				
	Manholes				
	Manhole type B, size 1050mm, reinforced concrete manhole slab and cover.				
K 151	Depth n.e 1.5m	nr	10.00		
K 152	Depth 1.5m - 2.0m	nr	15.00		
K 153	Depth 2.0m - 2.5m	nr	12.00		
K 154	Depth 2.5m - 3.0m	nr	24.00		
K 155	Depth 3.0m - 3.5m	nr	14.00		
K 156	Depth 3.5m - 4.0m	nr	11.00		
K 157	Depth >4.0m	nr	6.00		
K 166	Manhole type B, size 1050mm, reinforced concrete manhole slab and cover with Ditto- but depth 3.5m - 4.0m	nr	7.00		
K 167	Ditto- but depth >4.0m	nr	13.00		
	Total C/F to Next Page				

BILL NO. 3: 300mm PRIMARY SEWERS - CLAY WORKS					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	Total B/F From Previous Page				
	Crossings Include for all work associated with the crossings Pipe nominal bore 300mm				
K 631	River, stream and valley crossing and reinstatement;	nr	8.00		
K 642	Hedge crossing and reinstatement;	nr	8.00		
K 652	Wall crossing and reinstatement;	nr	8.00		
K 662	Fence crossing and reinstatement;	nr	8.00		
K682	Underground water mains crossing	nr	36.00		
	Reinstatement <i>Pipe nominal bore 300mm</i>				
K 731	Breaking up, temporary and permanent reinstatement of murrum roads	m	298.00		
K 741	Breaking up, temporary and permanent reinstatement of footpaths with slabs	m	595.00		
K 751	Reinstatement of land	m	595.00		
	CLASS L: SUPPORTS AND PROTECTION ANCILLARIES TO LAYING AND EXCAVATION				
	Extras to Excavation and Backfilling (Note: Blasting not allowed for any rock excavation)				
	In Pipe Trenches				
L111	Excavation of rock (Provisional)	m3	11,551.00		
L117	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	86.00		
L118	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	856.00		
	In manholes and Other Chambers (Note: Blasting not allowed for any rock excavation)				
L121	Excavation of rock (Provisional)	m3	1,056.00		
L127	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	18.00		
L128	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	176.00		
	Bed, Haunches and Surrounds Granular Material				
	<u>Pipeline nominal bore 300mm</u>				
L312	Sand as per specifications Beds 150 mm thick	m	1,426.00		
L322	Selected excavated granular material as per specifications	m	1,069.50		
L332	Beds 150 mm thick	m	1,069.50		
	Mass Concrete Grade 15/20 in 150mm Thick Beds, Haunches and Surrounds <u>300mm nominal bore pipeline</u>				
L442.1	Bed and haunch Type A (Concrete 0.1278m3/m)	m	3,973.00		
L442.2	Bed and haunch Type B (Concrete 0.1906m3/m)	m	133.00		
L442.3	Bed and haunch Type C (Concrete 0.2966m3/m)	m	697.00		
L442.4	Bed and haunch Type D (Concrete 0.3449m3/m)	m	1.00		
	Total C/F to Summary Sheet				

BILL NO. 3: 225mm SECONDARY SEWERS - CLAY WORKS					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	CLASS A - GENERAL ITEMS				
	Testing of the Works				
A260	Carrying out test on 225mm pipeline as specified or directed by the Engineer. Include provision of all equipment and materials	m	22,604.00		
	CLASS B - SITE INVESTIGATION				
B111	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth ne 1m (Provisional)	nr	46.00		
B112	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 1-2m (Provisional)	nr	46.00		
B113	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 2-3m (Provisional)	nr	46.00		
B114	construction size etc, of pipelines, services or Trial holes where ordered to prove location, existing structures, max depth 3-5m (Provisional)	nr	46.00		
	CLASS D - DEMOLITION AND SITE CLEARANCE				
D100	General site clearance through undeveloped land over the wayleave, include for any additional clearance required	ha	6.78		
D210	Removal of trees, girth 0.5-1m	nr	46.00		
D220	Removal of trees, girth 1-2m	nr	46.00		
D230	Removal of trees, girth 2-3m	nr	46.00		
D310	Removal of stump, diameter 0.5-1m	nr	46.00		
D461	Buildings of indeterminate construction Volume not exceeding 50m3	nr	76.00		
D462	Buildings of indeterminate construction Volume not exceeding 50-100m3	nr	46.00		
D561	Other structures of indeterminate construction Volume not exceeding 50m3	nr	76.00		
D562	Other structures of indeterminate construction Volume not exceeding 50-100m3	nr	76.00		
	CLASS I: PIPEWORK - PIPES				
	PRECAST CONCRETE PIPES TO BS 5911 WITH SPIGOT AND SOCKET FLEXIBLE JOINTS				
	The rates entered against the items in this section shall include for stripping top soil, laying aside and subsequently replacing over refilled trench, excavation in trench in material other than rock, shuttering where necessary, refilling and compacting, spreading surplus soil evenly over and alongside pipe trench compacting, supply lay and joint pipes to correct line and level. Depths are stated from ground level to invert level.				
	Nominal bore 225mm in trenches				
I 222	Depth n.e. 1.5m	m	4,582.00		
I 223	Depth 1.5m - 2.0m	m	5,669.00		
I 224	Depth 2.0m - 2.5m	m	5,411.00		
I 225	Depth 2.5m - 3.0m	m	3,497.00		
I 226	Depth 3.0m - 3.5m	m	2,106.00		
I 227	Depth 3.5m - 4.0m	m	1,024.00		
I 228	Depth >4.0m	m	255.00		
I431.1	Steel pipes nominal internal diameter 225mm for aerial crossings complete with fittings	m	60.00		
	CLASS K: PIPEWORK - MANHOLES AND PIPEWORK ANCILLARIES				
	Excavation quantities are given net. The rates entered are to include for manhole concrete slabs and covers, step irons or ladder, excavation, working room, trimming the base of the excavation, shuttering where necessary, refilling and compacting around the finished manholes, and disposing of surplus spoil local to the trench. Surplus spoil is to be evenly spread.				
	Manholes				
	Manhole type B, size 1050mm, reinforced concrete manhole slab and cover.				
K 151	Depth n.e 1.5m	nr	109.00		
K 152	Depth 1.5m - 2.0m	nr	143.00		
K 153	Depth 2.0m - 2.5m	nr	133.00		
K 154	Depth 2.5m - 3.0m	nr	84.00		
K 155	Depth 3.0m - 3.5m	nr	52.00		
K 156	Depth 3.5m - 4.0m	nr	26.00		
K 157	Depth >4.0m	nr	7.00		
	Manhole type B, size 1050mm, reinforced concrete manhole slab and cover with				
K 164	Ditto- but depth 2.5m - 3.0m	nr	6.00		
K 165	Ditto- but depth 3.0m - 3.5m	nr	20.00		
K 166	Ditto- but depth 3.5m - 4.0m	nr	18.00		
K 167	Ditto- but depth >4.0m	nr	30.00		
	Total C/F to Next Page				

BILL NO. 3: 225mm SECONDARY SEWERS - CLAY WORKS					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	Total B/F From Previous Page				
	Crossings Include for all work associated with the crossings Pipe nominal bore 225mm				
K 631	River, stream and valley crossing and reinstatement;	nr	46.00		
K 642	Hedge crossing and reinstatement;	nr	46.00		
K 652	Wall crossing and reinstatement;	nr	46.00		
K 662	Fence crossing and reinstatement;	nr	46.00		
K682	Underground water mains crossing	nr	227.00		
	Reinstatement <i>Pipe nominal bore 225mm</i>				
K 731	Breaking up, temporary and permanent reinstatement of murrum roads	m	1,884.00		
K 741	Breaking up, temporary and permanent reinstatement of footpaths with slabs	m	3,768.00		
K 751	Reinstatement of land	m	3,768.00		
	CLASS L: SUPPORTS AND PROTECTION ANCILLARIES TO LAYING AND EXCAVATION				
	Extras to Excavation and Backfilling (Note: Blasting not allowed for any rock excavation)				
	In Pipe Trenches				
L111	Excavation of rock (Provisional)	m3	12,000.00		
L117	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	543.00		
L118	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	5,425.00		
	In manholes and Other Chambers (Note: Blasting not allowed for any rock excavation) Excavation of rock				
L121	Excavation of rock (Provisional)	m3	6,648.00		
L127	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	111.00		
L128	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	1,108.00		
	Bed, Haunches and Surrounds Granular Material				
	<u>Pipeline nominal bore 225mm</u>				
L312	Sand as per specifications Beds 150 mm thick	m	9,041.60		
L322	Selected excavated granular material as per specifications	m	6,781.20		
L332	Beds 150 mm thick	m	6,781.20		
	Imported granular material as per specifications Beds 150 mm thick	m			
	Mass Concrete Grade 15/20 in 150mm Thick Beds, Haunches and Surrounds 225mm nominal bore pipeline				
L442.1	Bed and haunch Type A (Concrete 0.1078m3/m)	m	15,423		
L442.2	Bed and haunch Type B (Concrete 0.1558m3/m)	m	398		
L442.3	Bed and haunch Type C (Concrete 0.2450m3/m)	m	3,897		
L442.4	Bed and haunch Type D (Concrete 0.2821m3/m)	m	1		
	Total C/F to Summary Sheet				

BILL NO. 4: 450mm PRIMARY SEWERS - KASARANI					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	CLASS A - GENERAL ITEMS				
	Testing of the Works				
A260	Carrying out test on 450mm pipeline as specified or directed by the Engineer. Include provision of all equipment and materials	m	5,456.00		
	CLASS B - SITE INVESTIGATION				
B111	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth ne 1m (Provisional)	nr	5.00		
B112	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 1-2m (Provisional)	nr	5.00		
B113	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 2-3m (Provisional)	nr	5.00		
B114	construction size etc, of pipelines, services or Trial holes where ordered to prove location, existing structures, max depth 3-5m (Provisional)	nr	5.00		
	CLASS D - DEMOLITION AND SITE CLEARANCE				
D100	General site clearance through undeveloped land over the wayleave, include for any additional clearance required	ha	1.80		
D210	Removal of trees, girth 0.5-1m	nr	5.00		
	CLASS I: PIPEWORK - PIPES				
	PRECAST CONCRETE PIPES TO BS 5911 WITH SPIGOT AND SOCKET FLEXIBLE JOINTS				
	The rates entered against the items in this section shall include for stripping top soil, laying aside and subsequently replacing over refilled trench, excavation in trench in material other than rock, shuttering where necessary, refilling and compacting, spreading surplus soil evenly over and alongside pipe trench compacting, supply lay and joint pipes to correct line and level. Depths are stated from ground level to invert level.				
	Nominal bore 450mm in trenches				
I 232	Depth n.e. 1.5m	m	2,416.00		
I 233	Depth 1.5m - 2.0m	m	811.00		
I 234	Depth 2.0m - 2.5m	m	631.00		
I 235	Depth 2.5m - 3.0m	m	586.00		
I 236	Depth 3.0m - 3.5m	m	423.00		
I 237	Depth 3.5m - 4.0m	m	423.00		
I 238	Depth >4.0m	m	132.00		
I431	Steel pipes nominal internal diameter 450mm for aerial crossings complete with fittings	m	84.00		
	CLASS K: PIPEWORK - MANHOLES AND PIPEWORK ANCILLARIES				
	Excavation quantities are given net. The rates entered are to include for manhole concrete slabs and covers, step irons or ladder, excavation, working room, trimming the base of the excavation, shuttering where necessary, refilling and compacting around the finished manholes, and disposing of surplus spoil local to the trench. Surplus spoil is to be evenly spread.				
	Manholes				
	Manhole type B, size 1200mm, reinforced concrete manhole slab and cover.				
K 151	Depth n.e 1.5m	nr	48.00		
K 152	Ditto- but depth 1.5m - 2.0m	nr	37.00		
K 153	Ditto- but depth 2.0m - 2.5m	nr	21.00		
K 154	Ditto- but depth 2.5m - 3.0m	nr	12.00		
K 155	Ditto- but depth 3.0m - 3.5m	nr	4.00		
K 156	Ditto- but depth 3.5m - 4.0m	nr	2.00		
K 157	Ditto- but depth >4.0m	nr	1.00		
	Manhole type B, size 1200mm, reinforced concrete manhole slab and cover with				
K 166	Ditto- but depth 3.5m - 4.0m	nr	3.00		
K 167	Ditto- but depth >4.0m	nr	7.00		
	Total C/F to Next Page				
BILL NO. 4: 450mm PRIMARY SEWERS - KASARANI					

Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	Total B/F From Previous Page				
	Crossings Include for all work associated with the crossings Pipe nominal bore 450mm				
K 631	River, stream and valley crossing and reinstatement;	nr	2.00		
K 642	Hedge crossing and reinstatement;	nr	2.00		
K 652	Wall crossing and reinstatement;	nr	2.00		
K 662	Fence crossing and reinstatement;	nr	2.00		
K682	Underground water mains crossing	nr	6.00		
	Reinstatement <i>Pipe nominal bore 450mm</i>				
K 731	Breaking up, temporary and permanent reinstatement of murram roads	m	150.00		
K 741	Breaking up, temporary and permanent reinstatement of footpaths with slabs	m	159.00		
K 751	Reinstatement of land	m	124.00		
	CLASS L: SUPPORTS AND PROTECTION ANCILLARIES TO LAYING AND EXCAVATION Extras to Excavation and Backfilling (Note: Blasting not allowed for any rock excavation) In Pipe Trenches				
L111	Excavation of rock (Provisional)	m3	500.00		
L117	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	756.00		
L118	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	678.00		
	In manholes and Other Chambers (Note: Blasting not allowed for any rock excavation)				
L121	Excavation of rock (Provisional)	m3	500.00		
L127	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	1,650.00		
L128	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	794.00		
	Bed, Haunches and Surrounds Granular Material				
L312	Pipeline nominal bore 450mm Sand as per specifications Beds 150 mm thick	m	963.00		
L322	Selected excavated granular material as per specifications Beds 150 mm thick	m	743.00		
L332	Imported granular material as per specifications Beds 150 mm thick	m	423.00		
	Mass Concrete Grade 15/20 in 150mm Thick Beds, Haunches and Surrounds 450mm nominal bore pipeline				
L442.1	Bed and haunch Type A (Concrete 0.1689m3/m)	m	1,450.00		
L442.2	Bed and haunch Type B (Concrete 0.2645m3/m)	m	534.00		
L442.3	Bed and haunch Type C (Concrete 0.4059m3/m)	m	615.00		
L442.4	Bed and haunch Type D (Concrete 0.4818m3/m)	m	357.00		
	Total C/F to Summary Sheet				
	BILL NO. 4: 375mm PRIMARY SEWERS - KASARANI				

Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	CLASS A - GENERAL ITEMS				
	Testing of the Works Carrying out test on 375mm pipeline as specified or directed by the Engineer. Include provision of all equipment and materials	m	6,556.00		
A260					
	CLASS B - SITE INVESTIGATION Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth ne 1m (Provisional)	nr	5.00		
B111					
	CLASS D - DEMOLITION AND SITE CLEARANCE General site clearance through undeveloped land over the wayleave, include for any additional clearance required	ha	2.16		
D100					
D210	Removal of trees, girth 0.5-1m	nr	5.00		
	CLASS I: PIPEWORK - PIPES PRECAST CONCRETE PIPES TO BS 5911 WITH SPIGOT AND SOCKET FLEXIBLE JOINTS The rates entered against the items in this section shall include for stripping top soil, laying aside and subsequently replacing over refilled trench, excavation in trench in material other than rock, shuttering where necessary, refilling and compacting, spreading surplus soil evenly over and alongside pipe trench compacting, supply lay and joint pipes to correct line and level. Depths are stated from ground level to invert level.				
	Nominal bore 375mm in trenches				
I 232	Depth n.e. 1.5m	m	464.00		
I 233	Depth 1.5m - 2.0m	m	938.00		
I 234	Depth 2.0m - 2.5m	m	1,296.00		
I 235	Depth 2.5m - 3.0m	m	1,537.00		
I 236	Depth 3.0m - 3.5m	m	921.00		
I 237	Depth 3.5m - 4.0m	m	866.00		
I 238	Depth >4.0m	m	256.00		
I431	Steel pipes nominal internal diameter 375mm for aerial crossings complete with fittings	m	278.00		
	CLASS K: PIPEWORK - MANHOLES AND PIPEWORK ANCILLARIES Excavation quantities are given net. The rates entered are to include for manhole concrete slabs and covers, step irons or ladder, excavation, working room, trimming the base of the excavation, shuttering where necessary, refilling and compacting around the finished manholes, and disposing of surplus spoil local to the trench. Surplus spoil is to be evenly spread.				
	Manholes				
	Manhole type B, size 1050mm, reinforced concrete manhole slab and cover.				
K 151	Depth n.e 1.5m	nr	9.00		
K 152	Ditto- but depth 1.5m - 2.0m	nr	22.00		
K 153	Ditto- but depth 2.0m - 2.5m	nr	27.00		
K 154	Ditto- but depth 2.5m - 3.0m	nr	38.00		
K 155	Ditto- but depth 3.0m - 3.5m	nr	21.00		
K 156	Ditto- but depth 3.5m - 4.0m	nr	19.00		
K 157	Ditto- but depth >4.0m	nr	8.00		
	Manhole type B, size 1050mm, reinforced concrete manhole slab and cover with				
K 166	Ditto- but depth 3.5m - 4.0m	nr	3.00		
K 167	Ditto- but depth >4.0m	nr	11.00		
	Total C/F to Next Page				

BILL NO. 4: 375mm PRIMARY SEWERS - KASARANI					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	Total B/F From Previous Page				
	Crossings				
	Include for all work associated with the crossings				
	Pipe nominal bore 375mm				
K 631	River, stream and valley crossing and reinstatement;	nr	3.00		
K 642	Hedge crossing and reinstatement;	nr	3.00		
K 652	Wall crossing and reinstatement;	nr	3.00		
K 662	Fence crossing and reinstatement;	nr	3.00		
K682	Underground water mains crossing	nr	15.00		
	Reinstatement				
	<i>Pipe nominal bore 375mm</i>				
K 731	Breaking up, temporary and permanent reinstatement of murrum roads	m	120.00		
K 741	Breaking up, temporary and permanent reinstatement of footpaths with slabs	m	240.00		
K 751	Reinstatement of land	m	240.00		
	CLASS L: SUPPORTS AND PROTECTION ANCILLARIES TO LAYING AND EXCAVATION				
	Extras to Excavation and Backfilling				
	(Note: Blasting not allowed for any rock excavation)				
	In Pipe Trenches				
L111	Excavation of rock (Provisional)	m3	500.00		
L117	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	150.00		
L118	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	478.00		
	In manholes and Other Chambers				
	(Note: Blasting not allowed for any rock excavation)				
L121	Excavation of rock (Provisional)	m3	498.00		
L127	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	13.00		
L128	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	167.00		
	Bed, Haunches and Surrounds				
	Granular Material				
	<u>Pipeline nominal bore 375mm</u>				
L312	Sand as per specifications Beds 150 mm thick	m	575.20		
L322	Selected excavated granular material as per specifications	m	431.40		
L332	Beds 150 mm thick	m	431.40		
	Mass Concrete Grade 15/20 in 150mm Thick Beds, Haunches and Surrounds				
	<u>375mm nominal bore pipeline</u>				
L442.1	Bed and haunch Type A (Concrete 0.1471m3/m)	m	1,048.00		
L442.2	Bed and haunch Type B (Concrete 0.2256m3/m)	m	1,056.00		
L442.3	Bed and haunch Type C (Concrete 0.3458m3/m)	m	131.00		
L442.4	Bed and haunch Type D (Concrete 0.4093m3/m)	m	321.00		
	Total C/F to Summary Sheet				

BILL NO. 2: 300mm PRIMARY SEWERS - KASARANI					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	CLASS A - GENERAL ITEMS				
A260	Testing of the Works Carrying out test on 300mm pipeline as specified or directed by the Engineer. Include provision of all equipment and materials	m	10,681.00		
B111	CLASS B - SITE INVESTIGATION Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth ne 1m (Provisional)	nr	10.00		
D100	CLASS D - DEMOLITION AND SITE CLEARANCE General site clearance through undeveloped land over the wayleave, include for any additional clearance required	ha	3.52		
D210	Removal of trees, girth 0.5-1m	nr	5.00		
	CLASS I: PIPEWORK - PIPES PRECAST CONCRETE PIPES TO BS 5911 WITH SPIGOT AND SOCKET FLEXIBLE JOINTS The rates entered against the items in this section shall include for stripping top soil, laying aside and subsequently replacing over refilled trench, excavation in trench in material other than rock, shuttering where necessary, refilling and compacting, spreading surplus soil evenly over and alongside pipe trench compacting, supply lay and joint pipes to correct line and level.				
	Nominal bore 300mm in trenches				
I 222	Depth n.e. 1.5m	m	1,726.00		
I 223	Depth 1.5m - 2.0m	m	3,751.00		
I 224	Depth 2.0m - 2.5m	m	1,063.00		
I 225	Depth 2.5m - 3.0m	m	1,061.00		
I 226	Depth 3.0m - 3.5m	m	1,571.00		
I 227	Depth 3.5m - 4.0m	m	984.00		
I 228	Depth >4.0m	m	405.00		
I421	Steel pipes nominal internal diameter 300mm for aerial crossings complete with fittings	m	120.00		
	CLASS K: PIPEWORK - MANHOLES AND PIPEWORK ANCILLARIES Excavation quantities are given net. The rates entered are to include for manhole concrete slabs and covers, step irons or ladder, excavation, working room, trimming the base of the excavation, shuttering where necessary, refilling and compacting around the finished manholes, and disposing of surplus spoil local to the trench. Surplus spoil is to be evenly spread. Manholes				
	Manhole type B, size 1050mm, reinforced concrete manhole slab and cover.				
K 151	Depth n.e 1.5m	nr	44.00		
K 152	Ditto- but depth 1.5m - 2.0m	nr	78.00		
K 153	Ditto- but depth 2.0m - 2.5m	nr	23.00		
K 154	Ditto- but depth 2.5m - 3.0m	nr	23.00		
K 155	Ditto- but depth 3.0m - 3.5m	nr	37.00		
K 156	Ditto- but depth 3.5m - 4.0m	nr	16.00		
K 157	Ditto- but depth >4.0m	nr	3.00		
	Manhole type B, size 1050mm, reinforced concrete manhole slab and cover with				
K 166	Ditto- but depth 3.5m - 4.0m	nr	3.00		
K 167	Ditto- but depth >4.0m	nr	11.00		
	Total C/F to Next Page				

BILL NO. 2: 300mm PRIMARY SEWERS - KASARANI					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	Total B/F From Previous Page				
	Crossings Include for all work associated with the crossings Pipe nominal bore 300mm				
K 631	River, stream and valley crossing and reinstatement;	nr	10.00		
K 642	Hedge crossing and reinstatement;	nr	10.00		
K 652	Wall crossing and reinstatement;	nr	10.00		
K 662	Fence crossing and reinstatement;	nr	10.00		
K 682	Underground water mains crossing	nr	42.00		
	Reinstatement <i>Pipe nominal bore 300mm</i>				
K 731	Breaking up, temporary and permanent reinstatement of murrum roads	m	368.00		
K 741	Breaking up, temporary and permanent reinstatement of footpaths with slabs	m	667.00		
K 751	Reinstatement of land	m	672.00		
	CLASS L: SUPPORTS AND PROTECTION ANCILLARIES TO LAYING AND EXCAVATION				
	Extras to Excavation and Backfilling (Note: Blasting not allowed for any rock excavation)				
	In Pipe Trenches				
L111	Excavation of rock (Provisional)	m3	6,500.00		
	Excavation of soft material below the final surface	m3	150.00		
L117	and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)				
	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	1,050.00		
L118					
	In manholes and Other Chambers (Note: Blasting not allowed for any rock excavation)				
L121	Excavation of rock (Provisional)	m3	1,120.00		
	Excavation of soft material below the final surface	m3	320.00		
L127	and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)				
	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	294.00		
L128					
	Bed, Haunches and Surrounds Granular Material				
	<u>Pipeline nominal bore 300mm</u>				
L312	Sand as per specifications Beds 150 mm thick	m	1,938.00		
	Selected excavated granular material as per specifications	m	1,789.00		
L322	Beds 150 mm thick				
L332	Imported granular material as per specifications Beds 150 mm thick	m	1,883.00		
	Mass Concrete Grade 15/20 in 150mm Thick Beds, Haunches and Surrounds <u>300mm nominal bore pipeline</u>				
L442.1	Bed and haunch Type A (Concrete 0.1278m3/m)	m	1,923.00		
L442.2	Bed and haunch Type B (Concrete 0.1906m3/m)	m	1,631.00		
L442.3	Bed and haunch Type C (Concrete 0.2966m3/m)	m	3,790.00		
L442.4	Bed and haunch Type D (Concrete 0.3449m3/m)	m	3,337.00		
	Total C/F to Summary Sheet				

BILL NO. 4: 225mm SECONDARY SEWERS - KASARANI					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	CLASS A - GENERAL ITEMS				
A260	Testing of the Works Carrying out test on 225mm pipeline as specified or directed by the Engineer. Include provision of all equipment and materials	m	30,455.00		
B111	CLASS B - SITE INVESTIGATION Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth ne 1m (Provisional)	nr	25.00		
D100	CLASS D - DEMOLITION AND SITE CLEARANCE General site clearance through undeveloped land over the wayleave, include for any additional clearance required	ha	10.05		
D210	Removal of trees, girth 0.5-1m	nr	5.00		
	CLASS I: PIPEWORK - PIPES PRECAST CONCRETE PIPES TO BS 5911 WITH SPIGOT AND SOCKET FLEXIBLE JOINTS The rates entered against the items in this section shall include for stripping top soil, laying aside and subsequently replacing over refilled trench, excavation in trench in material other than rock, shuttering where necessary, refilling and compacting, spreading surplus soil evenly over and alongside pipe trench compacting, supply lay and joint pipes to correct line and level. Depths are stated from ground level to invert level.				
	Nominal bore 225mm in trenches				
I 222	Depth n.e. 1.5m	m	6,800.00		
I 223	Depth 1.5m - 2.0m	m	6,123.00		
I 224	Depth 2.0m - 2.5m	m	5,864.00		
I 225	Depth 2.5m - 3.0m	m	4,345.00		
I 226	Depth 3.0m - 3.5m	m	4,705.00		
I 227	Depth 3.5m - 4.0m	m	1,970.00		
I 228	Depth >4.0m	m	498.00		
#####	Steel pipes nominal internal diameter 225mm for aerial crossings complete with fittings	m	150.00		
	CLASS K: PIPEWORK - MANHOLES AND PIPEWORK ANCILLARIES Excavation quantities are given net. The rates entered are to include for manhole concrete slabs and covers, step irons or ladder, excavation, working room, trimming the base of the excavation, shuttering where necessary, refilling and compacting around the finished manholes, and disposing of surplus spoil local to the trench. Surplus spoil is to be evenly spread.				
	Manholes Manhole type B, size 1050mm, reinforced concrete manhole slab and cover.				
K 151	Depth n.e 1.5m	nr	142.00		
K 152	Depth 1.5m - 2.0m	nr	134.00		
K 153	Depth 2.0m - 2.5m	nr	168.00		
K 154	Depth 2.5m - 3.0m	nr	105.00		
K 155	Depth 3.0m - 3.5m	nr	36.00		
K 156	Depth 3.5m - 4.0m	nr	41.00		
K 157	Depth >4.0m	nr	5.00		
K 144	Manhole type B, size 1050mm, reinforced concrete manhole slab and cover with Ditto- but depth 2.5m - 3.0m	nr	8.00		
K 145	Ditto- but depth 3.0m - 3.5m	nr	15.00		
K 146	Ditto- but depth 3.5m - 4.0m	nr	33.00		
K 147	Ditto- but depth >4.0m	nr	64.00		
Total C/F to Next Page					

BILL NO. 2: 225mm PRIMARY SEWERS - KASARANI					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	Total B/F From Previous Page				
	Crossings Include for all work associated with the crossings Pipe nominal bore 225mm				
K 631	River, stream and valley crossing and reinstatement;	nr	66.00		
K 642	Hedge crossing and reinstatement;	nr	66.00		
K 652	Wall crossing and reinstatement;	nr	66.00		
K 662	Fence crossing and reinstatement;	nr	66.00		
K682	Underground water mains crossing	nr	329.00		
	Reinstatement <i>Pipe nominal bore 225mm</i>				
K 731	Breaking up, temporary and permanent reinstatement of murrum roads	m	2,735.00		
K 741	Breaking up, temporary and permanent reinstatement of footpaths with slabs	m	5,470.00		
K 751	Reinstatement of land	m	5,470.00		
	CLASS L: SUPPORTS AND PROTECTION ANCILLARIES TO LAYING AND EXCAVATION Extras to Excavation and Backfilling (Note: Blasting not allowed for any rock excavation) In Pipe Trenches				
L111	Excavation of rock (Provisional)	m3	12,000.00		
L117	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	788.00		
L118	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	2,877.00		
	In manholes and Other Chambers (Note: Blasting not allowed for any rock excavation) Excavation of rock				
L121	Excavation of rock (Provisional)	m3	8,736.00		
L127	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	146.00		
L128	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	1,456.00		
	Bed, Haunches and Surrounds Granular Material				
	<u>Pipeline nominal bore 225mm</u>				
L312	Sand as per specifications Beds 150 mm thick	m	13,127.20		
L322	Selected excavated granular material as per specifications Beds 150 mm thick	m	9,845.40		
L332	Imported granular material as per specifications Beds 150 mm thick	m	9,845.40		
	Mass Concrete Grade 15/20 in 150mm Thick Beds, Haunches and Surrounds 225mm nominal bore pipeline				
L442.1	Bed and haunch Type A (Concrete 0.1078m3/m)	m	5,407.00		
L442.2	Bed and haunch Type B (Concrete 0.1558m3/m)	m	1,506.00		
L442.3	Bed and haunch Type C (Concrete 0.2450m3/m)	m	600.00		
L442.4	Bed and haunch Type D (Concrete 0.2821m3/m)	m	1,000.00		
	Total C/F to Summary Sheet				

BILL NO. 5: HOUSEHOLD CONNECTIONS					
Item No	Description	Unit	Quantity	Rate (KShs.)	Amount (KShs)
	<p>Typical Arrangement for a Consumer Sewer Connection is shown in the Standard Drawings.</p> <p>It is estimated that the approximate number of consumer sewer connections to be carried out in the Project Area is 4,000. The connection works are to be carried out in liaison with the respective Water Service Provider, who will receive, process and approve the applications for connections. The Contractor to obtain from Water Service Provider the exact number of connections and their locations before ordering materials and carrying out any works under this Bill.</p> <p>Consumer Connection Works will commence during the Construction Period and extend to the Defects Liability Period (DLP). The connections will be carried out as soon as the sewers are commissioned. Taking Over will be on completion of the Connections. The Contractor should allow for this in their rates. There will be no extra cost of carrying out the Connection Works during DLP.</p> <p><u>CLASS A: GENERAL ITEMS</u></p> <p>A2 Specified Requirements</p> <p>A260 Allow for water testing of the sewer connection including sewer pipes and inspection chambers as specified including all requisite Materials, Personnel, Testing Equipment etc.</p> <p>A277 Allow for keeping trenches and other excavation free of water which may have entered through ground seepage, rain or by other means as directed by the Engineer.</p> <p><u>CLASS I : PIPEWORK - PIPES</u></p> <p>A - Supply of Pipes Excavation, laying and jointing is included in 'B' - Pipe Laying</p> <p>Supply, Transport to Site and Store. The rate to include jointing materials, bolts, gaskets, rubber rings, etc.</p> <p>I511 160mm outside diameter uPVC sewer pipe Class 41</p> <p>B - Pipe Laying The rate quoted shall be deemed to include excavation and backfilling with selected excavated material, of pipe trenches. The rates shall also include disposal of surplus material to tips identified by the Contractor in liaison with the Local Authority, transport of material from site store to working areas, laying and jointing of pipes and fittings.</p> <p>I512 160mm outside diameter uPVC sewer pipe Class 41 Depth not exceeding 2.5m</p> <p><u>CLASS J: FITTINGS AND VALVES</u></p> <p>J22 Supply, transport to site, transport from site store lay, joint and test, 45° Concrete socketed Y Junctions. The rate to include lean concrete plug and surround, jointing material, rubber rings etc. The rate should also include mass concrete which will be required for reduction of the Y Junction to the respective service lines.</p> <p>J221 225mm off 225 (Provisional)</p> <p>J222 315mm off 315 (Provisional)</p> <p>J223 355mm off 355 (Provisional)</p>				
	Total C/F to Next Page				

Item No	Description	Unit	Quantity	Rate (KShs.)	Amount (KShs)
BILL NO. 5: HOUSEHOLD CONNECTIONS					
	Total B/F From Previous Page				
J52	Supply, transport to site, transport from site store lay, joint and test, 45° uPVC socketed Y Junctions. The rate to include lean concrete plug and surround, jointing				
J521	160mm off 200 (Provisional)	nr	1,000		
J522	160mm off 315 (Provisional)	nr	300		
J523	160mm off 400 (Provisional)	nr	300		
	<u>ANCILLARIES</u>				
K21	Masonry Inspection Chambers				
K211	Provide all materials, construct and test sewer inspection chambers of depth not exceeding 1.0m, internal dimensions 450mm x 600mm constructed with 150mm thick masonry walls reinforced with hoop irons at every alternate course as shown on Drawing. Each Chamber is to serve two plots. Include for provision and fixing of light duty rectangular mild steel frame and cover. The cover to be concrete filled as detailed. The rate should be inclusive of two flexible joints adjacent to the Inspection Chamber as detailed and provision	Nr	6,000		
K6	Crossings				
K651	Allow for crossing existing boundary walls, including reinstatement to original state. Nominal bore not exceeding 200mm	Item	L.S		
K661	Allow for crossing existing fences (chain link, barbed wire etc.), including reinstatement to original state. Nominal bore not exceeding 200mm	Item	L.S		
K671	Allow for crossing existing drains and sewers, and reinstate these after construction of sewer has been completed. Pipe inside diameter n.e. 200mm.	Item	L.S		
	<u>CLASS L: PIPEWORK - ANCILLARIES TO LAYING AND EXCAVATION</u>				
	Extras to excavation and backfilling in pipe trenches				
L111.1	Excavation in rock (Provisional)	m ³	1,000		
	Total C/F to Summary Sheet				

BILL NO. 6: DN900mm DANDORA SEWERS					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	CLASS A - GENERAL ITEMS				
	Testing of the Works				
A260	Carrying out test on 900mm pipeline as specified or directed by the Engineer. Include provision of all equipment and materials	m	4,400.00		
	CLASS B - SITE INVESTIGATION				
B111	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth ne 1m (Provisional)	nr	2.00		
B112	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 1-2m (Provisional)	nr	2.00		
B113	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 2-3m (Provisional)	nr	2.00		
B114	construction size etc, of pipelines, services or Trial holes where ordered to prove location, existing structures, max depth 3-5m (Provisional)	nr	2.00		
	CLASS D - DEMOLITION AND SITE CLEARANCE				
D1	General clearance, 1.5m on either side of the centreline of the sewer line route where applicable.	SM	13,200.00		
F267	Supply all materials (Concrete grade 30, Y25, Y16, formworks, steel straps etc.) and cast 1200*600*5000mm RC piers and 2400*1200*600mm RC bases as per drawings and specifications. Allow for erection of the DN900mm steel pipe aerial crossing across Nairobi River and connection to Trunk Line, inclusive of all applicable materials and	Nr	15.00		
D462	Buildings of indeterminate construction Volume not exceeding 50-100m3	nr	2.00		
D561	Other structures of indeterminate construction Volume not exceeding 50m3	nr	3.00		
	CLASS I: PIPEWORK - PIPES				
	PRECAST CONCRETE PIPES TO BS 5911 WITH SPIGOT AND SOCKET FLEXIBLE JOINTS				
I2*	Provision for supply, laying and jointing rigid joint socket & spigot concrete pipes to BS 5911 (or jacking pipes to EU Standards). Rate to include excavation and backfilling of excavations, preparation of excavation surfaces; upholding sides of the excavation, disposal of excess excavated material, removal of dead services.				
I258	Nominal bore 900mm				
I 233	Depth 1.5m - 2.0m	m	810.00		
I 234	Depth 2.0m - 2.5m	m	420.00		
I 235	Depth 2.5m - 3.0m	m	720.00		
I 236	Depth 3.0m - 3.5m	m	880.00		
I 237	Depth 3.5m - 4.0m	m	850.00		
I 238	Depth >4.0m	m	540.00		
I458	Supply, Joint and lay to grade and level DN900 epoxy coated, mortar lined double flanged steel pipes.	m	180.00		
	CLASS K: PIPEWORK - MANHOLES AND PIPEWORK ANCILLARIES				
	Provision for supply erecting and installation of pre-cast concrete ring manholes and backdrops (where applicable) to BS 5911. Rate to include excavation to inverts, for preparation of excavation surfaces; upholding sides of the excavation, disposal of excess excavated material, removal of dead services. Rate to include installation of precast concrete manhole cover slabs, triangular cast iron frame with recessed cast iron concrete fill cover (or 40T polyresin access covers and frames if approved by the Engineer) and				
K1*	Manholes				
	Manhole type B, size 1500mm, reinforced concrete manhole slab and cover.				
K 152	Ditto- but depth 1.5m - 2.0m	nr	22.00		
K 153	Ditto- but depth 2.0m - 2.5m	nr	15.00		
K 154	Ditto- but depth 2.5m - 3.0m	nr	20.00		
K 155	Ditto- but depth 3.0m - 3.5m	nr	25.00		
K 156	Ditto- but depth 3.5m - 4.0m	nr	25.00		
K 157	Ditto- but depth >4.0m	nr	15.00		
	Manhole type B, size 1500mm, reinforced concrete manhole slab and cover with				
K 166	Ditto- but depth 3.5m - 4.0m	nr	7.00		
K 167	Ditto- but depth >4.0m	nr	4.00		
	Total C/F to Next Page				

BILL NO. 6: DN900mm DANDORA SEWERS					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	Total B/F From Previous Page				-
	Crossings Include for all work associated with the crossings Pipe nominal bore 900mm				
K 631	River, stream and valley crossing and reinstatement;	nr	4.00		
K 642	Hedge crossing and reinstatement;	nr	1.00		
K 652	Wall crossing and reinstatement;	nr	1.00		
K 662	Fence crossing and reinstatement;	nr	1.00		
K682	Underground water mains crossing	nr	4.00		
	Reinstatement <i>Pipe nominal bore 900mm</i>				
K 731	Breaking up, temporary and permanent reinstatement of murram roads	m	40.00		
K 741	Breaking up, temporary and permanent reinstatement of footpaths with slabs	m	150.00		
K 751	Reinstatement of land	m	120.00		
	Provide for tie-in works between the new sewer line works and existing sewer lines and/or household/building connections. Rate to include interception of existing sewerline in Dandora dumpsite.	sum	1		
	CLASS L: SUPPORTS AND PROTECTION ANCILLARIES TO LAYING AND EXCAVATION Extras to Excavation and Backfilling (Note: Blasting not allowed for any rock excavation) In Pipe Trenches				
L111	Excavation of rock (Provisional)	m3	1,500.00		
	Excavation of soft material below the final surface	m3	100.00		
L117	and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)				
	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding	m3	200.00		
L118	1.0m (Provisional)				
	In manholes and Other Chambers (Note: Blasting not allowed for any rock excavation)				
L121	Excavation of rock (Provisional)	m3	300.00		
	Excavation of soft material below the final surface	m3	50.00		
L127	and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)				
	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding	m3	80.00		
L128	1.0m (Provisional)				
	Bed, Haunches and Surrounds Granular Material				
	Pipeline nominal bore 600mm				
L312	Sand as per specifications Beds 150 mm thick	m	575.20		
L322	Selected excavated granular material as per specifications Beds 150 mm thick	m	431.40		
L332	Imported granular material as per specifications Beds 150 mm thick	m	431.40		
	Mass Concrete Grade 15/20 in 150mm Thick Beds, Haunches and Surrounds 900mm nominal bore pipeline				
L442.1	Bed and haunch Type A (Concrete 0.3076m3/m)	m	705.00		
L442.2	Bed and haunch Type B (Concrete 0.5162m3/m)	m	680.00		
L442.3	Bed and haunch Type C (Concrete 0.7670m3/m)	m	1,290.00		
L442.4	Bed and haunch Type D (Concrete 0.9618m3/m)	m	1,725.00		
	Total C/F to Summary Sheet				

BILL NO. 7A: DN900mm EMBAKASI NORTH SEWERS					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	CLASS A - GENERAL ITEMS				
	Testing of the Works				
A260	Carrying out test on 900mm pipeline as specified or directed by the Engineer. Include provision of all equipment and materials	m	5,300.00		
	CLASS B - SITE INVESTIGATION				
B111	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth ne 1m	nr	2.00		
B112	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 1-2m	nr	2.00		
B113	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 2-3m	nr	2.00		
B114	ordered to prove location, existing structures, max depth 3-5m (Provisional)	nr	2.00		
	CLASS D - DEMOLITION AND SITE CLEARANCE				
D1	General clearance, 1.5m on either side of the centreline of the sewer line route where applicable.	ha	15.90		
D462	100m3	nr	2.00		
D561	Other structures of indeterminate construction Volume not exceeding 50m3	nr	3.00		
	CLASS I: PIPEWORK - PIPES				
	PRECAST CONCRETE PIPES TO BS 5911 WITH SPIGOT AND SOCKET FLEXIBLE JOINTS				
	Provision for supply, laying and jointing rigid joint socket & spigot concrete pipes to BS 5911 (or jacking pipes to EU Standards). Rate to include excavation and backfilling of excavations, preparation of excavation surfaces; upholding sides of the excavation, disposal of excess excavated material, removal of dead				
I2*					
I258	Nominal bore 900mm				
I 233	Depth 1.5m - 2.0m	m	851.00		
I 234	Depth 2.0m - 2.5m	m	569.00		
I 235	Depth 2.5m - 3.0m	m	801.00		
I 236	Depth 3.0m - 3.5m	m	885.00		
I 237	Depth 3.5m - 4.0m	m	963.00		
I 238	Depth >4.0m	m	642.00		
I458	Supply, Joint and lay to grade and level DN900 epoxy coated, mortar lined double flanged steel pipes.	m	589.00		
	CLASS K: PIPEWORK - MANHOLES AND PIPEWORK ANCILLARIES				
	Provision for supply erecting and installation of pre-cast concrete ring manholes and backdrops (where applicable) to BS 5911. Rate to include excavation to inverts, for preparation of excavation surfaces; upholding sides of the excavation, disposal of excess excavated material, removal of dead services. Rate to include installation of precast concrete manhole cover slabs, triangular cast				
K1*	Manholes				
	Manhole type B, size 1500mm, reinforced concrete manhole slab and cover.				
K 152	Ditto- but depth 1.5m - 2.0m	nr	32.00		
K 153	Ditto- but depth 2.0m - 2.5m	nr	21.00		
K 154	Ditto- but depth 2.5m - 3.0m	nr	33.00		
K 155	Ditto- but depth 3.0m - 3.5m	nr	30.00		
K 156	Ditto- but depth 3.5m - 4.0m	nr	38.00		
K 157	Ditto- but depth >4.0m	nr	21.00		
	Manhole type B, size 1500mm, reinforced concrete manhole slab and cover with backdrop.				
K 166	Ditto- but depth 3.5m - 4.0m	nr	6.00		
K 167	Ditto- but depth >4.0m	nr	8.00		
	Total C/F to Next Page				

BILL NO. 7A: DN900mm EMBAKASI NORTH SEWERS					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	Total B/F From Previous Page				
	Crossings Include for all work associated with the crossings Pipe nominal bore 900mm				
K 631	River, stream and valley crossing and reinstatement;	nr	1.00		
K 642	Hedge crossing and reinstatement;	nr	1.00		
K 652	Wall crossing and reinstatement;	nr	1.00		
K 662	Fence crossing and reinstatement;	nr	1.00		
K682	Underground water mains crossing	nr	1.00		
	Reinstatement <i>Pipe nominal bore 900mm</i>				
K 731	Breaking up, temporary and permanent reinstatement of murram	m	40.00		
K 741	Breaking up, temporary and permanent reinstatement of footpaths with slabs	m	150.00		
K 751	Reinstatement of land	m	120.00		
K852	Provide for tie-in works between the new sewer line works and existing sewer lines and/or household/building connections. Rate to include interception of existing sewerline in Dandora dumpsite.	sum	1		
	CLASS L: SUPPORTS AND PROTECTION ANCILLARIES TO LAYING AND EXCAVATION Extras to Excavation and Backfilling (Note: Blasting not allowed for any rock excavation) In Pipe Trenches				
L111	Excavation of rock (Provisional)	m3	1,800.00		
L117	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	120.00		
L118	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m	m3	250.00		
	In manholes and Other Chambers (Note: Blasting not allowed for any rock excavation)				
L121	Excavation of rock (Provisional)	m3	330.00		
L127	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	60.00		
L128	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m	m3	84.00		
	Bed, Haunches and Surrounds Granular Material				
L312	Pipeline nominal bore 600mm Sand as per specifications Beds 150 mm thick	m	580.00		
L322	Selected excavated granular material as per specifications Beds 150 mm thick	m	440.00		
L332	Imported granular material as per specifications Beds 150 mm	m	440.00		
	Mass Concrete Grade 15/20 in 150mm Thick Beds, Haunches and Surrounds 900mm nominal bore pipeline				
L442.1	Bed and haunch Type A (Concrete 0.3076m3/m)	m	875.00		
L442.2	Bed and haunch Type B (Concrete 0.5162m3/m)	m	898.00		
L442.3	Bed and haunch Type C (Concrete 0.7670m3/m)	m	1,292.00		
L442.4	Bed and haunch Type D (Concrete 0.9618m3/m)	m	2,235.00		
	Total C/F to Summary Sheet				

BILL NO. 7B: DN300mm EMBAKASI NORTH RETICULATION SEWERS					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	CLASS A - GENERAL ITEMS				
	Testing of the Works				
A260	Carrying out test on 300mm pipeline as specified or directed by the Engineer. Include provision of all equipment and materials	m	5,535.00		
	CLASS B - SITE INVESTIGATION				
B111	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth ne 1m	nr	5.00		
B112	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 1-2m	nr	5.00		
B113	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 2-3m	nr	5.00		
B114	construction size etc, of pipelines, services or Trial holes where ordered to prove location, existing structures, max depth 3-5m (Provisional)	nr	5.00		
	CLASS D - DEMOLITION AND SITE CLEARANCE				
D100	General site clearance through undeveloped land over the wayleave, include for any additional clearance required	ha	1.83		
D210	Removal of trees, girth 0.5-1m	nr	2.00		
D220	Removal of trees, girth 1-2m	nr	2.00		
D230	Removal of trees, girth 2-3m	nr	2.00		
D310	Removal of stump, diameter 0.5-1m	nr	2.00		
D461	Buildings of indeterminate construction Volume not exceeding	nr	4.00		
D462	Buildings of indeterminate construction Volume not exceeding 50-100m3	nr	4.00		
D561	Other structures of indeterminate construction Volume not exceeding 50m3	nr	4.00		
D562	Other structures of indeterminate construction Volume not exceeding 50-100m3	nr	4.00		
	CLASS I: PIPEWORK - PIPES				
	PRECAST CONCRETE PIPES TO BS 5911 WITH SPIGOT AND SOCKET FLEXIBLE JOINTS				
	The rates entered against the items in this section shall include for stripping top soil, laying aside and subsequently replacing over refilled trench, excavation in trench in material other than rock, shuttering where necessary, refilling and compacting, spreading surplus soil				
	Nominal bore 300mm in trenches				
I 222	Depth n.e. 1.5m	m	522.00		
I 223	Depth 1.5m - 2.0m	m	962.00		
I 224	Depth 2.0m - 2.5m	m	934.00		
I 225	Depth 2.5m - 3.0m	m	842.00		
I 226	Depth 3.0m - 3.5m	m	853.00		
I 227	Depth 3.5m - 4.0m	m	749.00		
I 228	Depth >4.0m	m	472.00		
I421	Steel pipes nominal internal diameter 300mm for aerial crossings complete with fittings	m	201.00		
	CLASS K: PIPEWORK - MANHOLES AND PIPEWORK ANCILLARIES				
	Excavation quantities are given net. The rates entered are to include for manhole concrete slabs and covers, step irons or ladder, excavation, working room, trimming the base of the excavation, shuttering where necessary, refilling and compacting around the finished manholes, and disposing of surplus spoil local to the trench. Surplus spoil is to be evenly spread.				
	Manholes				
	Manhole type B, size 1050mm, reinforced concrete manhole slab and cover.				
K 151	Depth n.e 1.5m	nr	25.00		
K 152	Ditto- but depth 1.5m - 2.0m	nr	46.00		
K 153	Ditto- but depth 2.0m - 2.5m	nr	43.00		
K 154	Ditto- but depth 2.5m - 3.0m	nr	36.00		
K 155	Ditto- but depth 3.0m - 3.5m	nr	30.00		
K 156	Ditto- but depth 3.5m - 4.0m	nr	21.00		
K 157	Ditto- but depth >4.0m	nr	9.00		
	Total C/F to Next Page				

BILL NO. 7B: DN300mm EMBAKASI NORTH RETICULATION SEWERS					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	Total B/F From Previous Page				
	Manhole type B, size 1050mm, reinforced concrete manhole slab and cover with backdrop.				
K 166	Ditto- but depth 3.5m - 4.0m	nr	2.00		
K 167	Ditto- but depth >4.0m	nr	4.00		
	Crossings				
	Include for all work associated with the crossings				
	Pipe nominal bore 300mm				
K 631	River, stream and valley crossing and reinstatement;	nr	3.00		
K 642	Hedge crossing and reinstatement;	nr	3.00		
K 652	Wall crossing and reinstatement;	nr	3.00		
K 662	Fence crossing and reinstatement;	nr	3.00		
K 682	Underground water mains crossing	nr	3.00		
	Reinstatement				
	<i>Pipe nominal bore 300mm</i>				
K 731	Breaking up, temporary and permanent reinstatement of murrum	m	265.00		
K 741	Breaking up, temporary and permanent reinstatement of footpaths with slabs	m	343.00		
K 751	Reinstatement of land	m	234.00		
	CLASS L: SUPPORTS AND PROTECTION ANCILLARIES TO LAYING AND EXCAVATION				
	Extras to Excavation and Backfilling				
	(Note: Blasting not allowed for any rock excavation)				
	In Pipe Trenches				
L111	Excavation of rock (Provisional)	m3	2,000.00		
	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m	m3	180.00		
L117	(Provisional)				
	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m	m3	870.00		
L118					
	In manholes and Other Chambers				
	(Note: Blasting not allowed for any rock excavation)				
L121	Excavation of rock (Provisional)	m3	800.00		
	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m	m3	280.00		
L127	(Provisional)				
	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m	m3	250.00		
L128					
	Bed, Haunches and Surrounds				
	Granular Material				
	<u>Pipeline nominal bore 300mm</u>				
L312	Sand as per specifications Beds 150 mm thick	m	948.00		
	Selected excavated granular material as per specifications				
L322	Beds 150 mm thick	m	998.00		
L332	Imported granular material as per specifications Beds 150 mm	m	998.00		
	Mass Concrete Grade 15/20 in 150mm Thick Beds, Haunches and Surrounds				
	<u>300mm nominal bore pipeline</u>				
L442.1	Bed and haunch Type A (Concrete 0.1278m3/m)	m	456.00		
L442.2	Bed and haunch Type B (Concrete 0.1906m3/m)	m	1,522.00		
L442.3	Bed and haunch Type C (Concrete 0.2966m3/m)	m	1,605.00		
L442.4	Bed and haunch Type D (Concrete 0.3449m3/m)	m	1,952.00		
	Total C/F to Summary Sheet				

BILL NO. 7C: ADMINISTRATION BUILDING

ITEM	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (KShs)
E	<u>EARTHWORKS</u>				
E4	GENERAL EXCAVATION				
E410	Excavation 200mm top soil and dispose	m ²	98		
E443.2	Excavation in class III material max. depth 0.5-1m for disposal	m ³	117		
E435.1	Extra over excavation, depth 2-5m for re-use	m ³	30		
E443	Excavation in Rock material max depth 1.5m for re-use in Gabion Boxes and excess disposed off the site. For Weir, Chambers and	m ³	80		
E6	<u>FILLING AND COMPACTION</u>				
E6112	Hardcore Using excavation Class I material	m ³	14		
F	<u>IN-SITU CONCRETE</u>				
F3	Provision and placing of concrete. Rates to include supplying, mixing, placing, vibrating, curing etc. Provision for strength test in accordance with the specification				
F323	<u>Concrete Grade:15</u> Thickness 50 - 100 mm Blinding 20 mm aggregate	m ³	5		
F333	<u>Concrete Grade:20</u> Thickness: 150-300 mm Bases, footing & ground slabs 20 mm aggregate	m ³	30		
G	<u>CONCRETE ANCILLARIES</u>				
G2	FORMWORK: FAIR FINISH				
G241	<u>Plane vertical</u> Fair finish to vertical sides of ring beam	m ²	124		
G5	REINFORCEMENT				
G522	High yield steel bars	Tons	2		
G570	Wire weld fabric BS Ref. A252	m ²	68		
G8	CONCRETE ACCESSORIES				
G812.1	<u>Finishing of top surface</u> 40mm screed, cement: sand 1:3, smooth trowel finish	m ²	120		
O	<u>TIMBER</u>				
O7	FITTINGS AND FASTENINGS				
O740	Bolts	nr	78		
O8	ROOFING				
O811	Roofing timber cypress 100x50	m	641		
O812	Ditto cypress 150x75	m	166		
O813	Ditto cypress 100x75	m	543		
O814	Ditto timber cypress 100x100 wall plate	m	25		
O815	300x25 Faccia Board	m	45		
O815	<u>Cladding</u> 26 gauge GCI sheeting	m ²	115		
O816	Ridge cap	m	18		
U	<u>BRICKWORK, BLOCKWORK & MASONRY</u>				
U431	<u>One block construction</u> Vertical walls: Thickness 150-250mm for superstructure	m ²	177		
U491	<u>Blockwork ancillaries</u> Joint reinforcement using hoop iron in every other course	m	377		
U492	Damp proof course.	m	63		
U492.2	Damp proof Membrane	m ²	68		
TOTAL CARRIED FORWARD TO NEXT PAGE					

BILL NO. 7C: ADMINISTRATION BUILDING

ITEM	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (KShs)
	Total B/F From Previous Page				
V	<u>PAINTING</u>				
V523	2 coats of emulsion paint on wooden doors and windows	m ²	32		
V553	2 coats of emulsion paint to internal wall surface	m ²	191		
W	<u>WATERPROOFING</u>				
W1	<u>DAMP PROOFING</u>				
	<u>Rendering with proprietary mix mortar</u>				
W153	Internal 20mm mortar rendering, cement/sand 1:4 painted "soft white" to Ks10 B 15 or similar.	m ²	191		
W5	<u>SPRAYED OR BRUSHED WATER PROOFING USING</u>				
W50	External spray of tyrolean coloured soft white to Ks 10 B 15 or	m ²	212		
X	<u>MISCELLANEOUS WORK</u>				
X3	<u>DRAINAGE TO STRUCTURES ABOVE GROUND</u>				
X331	Gutters and gutters fittings	m	35		
X332	Downpipes and all the fittings	m	17		
X6	<u>WINDOWS</u>				
X68	HD 11FS window as specified in th drawing	nr	2		
X691	HD 2FS window as specified in th drawing	nr	1		
X692	HD 4S window as specified in th drawing	nr	3		
X693	2NE 5F window as specified in th drawing	nr	2		
X7	<u>DOORS</u>				
X721	<u>Wood, flush, external</u>				
X722	Single leaf, standard, 800mm wide	nr	3		
X724	Single leaf, standard, 900mm wide	nr	5		
X91	<u>SUBSTRUCTURE WALLING</u>				
X91.1	Supply, lay and join with sand cement motar 230mm thick stone masonry wall in strip foundation	m ²	25		
X92	<u>CEILING</u>				
X92.1	Allow for fixing 12mm celotex ceiling	m ²	64		
X92.2	Allow for the painting of the ceiling with Distemper	m ²	64		
X93	<u>OTHERS</u>				
X93.1	Provide for supply and installation of plumbing facilities in the house as specified in the drawing. Include for installation of water closets, cisterns shower fittings, stainless steel sinks, dhobi sinks, hand wash basins, overhead storage reservoir	Sum	1		
X93.2	Provide for supply and installation of all fitting in the house as specified in the drawing. Include for installation of table tops, store shelves above and under the bable tops,store shelves,and work tops, and other accessories	Sum	1		
X93.3	Provide for supply and installation of all electrical fittings in the house as directed by the Engineer. Include for complete wiring, installation of consumer meters, power sockets, lighting systems and connection to existing grid as drected	Sum	1		
Total C/F to Summary Sheet					

BILL NO. 10-EMBAKASI NORTH WORKS SUMARY SHEET					
ITEM	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (KShs)
7A	EMBAKASI NORTH TRUNK SEWER				
7B	EMBAKASI NORTH RETICULATION				
7C	MISCELLENEOUS WORKS				
BILL 10.0 TOTAL CARRIED TO COLLECTION SHEET					

BILL 8		BILL 8A: BOX CULVERT			
ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT
	CLASS A - GENERAL ITEMS				
	Testing of the Works				
A260.1	Carrying out water test on 900mm pipeline including provision of all equipment and materials	m	40		
	CLASS B - SITE INVESTIGATION				
B111	Trial hole where ordered to prove location, construction size etc of pipelines, services or existing structures	nr	10		
	CLASS D - DEMOLITION AND SITE CLEARANCE				
D100	General site clearance through undeveloped land over the wayleave, include for any additional clearance required	ha	0.12		
D210	Removal of trees, girth 0.5 - 1m	nr	20		
	CLASS E: EARTHWORKS				
	Excavation				
	<i>Excavation for Foundations</i>				
E311	Top soil, maximum depth n.e. 0.25m.	m ³	20		
E323	Material other than topsoil, rock, or artificial hard material; depth 0.25-1.5m.	m ³	50		
	<i>Excavation Ancillaries</i>				
	<u>Disposal of Excavated Material</u>				
	Approved material shall be retained for backfilling and unsuitable material shall be disposed to tip. Contractor identify tip site	m ³	10		
	CLASS F: IN SITU CONCRETE				
	Note: All concrete designed mix and structural concrete to BS 5328				
	Provision of Concrete				
	Provide materials and mix concrete to the specified class; cement to BS 12 or BS 146				
F233	Provision of concrete grade C 15/20	m ³	10		
F253	Provision of concrete grade C25/20	m ³	100		
G832.2	200mm diameter steel pipe with flange and bolt each 600mm long projecting from two surfaces; include supply of the inserted pipe. (Drain Pipe)	nr	18		
	CLASS G: CONCRETE ANCILLARIES				
	Formwork: Fair Finish				
G213	Plane Vertical and Horizontal width 0.2-0.4m	m ²	200		
	Reinforcement				
	Rate to include for cutting, bending, supporting tying and securing				
G520	High yield steel bars to BS4449 of nominal size 10mm as	t	7		
G566	BRC Type A393	m ²	55		
	Joints				
G653	Plastic or rubber centre bulb water stop, sealant, filler rebate/grooves etc. as specified or directed by engineer	m	40		
	Concrete Accessories				
	<u>Finishing of Surfaces</u>				
G812	Finishing of top surfaces, steel trowel	m ²	40		
	TOTAL CARRIED FORWARD TO NEXT PAGE				

BILL 8A: BOX CULVERT					
ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT
	Total B/F From Previous Page				
	CLASS K: PIPEWORK - MANHOLES AND PIPEWORK ANCILLARIES				
	Excavation quantities are given net. The rates entered are to include for manhole concrete slabs and covers, step irons or ladder, excavation, working room, trimming the base of the excavation, shuttering where necessary, refilling and compacting around the finished manholes, and disposing of surplus spoil local to the trench. Surplus spoil is to be evenly spread.				
	Excavation in any material other than rock.				
	Manholes				
	Manhole type A, size 1500mm, reinforced concrete and GRP cover.				
K 152	Depth 1.5 - 2.0 m	nr	1		
	CLASS L: SUPPORTS AND PROTECTION ANCILLARIES TO LAYING AND EXCAVATION				
	Bed, Haunches and Surrounds				
	<i>Granular Material</i>				
L534	Imported granular granular material as per specifications.	m	10		
534.1	Surrounds 150mm thick.				
	Precast concrete cover 1.3m x 0.9m	nr	30		
BILL 8A TOTAL CARRIED TO SUMMARY PAGE					

BILL NO. 8B: ADMINISTRATION BUILDING					
ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT
E	EARTHWORKS				
E4	GENERAL EXCAVATION				
E410	Excavation 200mm top soil and dispose	m ²	98		
E443.2	Excavation in class III material max. depth 0.5-1m for disposal	m ³	117		
E435.1	Extra over excavation, depth 2-5m for re-use	m ³	30		
E443	Excavation in Rock material max depth 1.5m for re-use in Gabion Boxes and excess disposed off the site. For Weir, Chambers and	m ³	80		
E6	FILLING AND COMPACTION				
E6112	Hardcore Using excavation Class I material	m ³	14		
F	IN-SITU CONCRETE				
F3	Provision and placing of concrete. Rates to include supplying, mixing, placing, vibrating, curing etc. Provision for strength test in accordance with the specification				
F323	<u>Concrete Grade:15</u> Thickness 50 - 100 mm Blinding 20 mm aggregate	m ³	5		
F333	<u>Concrete Grade:20</u> Thickness: 150-300 mm Bases, footing & ground slabs 20 mm aggregate	m ³	30		
G	CONCRETE ANCILLARIES				
G2	FORMWORK: FAIR FINISH				
G241	<u>Plane vertical</u> Fair finish to vertical sides of ring beam	m ²	124		
G5	REINFORCEMENT				
G522	High yield steel bars	Tons	2		
G570	Wire weld fabric BS Ref. A252	m ²	68		
G8	CONCRETE ACCESSORIES				
G812.1	<u>Finishing of top surface</u> 40mm screed, cement: sand 1:3, smooth trowel finish	m ²	120		
O	TIMBER				
O7	FITTINGS AND FASTENINGS				
O740	Bolts	nr	78		
O8	ROOFING				
O811	Roofing timber cypress 100x50	m	641		
O812	Ditto cypress 150x75	m	166		
O813	Ditto cypress 100x75	m	543		
O814	Ditto timber cypress 100x100 wall plate	m	25		
O815	300x25 Faccia Board	m	45		
O815	<u>Cladding</u> 26 gauge GCI sheeting	m ²	115		
O816	Ridge cap	m	18		
U	BRICKWORK, BLOCKWORK & MASONRY				
U431	<u>One block construction</u> Vertical walls: Thickness 150-250mm for superstructure	m ²	177		
U491	<u>Blockwork ancillaries</u> Joint reinforcement using hoop iron in every other course	m	377		
U492	Damp proof course.	m	63		
U492.2	Damp proof Membrane	m ²	68		
TOTAL CARRIED FORWARD TO NEXT PAGE					

BILL NO. 8B: ADMINISTRATION BUILDING					
ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT
	Total B/F From Previous Page				
V	<u>PAINTING</u>				
V523	2 coats of emulsion paint on wooden doors and windows	m ²	32		
V553	2 coats of emulsion paint to internal wall surface	m ²	191		
W	<u>WATERPROOFING</u>				
W1	<u>DAMP PROOFING</u>				
	<u>Rendering with proprietary mix mortar</u>				
W153	Internal 20mm mortar rendering, cement/sand 1:4 painted "soft white" to Ks10 B 15 or similar.	m ²	191		
W5	<u>SPRAYED OR BRUSHED WATER PROOFING USING</u>				
W50	External spray of tyrolean coloured soft white to Ks 10 B 15 or	m ²	212		
X	<u>MISCELLANEOUS WORK</u>				
X3	<u>DRAINAGE TO STRUCTURES ABOVE GROUND</u>				
X331	Gutters and gutters fittings	m	35		
X332	Downpipes and all the fittings	m	17		
X6	<u>WINDOWS</u>				
X68	HD 11FS window as specified in th drawing	nr	2		
X691	HD 2FS window as specified in th drawing	nr	1		
X692	HD 4S window as specified in th drawing	nr	3		
X693	2NE 5F window as specified in th drawing	nr	2		
X7	<u>DOORS</u>				
X721	<u>Wood, flush, external</u>				
X722	Single leaf, standard, 800mm wide	nr	3		
X724	Single leaf, standard, 900mm wide	nr	5		
X91	<u>SUBSTRUCTURE WALLING</u>				
X91.1	Supply, lay and join with sand cement motar 230mm thick stone masonry wall in strip foundation	m ²	25		
X92	<u>CEILING</u>				
X92.1	Allow for fixing 12mm celotex ceiling	m ²	64		
X92.2	Allow for the painting of the ceiling with Distemper	m ²	64		
X93	<u>OTHERS</u>				
X93.1	Provide for supply and installation of plumbing facilities in the house as specified in the drawing. Include for installation of water closets, cisterns shower fittings, stainless steel sinks, dhobi sinks, hand wash basins. overhead storage reservoir	Sum	1		
X93.2	Provide for supply and installation of all fitting in the house as specified in the drawing. Include for installation of table tops, store shelves above and under the bable tops,store shelves,and work tops, and other accessories	Sum	1		
X93.3	Provide for supply and installation of all electrical fittings in the house as directed by the Engineer. Include for complete wiring, installation of consumer meters, power sockets, lighting systems and connection to existing grid as drected	Sum	1		
BILL 8B TOTAL CARRIED TO COLLOECTION SHEET					

BILL NO. 8C: ONE BED ROOM HOUSES, 2No.

ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT
	CLASS D - DEMOLITION AND SITE CLEARANCE				
D100	General site clearance through un developed land over Way leave, include any additional clearance required including excavations to a depth 150mm	ha	0.10		
	CLASS E ; EARTH WORKS				
	General Excavations for inlet works				
	Excavation shall include for strutting, shuttering, stabilising excavated surfaces and keeping it free of water by bailing out, pumping or other means and preparing the excavated material.				
E311	Top soil for reuse to depth upto 0.25m	M ³	6		
E332	Material other than top soil, rock or artificial hard material; maximum depth 0.25 - 0.5m	M ³	13		
E333	Material other than top soil, rock or artificial hard material; maximum depth 0.5-1.0m	M ³	25		
E354	Rock material for re-use; max depth 1.0 - 2.0m	M ³	51		
E540	Excavation of material below final surface of ponds and replacing with hard material compacted to 95% MDD.	M ³	30		
	Filling				
	Return fill and ram selected excavated material as directed by the Engineer as follows.				
E611	Top soil for reuse to depth upto 0.25m	M ³	4		
E613	selected excavated material other than top soil, rock or artificial hard material 0.25 -0.5m	M ³	8		
E614	selected excavated material other than top soil, rock or artificial hard material 0.25 -0.5m	M ³	16		
E616	Excavated rock for hardcore, depth 1 - 2.0m	M ³	31		
	Disposal of excavated material				
	<i>Cart away surplus excavated material to the contractors tip as directed by the engineer as follows;</i>				
E321	Top soil for re- use to depth upto 0.25m	M ³	2		
E342	hard material; max depth 0.25-0.5	M ³	4		
E343	Material other topsoil, rock or artificial hard material; maximum depth 0.5 -1.0	M ³	8		
E364	Rock material for re- use; maximum depth 1.0m - 2.0m	M ³	17		
	CLASS F : IN SITU CONCRETE				
	<i>Provide, place, vibrate and cure the following classes of concrete.</i>				
F611	75mm thick class 15 concrete to constitute the blinding layer for strip footing/foundation	M ²	1		
F621.1	strip footing of thickness 400mm	M ³	8		
F621.2	Ground slabs; thickness 150mm	M ³	7		
F681	Mass concrete for chimney wall of thickness 50mm	M ³	0.12		
F763	Reinforced ring beam (lintel) of depth 600mm	M ³	4		
F751	Reinforced columns with cross sectional area; 0.03 - 0.1m ²	M ³	1		
	CLASS G: CONCRETE ANCILLARIES				
	Formwork; Fair finish				
G213	Vertical sides of strip footing	M ²	39		
G 242.1	External sides of ground floor slab; width 0.1 - 0.2m	M ²	5		
G241	External sides of beam; width 0.2 - 0.4m	M ²	46		
G242	External sides of wall column; width 0.2m - 0.4m	M ²	14		
G242	Formwork for kitchen shelves	M ²	8		
	Reinforcement				
	Rate to include for cutting, bending, supporting, tying and securing reinforcement				
G522	Nominal size 8mm. R8	t	0.012		
G523	Nominal size 10mm	t	0.010		
G562	steel fabric mesh reinforcement to BS 4483 ref A142 ; concrete nominal mass 2 - 3kg/m ²	m ²	50		
TOTAL CARRIED FORWARD TO NEXT PAGE					

BILL NO. 8C: ONE BED ROOM HOUSES, 2No.					
ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT
	Total B/F From Previous Page				
	<u>CLASS H; PRECAST CONCRETE</u>				
H511	Include for laying sand and jointing 600x600x50mm precast concrete paving slabs	nr	44		
H512	Include for laying sand and jointing 600x600x125mm I.B.D for storm water drainage	nr	152		
	<u>CLASS O; MISCELLANEOUS</u>				
	Softwood componets				
	roofing				
O117.1	5 No Trusses including all fixings	nr	5		
O117.2	6X100 x 50mm purlins	m	72		
O117.3	2 x 100 x 50mm ridge beam	m	25		
O117.4	100 x 50 wall plate	m	12		
O117.5	metal cleats	nr	6		
O117.6	230X20mm fascia board including rain gutter	m	34		
O117.1	galvinised iron sheets; gauge 26 and cap	m2	113		
	<u>CLASS U; MASONARY</u>				
	TO ICLUDE SUPPLYING, LAYING AND JOINING OF MASONRY WALS USING MOORTAR(1:5)				
U511.1	Fine chiseled dressed natural stone, masonry block for walls , 100mm thick	m ²	40		
U511.2	Fine chiseled dressed natural stone, masonry block for walls , 200mm thick	m ²	90		
	<u>CLASS V; PAINTING</u>				
V553.1	Apply three coats of pastic emulsion paint on piastered internal walls.	m ²	40		
V553.2	Apply three coats of plastic water paint on plastered external walls.	m ²	88		
	<u>CLASS W; WATER PROOFING</u>				
	Damp proofing				
W116	Damp proofing asphalt width not exceeding 300mm	m	33		
W131	Penotron basement water proofing	m ²	20		
	<u>CLASS Z; SIMPLE WORKS INCIDENTAL TO CIVIL ENGINEERING WORKS</u>				
	Carpentry and joinery				
	Windows, Doors, and Glazing				
	Rate to include supply of materials/fittings,fixing and or drilling, cutting of associated works, and painting with 3 coats				
	<u>Doors</u>				
	<u>cost to include frames, hinges, locks, handles , stoppers and fixing according to specifications.</u>				
Z313.1	900x2160mm steel door.	m	1		
Z313.2	850x2180mm cypress doors for wash rooms.	m ²	6		
	<u>WINDOWS</u>				
	Glass lourverd windows complete with frame iron mongery, mosquito gauze, glass panes(5mm thick) and painted with 3 coats of paint as specified with 3 coats. Include for supply and Window size 600x1200mm				
Z321.1		nr	3		
	<u>Surface finishes</u>				
Z411	Cement sand 20mm screed on floors	m ²	50		
Z413.1	cement/sand 20mm plaster on internal walls	m ²	40		
Z413.2	cement /sand walls 20mm render external walls.	m ²	88		
Z452	ceiling board; celotex painted with distemper.	m ²	50		
Z452	Floor tiles	m ²	50		
TOTAL CARRIED FORWARD TO NEXT PAGE					-

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BILL 8C TOTAL CARRIED TO SUMMARY PAGE					
BILL NO. 8D: ACCESSORY SITE WORKS					
ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT
	CLASS D - DEMOLITION AND SITE CLEARANCE General site clearance through un developed land over Way leave, include any additional clearance required including excavations to a depth 150mm	ha	0.10		
	CLASS E ; EARTH WORKS Excavations Excavation shall include for strutting, shuttering, stabilising, excavated surfaces and keeping it free of water by bailing out, pumping or other means and preparing the excavated surfaces.				
E531	Black cotton soil	m3	200		
E532	soft rock material	m3	200		
E533	Hard rock material class	m3	200		
	FILLING <i>Return, fill and ram selected excavated material as directed by the engineer as follows.</i>				
E611	Filling with selected excavated rock material or imported murrum for the 150mm wearing course for the parking as instructed by the <u>Disposal of Excavated material</u> Cart away surplus excavated material to the contractor's tip as directed by the engineer as follows;	m2	600		
E320	Black cotton soil and rock material.	m3	100		
H512	CLASS H; PRECAST CONCRETE 600X250X125MM I.B.D for storm water drainage	nr	100		
	CLASS D - DEMOLITION AND SITE CLEARANCE General site clearance through un developed land over Way leave, include any additional clearance required including excavations to a depth 150mm	ha	0.12		
	CLASS E ; EARTH WORKS General Excavations for inlet works Include , excavation, leveling, and compaction to the finished levels for the entire access road as indicated in the drawings and as per Engineers directive.				
E210	soft rock material	m3	100		
E230	Hard rock material class ii	m3	100		
	Excavation Ancillaries Trimming of excavated surfaces. Include ,excavation, trimming, shsaping and preparing of surfaces of the access road in order to attain side slopes indicated on the Slopes in black cotton soil, soft rock material and hard rock	m3	150		
	FILLING <i>Include filling, benching in layers of 200mm and compacting upto finished ground levels fojr the full length of access road.</i>				
E632	Filling with selected materials or imported murrum for the 150mm wearing course for access of road as instructed by the Engineer.	m2	400		
E636.2	Filling / levelling in layers o 200mm with selected material to make up 500mm base layer for access road as instructed by the engineer.	m2	400		
E636.2	General filling with selected excavated soft material to make subgrade formation level for access road.	m2	400		
	Landscaping Include preparing and grassing of the outer sloping sides of the access road embankment and the channel slopes.				
TOTAL CARRIED TO COLLECTION SHEET					

BILL NO. 8D: ACCESSORY SITE WORKS

ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT
	Total B/F From Previous Page				
E636.2	Grassing of side slopes of the access road channels as shown in the drawing or directed by the engineer.	m2	400		
	CLASS G: PRECAST CONCRETE				
H511.1	Provide, lay and joint 600x450x225mm invert block drains on both sides of access road .	nr	500		
H511.2	Provide, lay and joint 600x225x75mm side slabs on both sides of access road channel, include for laying and jointing.	nr	500		
	CLASS F: INSITU CONCRETE				
	Place , vibrate, and cure concrete in the following elements of structures as per details in the drawings,,,				
G213	Mass concrete Class 20/20 on bas slabs; 150mm thick	m3	10		
G213	Mass concrete Class 20/20 on headwalls and wing walls; 150mm	m3	10		
	CLASS G: CONCRETE ANCILLARIES				
	Formwork				
G145	Rough finish ; plane vertical sides of headwalls.	m2	40		
G243	Fair finish; plane vertical sides of headwalls and wing walls.	m2	40		
	Concrete Block Paved Roads				
	<u>Sub-Base and Base Courses: Provide, Lay and Compact to required relative density as per Clause 304 of Specifications:</u>				
3.6	Hand packed hardcore compacted to CBR not less than 30 up to formation level (where road is in fill)	m2	400		
3.7	Base 200mm thick crusher run or quarry chips (hand packed), including for watering and stone dust blinding as directed.	m2	400		
3.8	200mm murrum, include for watering and stone dust blinding as directed	m2	400		
3.9	Provide and apply approved weed killer / herbicide to road surface in accordance with manufacturer's instructions	m2	400		
	Concrete Block Paving (as Manufactured by Bamburi Special Products Ltd. or Other Approved Supplier)				
3.10	Supply and lay Medium Duty Paving Blocks, 60mm thick, Minimum strength 37-41N/mm ² laid on and including 50mm thick sand bed and compacted by surface vibration	m ²	300		
4.00	Footpaths				
	Provide and lay:				
4.10	100mm murrum sub-base, compacted to Engineer's approval	m ²	300		
4.20	50mm thick concrete bed for footpath (Class 15)	m ²	300		
10.X91.1	Allow PC sum for application to KPLC and electrical power	pc	1		
10.X91.2	Electrification of the Treatment Works. (including wiring and electrical fittings, 10Nr Compound Lighting using 10m light poles and LED bulbs.)	item	1		
10.X91.5	Contractors overhead on Items X91.1 and X91.4	%	-		
1	FENCING AND GATES				
	Excavate for post holes, provide all materials and construct chain link fence on concrete posts at 3m centre to centre as specified by the engineer including straining posts at every 10th post and additional posts at corners	LM	380		
1.2	Provide all materials and construct Pedestrian gate 5.0m wide including 2 Nr. Pillars, footings, etc. as directed by the engineer	Nr	2		
BILL 8D TOTAL CARRIED TO SUMMARY PAGE					

BILL NO. 8E GATE HOUSE					
ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT
1.0	<u>SUBSTRUCTURES (PROVISIONAL)</u> <u>Excavations and Earthworks</u>				
1.1	Excavate average 200mm deep to remove vegetable soil and cart	m2	18		
1.2	<u>Excavate 0.00-1.50m deep starting from stripped level to</u> Foundations	m3	11		
1.3	<u>Extra over excavation in any position for:-</u> Excavating in compacted gravel or decomposed rock	m3	5		
1.4	Excavating in hard rock of all classes	m3	3		
1.4	<u>Approved selected Filling</u> Fill and ram selected excavated materials around foundations and buildings	m3	9		
1.5	<u>Approved filling as described:-</u> Provide and deposit approved hardcore fill material 200mm thick in making up levels including achieving satisfactory compaction	m2	11		
1.6	Provide, lay and level out, 50mm thick fine crushed stone, sand or gravel blinding to surface of filling, including watering and rolling to achieve satisfactory compaction	m2	11		
1.7	<u>Disposal of Surplus Spoil:-</u> site	m3	25		
1.8	<u>Anti-Termite Treatment</u> Chemical anti-termite treatment to surface of filling with an approved insecticide	m2	11		
1.9	<u>Damp-proof Membrane</u> 500 Gauge polythene sheeting, laid over hardcore in two layers	m2	11		
1.10	<u>Concrete Work:</u> <u>Mass Concrete Class 15 (1:4:8) , 40mm maximum aggregate as described in:-</u> 50mm thick blinding under foundation concrete	m2	13		
1.11	<u>Guaranteed Strength Reinforced Concrete Class 20/20mm maximum aggregate as described in:-</u> Foundation trenches, columns and piers combined with foundation trenches	m3	2		
1.12	100mm Thick surface bed	m2	11		
1.13	<u>Reinforcement</u> <u>Fabric Reinforcement No. A142 Mesh Size 150 x 150mm</u> <u>Weighing 2.22 kgs Per m2 , Including Bends, Tying Wire and</u> Fabric reinforcement with minimum 150mm wide side and end laps, laid in bed	m2	11		
1.14	<u>Provide and Fix High Tensile Steel Reinforcement to SRN 127 including cutting, bending, propping with spacers and tying as specified :-</u> Reinforcement, all diameters	Kg	94		
1.15	<u>Formwork</u> <u>Provide and fix shuttering including propping, strutting and striking, all as specified</u> <u>Wrot Formwork - Class F3 Finish:-</u> Edges of beds and pavings 75 - 150mm wide	m	13		
PAGE TOTAL CARRIED TO NEXT PAGE					

BILL NO. 8E GATE HOUSE					
ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT
	Total B/F From Previous Page				
	<u>Walling.</u> <u>Natural Stone Block Walling, Medium Chisel Dressed,</u> <u>Reinforced with 20 swg Hoop Iron at every third course, and</u> <u>Bedded, Jointed and Pointed in Cement Mortar (1:5):-</u>				
1.16	200 mm Walling	m2	20		
1.17	Extra over 200 mm walling for attached piers 400mm wide projecting 200mm from the wall face	m	1		
	<u>Damp-proof course:</u> <u>Bituminous felt damp-proof course as described:-</u>				
1.18	200mm Wide under walls	m	13		
	<u>Plinths.</u>				
1.19	15mm Cement and sand (1:4) render to plinth walls, finished with a wood float	m2	11		
1.20	Prepare and apply two coats of bituminous paint on rendered plinth walls	m2	13		
	<u>Disposal of Water</u>				
1.21	Keep excavations free from all water except spring or running	Item	1		
	<u>Planking and Strutting</u>				
1.22	Allow for normal planking and strutting to uphold sides of excavations (except special shoring or sheet steel piling)	Item	1		
	<u>SUPERSTRUCTURE</u>				
2.0	<u>CONCRETE, FORMWORK, REINFORCEMENT</u> <u>Guaranteed Strength Reinforced Concrete Class 25/20mm as described in:</u>				
2.1	Beams	m3	1		
	<u>Formwork</u> <u>Provide and fix shuttering including propping, strutting and striking, all as specified</u> <u>Wrot Formwork - Class F3 Finish :-</u>				
2.2	Sides and soffites of beams	m2	11		
	<u>Reinforcement</u>				
	<u>Provide and Fix High Tensile Steel Reinforcement to SRN 127 including cutting, bending, propping with spacers and tying as specified :-</u>				
2.3	Reinforcement, all diameters	Kg	94		
3.0	<u>WALLING</u> <u>External Walls</u> <u>Selected Natural Stone Block Walling, Fine Chisel Dressed or Machine Dressed, Reinforced with 20 swg Hoop Iron at every third courses, and Bedded, Jointed and Pointed in Cement</u>				
3.1	200mm Thick walling	m2	25		
3.2	Extra over 200 mm walling for attached piers 400mm wide projecting 200mm from the wall face	m	2		
	<u>Labours</u>				
3.3	Extra over walling for ruled horizontal and flush vertical joints	m2	25		
3.4	200mm Thick x 275mm wide dressed stone cill bedded, jointed and pointed in cement mortar on top of 200mm wall	m	2		
4.0	<u>ROOF COVERINGS</u> <u>Guaranteed Strength Reinforced Concrete Class 25/20mm as described in:</u>				
4.1	Roofing slab 150mm thick	m3	2		
PAGE TOTAL CARRIED TO NEXT PAGE					

BILL NO. 8E GATE HOUSE					
ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT
	Total B/F From Previous Page				
3.4	<u>Dressed Stone Cills</u> 200mm Thick x 275mm wide dressed stone cill bedded, jointed and pointed in cement mortar on top of 200mm wall	m	2		
4.0	<u>ROOF COVERINGS</u> <u>Guaranteed Strength Reinforced Concrete Class 25/20mm as described in:-</u>				
4.1	Roofing slab 150mm thick	m3	2		
	<u>Formwork</u> <u>Provide and fix shuttering including propping, strutting and striking, all as specified</u>				
4.2	<u>Wrot Formwork - Class F3 Finish:-</u> Soffist and edges of roof slabs 75 - 150mm wide	m2	13		
	<u>Reinforcement</u> <u>Provide and Fix High Tensile Steel Reinforcement to SRN 127 including cutting, bending, propping with spacers and tying as specified :-</u>				
4.2	Reinforcement, all diameters	Kg	780		
	<u>Fittings</u> <u>The Following In Concrete Worktop 2000mm long x 600mm wide</u>				
5.8	75mm Thick reinforced Concrete Class 20/20mm worktop	m2	4		
5.9	Mesh Reinforcement Ref. A 142 in concrete top slab.	m2	3		
5.10	Sawn formwork as described to horizontal soffites of worktop	m2	3		
5.11	Ditto to edges 75-150mm girth	m	7		
5.12	20mm Thick cement and sand (1:4) screed to top and sides of	m2	12		
5.13	12.5mm Thick gauged cement plaster to horizontal soffites of	m2	11		
5.14	Prepare and apply two coats plastic emulsion paint to plastered horizontal soffites of worktop	m2	11		
5.15	Form groove 100mm deep in masonry wall to receive 75mm edge of concrete bench, build in last and make good	m	7		
7.0	<u>IRONMONGERY</u> <u>Supply and Fix the following Ironmongery selected from "Union" Catalogue complete with matching screws:-</u>				
7.1	Pairs 100 mm Steel heavy duty washered butt hinges	Nr	3		
7.2	Three-lever mortice lock as "Union Ref: 680-06-77AS with set of brass lever handles and furniture	Nr	1		
7.3	Rubber door stop fixed to floor or wall with screw	Nr	1		
7.4	Solid 251/C91 hat and coat hook with rubber buffer	Nr	1		
8.0	<u>METALWORK</u> <u>Steel Casement Windows</u> <u>Supply and fix the following Standard Section Horizontal Bar Type Steel Casement Windows with one coat lead oxide primer complete with opening accessories including bedding and pointing around frames in cement mortar:-</u>				
8.1	<u>Window size 830 x 1200mm high with 2 No. top-hung ventilators each with permanent ventilator hood over (W5)</u> <u>Burglar-Proofing to Windows</u> <u>Burglar-proofing comprising 25 x 3mm thick vertical and horizontal mild steel members at 150mm centres, including one coat lead oxide primer and fixing to the following windows</u>	Nr	2		
8.3	To window size 830 x 1200mm high (W5)	Nr	2		
PAGE TOTAL CARRIED FORWARD TO NEXT PAGE					

BILL NO. 8E GATE HOUSE					
ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT
	Total B/F From Previous Page				
	<u>Steel Doors</u>				
	<u>Pressed Metal Doors</u>				
	Supply and Fix the following Pressed Metal Doors with 100 x 50mm Stiles and Top Rails, 150 x 50mm Middle and Bottom Rails With Pressed Metal Infill 100 x 50mm Pressed Metal Frames, Including Hinges, Pad Bolts and Tower Bolts, All To Manufacturer's Details, with one coat lead oxide primer complete with opening accessories including bedding and pointing around Single door size 900 x 2200 mm high	Nr	1		
9.0	<u>PLASTERING</u>				
	<u>12.5mm Thick Gauged Cement Plaster as described internally</u>				
9.1	Concrete or blockwork	m2	25		
9.2	Reveals of openings	m2	2		
	<u>Screeds</u>				
	<u>Bonded cement and sand (1:4) screed bed in one coat, well bonded to concrete base as described:-</u>				
9.3	40mm Thick paving with wood float finish on concrete	m2	11		
9.4	100 x 20mm Thick skirting laid with a square top edge and coved junction with floor finish	m	7		
10.0	<u>GLAZING</u>				
	<u>4mm Thick Clear Sheet Glass And Glazing to Steel Casements with putty in panes:-</u>				
10.1	0.10 - 0.50 Square metres	m2	2.00		
11.0	<u>PAINTING AND DECORATING</u>				
	<u>Prepare and apply one coat aluminium primer before fixing</u>				
11.1	Backs of wood 0-100m girth	m	1		
	<u>Prepare, knot, prime, stop and apply three coats first quality gloss paint to wood surfaces</u>				
	<u>Internally on:-</u>				
11.4	Surfaces 0-100mm girth	m	13		
11.5	Ditto 200-300m girth	m	7		
11.6	General surfaces of doors (measured flat overall)	m2	20		
	<u>Prepare, touch up primer and apply three coats gloss paint : Externally on:-</u>				
11.7	General surfaces of glazed metal windows, including burglar-proofing (measured flat overall)	m2	2		
	<u>Internally on:-</u>				
11.8	General surfaces of glazed metal windows, including burglar-proofing (measured flat overall)	m2	2		
	<u>Prepare and apply three coats exterior quality plastic emulsion paint:-</u>				
	<u>Externally on:-</u>				
11.9	Fair-faced horizontal sides and soffites of beams	m2	4		
	<u>Prepare and apply three coats interior quality plastic Internally on:-</u>				
11.10	Plastered concrete or blockwork	m2	13		
11.11	Ditto reveals of openings	m2	2		
11.12	Horizontal soffites of suspended ceilings slab	m2	11		
11.13	Horizontal surfaces 100-200mm girth	m	11		
	<u>Prepare and apply High Strength Non-skid Epoxy Flooring</u>				
11.14	Cement and sand screed floors, skirtings, treads, risers, etc.	m2	11		
BILL 8E TOTAL CARRIED TO SUMMARY PAGE					

BILL 8F ABLUTION BLOCK					
ITEM No.	DESCRIPTION	UNIT	QUANTITY	RATE (KShs.)	AMOUNT
1	<u>SUBSTRUCTURES</u>				
	<u>SITE CLEARANCE & TOP SOIL STRIPPING</u>				
1.1	Clear area around the site of all grass, bushes, shrubs, hedges, grub up roots and cart away to tips as directed by the Engineer	m ²	225		
1.2	Cut down trees, grub up roots and burn debris. Girth n.e. 1.2m (Provisional)	nr	1		
1.3	Excavate over site for buildings, roads, etc. average 150mm deep to remove vegetable soil and stack part of material for use as and where directed by the Engineer, cart away surplus to tips	m ²	225		
	<u>EXCAVATION</u>				
	The rates shall include for all strutting, shuttering, stabilising the excavation faces, and keeping the excavation free of water by pumping, bailing or other means				
1.4	Excavate below stripped level to formation level in common material, part backfill after construction and remainder, cart away to tips or use as fill on site, all as directed by the Engineer.	m ³	10		
1.5	-Ditto- but maximum depth 1.0 m to 2.0 m	m ³	10		
1.6	-Ditto- but maximum depth 2.0 m to 3.0 m	m ³	10		
	<u>Extra Over Excavation in any Position For:- (Provisional)</u>				
1.7	Excavating in rock Class "A"	m ³	1		
1.8	Excavating in rock Class "B"	m ³	1		
1.9	Excavating in rock Class "C"	m ³	8		
	<u>Approved Selected Filling as Described:-</u>				
1.10	Fill and ram selected excavated materials inside the existing pit	m ³	25		
	<u>Approved Hardcore Filling as Described:-</u>				
1.11	Provide and deposit approved imported hardcore in maximum 150mm thick layers in making up levels including achieving satisfactory compaction	m ³			
1.12	Provide, lay and level out fine crushed stone, sand or gravel blinding 50mm thick to surface of filling, including watering and rolling to achieve satisfactory compaction	m ³	75		
1.13	Cart away surplus excavated materials to an approved dumping site	m ³	35		
	<u>Anti-Termite Treatment</u>				
1.14	Chemical anti-termite treatment to surface of filling with an approved insecticide	m ²	75		
	<u>Damp-proof Membrane</u>				
1.15	500 Gauge polythene sheeting, laid over hardcore	m ²	75		
	<u>Disposal of Surplus Spoil:-</u>				
	<u>Concrete Work:</u>				
	Mass Concrete Class 15/20mm Maximum Aggregate as Described in:-				
1.16	50mm Thick blinding under foundation concrete, column bases or over hardcore	m ²	75		
	Guaranteed Strength Reinforced Concrete Class 25/20mm Maximum Aggregate as Described in:-				
1.17	Foundation trenches, column bases and entrance steps	m ³	10		
1.18	150mm Thick surface bed	m ²	75		
1.19	150mm Thick ramp laid to slope not exceeding 15 degrees from horizontal at entrance	m ²	10		
1.20	Extra over concrete for tamping whilst still green to make ribbed	m ²	10		
	<u>Guaranteed Strength Reinforced Concrete Class 25/20mm Maximum aggregate as Described in:-</u>				
	Isolated columns and piers in foundations	m ³	3		
PAGE TOTAL CARRIED FORWARD TO NEXT PAGE					

BILL 8F ABLUTION BLOCK					
ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT
	Total B/F From Previous Page				
	Reinforcement				
	Fabric Reinforcement No. A142 Mesh Size 200 x 200mm Weighing 3.95 kgs Per m², Including Bends, Tying Wire and Fabric reinforcement with minimum 200mm wide side and end laps, laid in bed	m ²	75		
1.21					
	Provide and Fix High Tensile Steel Reinforcement to SRN 127 including Cutting, Bending, Propping with Spacers and Tying as Specified :-				
1.23	Reinforcement, all diameters	kg	1,000		
	Formwork				
	Provide and Fix Shuttering Including Propping, Strutting and Striking, all as Specified				
	Sawn Formwork - Class F1 Finish:-				
1.24	Vertical sides of column bases, columns, sides of foundations and steps in foundations	m ²	50		
	Wrot Formwork - Class F3 Finish:-				
1.25	Edges of beds, pavings, plinths and risers of steps not exceeding 300mm wide	m ²	40		
	Walling,				
	Solid Concrete Block Walling With Concrete Blocks to BS 2028, Type "A" with Minimum Crushing Strength of 3.7N/mm² at 28 Days, Reinforced with 20 swg Hoop Iron at alternate course, and Bedded, Jointed and Pointed in Cement 200 mm Walling	m ²	60		
1.26					
	Damp-proof course:				
	Bituminous felt damp-proof course as described:-				
1.27	200mm Wide under walls	m	45		
1.28	100mm Wide under walls	m	12		
2	SUPERSTRUCTURE				
	CONCRETE, FORMWORK, REINFORCEMENT				
	Guaranteed Strength Reinforced Concrete Class 25/20mm as Described in:				
2.1	Columns and beams including 4m high tank support structure	m ³	4		
2.2	300mm thick, 500mm wide raised plinth in shower units for dressing area	m ³	1		
	Worktops				
2.3	75mm thick, 500mm wide platform at 1m high supported on the structure's masonry walling in the shower unit	nr	2		
2.4	75mm thick, 500mm wide, 900mm high worktop made from supported on masonry walling support at ends and center in Ladies washroom. Finishing with 200mm x 300mm ceramic tiles on top	nr	1		
	Formwork				
	Provide and Fix Shuttering Including Propping, Strutting and Striking, all as Specified				
	Wrot Formwork - Class F3 Finish :-				
2.5	Vertical sides of columns	m ²	10		
2.6	Sides and soffits of beams	m ²	60		
2.7	Edges of risers of steps not exceeding 200mm wide	m ²	10		
	Reinforcement				
	Provide and Fix High Tensile Steel Reinforcement to SRN 127 Including Cutting, Bending, Propping with Spacers and Tying as Specified :-				
2.8	Reinforcement, all diameters	kg	560		
PAGE TOTAL CARRIED FORWARD TO NEXT PAGE					

BILL 8F ABLUTION BLOCK					
ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT
	Total B/F From Previous Page				
	<u>Labours</u>				
3.2	Extra over walling for ruled horizontal and flush vertical joints	m ²	120		
	<u>Precast Concrete Louvre Block Walling :-</u>				
	<u>Internal Walls</u>				
	Solid Concrete Block Walling With Concrete Blocks to BS 2028, Type "A" with Minimum Crushing Strength of 3.7N/mm² at 28 Days, Reinforced with 20 swg Hoop Iron at alternate course, and Bedded, Jointed and Pointed in Cement				
3.3	150mm Thick walling	m ²	20		
3.4	100mm Thick walling	m ²	100		
4	ROOF COVERINGS				
	Other Roof Members				
	Sawn Cypress Grade II Maximum Moisture Content 12% Seasoned and Pressure Impregnated with Wood Preservative and Timber Joints with Bolted and Nailed Connections to the				
4.6	150 x 50mm Intermediate, hip and valley rafters	m	60		
4.7	150 x 50mm Struts	m	15		
4.8	150 x 50mm Tie beam	m	25		
4.9	100 x 50mm Purlins	m	70		
4.10	100 x 50mm Wall plate tied to wall with 20 s.w.g. hoop iron at 900mm centres and bedded in cement mortar (1:4) on top of wall	m	40		
4.11	Scarfed joint to 150 x 50mm timber member	nr	20		
	<u>Sundries</u>				
4.12	Bed wall plate in cement mortar (1:4)	m	40		
	<u>General Timbers</u>				
	Wrot Prime Grade Cypress, Including Finishing With Three Coats First Quality Gloss Paint :-				
4.13	250 x 40mm Fascia board	m	50		
4.14	Tongue & Groove (T&G) Boarding on underside of roof overhang, including provision of roof venting holes with gauze.	m ²	30		
5	<u>METALWORK</u>				
	Steel Doors				
	Pressed Metal Louvre Doors				
	Supply and Fix the following Pressed Metal Louvre Doors with 100 x 50mm Stiles and Top Rails, 150 x 50mm Middle and Bottom Rails With Pressed Metal Infill Louvres and 100 x 50mm Pressed Metal Frames, Including Hinges, Pad Bolts and Tower Bolts, All To Manufacturer's Details, with three coats gloss paint complete with Opening Accessories Including Bedding and Pointing Around Frames in Cement Mortar.				
5.1	Single door size 900 x 2400mm high (D2)	nr	2		
	<u>Barrier at the front service area</u>				
5.2	12mm diameter vertical mild steel members at 250mm centres, 1500mm high including one coat chemical resistant paint and fixing on the opening at the service area.	nr	1		
5.3	Area of opening requiring barrier	m ²	5		
5.4	Metal sheet window for the front opening, 2mm thick. The metal window should have a mechanism for fully lifting to open during operating hours and easy to lock when required.	m ²	5		
PAGE TOTAL CARRIED FORWARD TO NEXT PAGE					

BILL 8F ABLUTION BLOCK					
ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT
	Total B/F From Previous Page				
	<u>Barrier at the front service area</u>				
5.2	12mm diameter vertical mild steel members at 250mm centres, 1500mm high including one coat chemical resistant paint and fixing on the opening at the service area.	nr	1		
5.3	Area of opening requiring barrier	m ²	5		
5.4	Metal sheet window for the front opening, 2mm thick. The metal window should have a mechanism for fully lifting to open during operating hours and easy to lock when required.	m ²	5		
6	<u>TIMBER DOORS</u>				
	Door Frame				
	Wrot Cypress Door Frames size 100 x 50mm with a suitable rebate to receive hinged door panel, including suitable mild steel clamps fixed to back of frame and fixing to door opening size and all necessary woodwork finishes (prepare, knot, prime, stain and apply two undercoats and one finishing coat				
6.1	Frame to fit door opening 900mm wide x 2400mm high	nr	10		
	Doors				
	Supply and Fix 50mm Thick Prime Grade Cypress Panelled Door With 50 x 100mm Stiles and Top Rails, 50 x 150mm Middle and Bottom Rails and Infill Panels in 50 x 100mm T & G battens. Rate to include for 3 Nr 100mm steel heavy duty washered butt hinges, three lever mortice lock as 'Union Ref:2237' with a set of aluminium lever handles as 'Union' Ref.681-06-02 and rubber door stop and three coats of gloss paint complete with bedding and pointing around frames in cement mortar. (See Door Details in Standard Drawings):-				
6.2	Door size 800 x 2030 mm high with 990 x 140mm Georgian wired clear glass view panel	nr	10		
6.3	Supply and fix Stainless steel buffer coat hooks	nr	12		
6.4	Supply and fix 100mm D-pull handles	nr	10		
7	<u>CEILING</u>				
	12mm Thick Approved Plasterboard in Sheets Size 2400 x 1200mm Fixed to and Including 50 x 50mm Sawn Cypress Grade 2 Battens at 600mm Centres in Both Directions				
	Complete with Gance Jointing Material				
7.1	Horizontal ceiling fixed to underside of trusses	m ²	300		
7.2	12mm Cornice 50mm high, plugged	m	110		
7.3	Extra over ceiling lining for forming removable access trap door size 600 x 600mm with 100 x 38 mm sawn treated cypress trimming joists between tie beams, 120 x 20mm (finished) wrot cypress frame all round and 20mm blockboard removable panel set	nr	2		
8	<u>RENDERING</u>				
	12.5mm Thick Cement and Sand Render as Described				
8.1	Blockwork and concrete surfaces	m ²	120		
	<u>Screeds</u>				
	Bonded cement and sand (1:4) screed bed in one coat, well bonded to concrete base as described:-				
8.2	38mm Thick screed laid level to receive floor tiling (measured separately)	m ²	90		
8.3	12mm (minimum) Thick Cement and sand backing (1:4) with approved plasticiser to receive granito floor laid to skirtings, treads and risers (measured separately)	m ²	20		
	Bonded cement and sand (1:4) screed bed in one coat with approved hardener incorporated in the mix, well bonded to concrete base as described:-				
8.4	12mm (minimum) Thick screed laid level to receive ceramic wall tiles (measured separately)	m ²	300		
PAGE TOTAL CARRIED FORWARD TO NEXT PAGE					

BILL 8F ABLUTION BLOCK					
ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT
	Total B/F From Previous Page				
9	PLASTERING 12.5mm Thick Gauged Cement Plaster as Described Internally on :-				
9.1	Blockwork and concrete surfaces	m ²	300		
10	PAINTING AND DECORATING Prepare and Apply Three Coats Exterior Quality Plastic Emulsion Paint:- Externally on:-				
10.1	Fair-faced concrete surfaces	m ²	300		
	Internally on:- Wall Tiles Coloured Ceramic Wall Tiles from Saj Co. as supplied by M/s Tile & Carpet Centre, or other equal and approved				
10.2	200 x 300mm Thick coloured wall tiles laid on backing (measured separately) and joints filled in approved filler to match colour of	m ²	300		
	Sundries PVC tiling edge to external corners of tiles (Provisional)	m	75		
11	FLOOR FINISHES Ceramic Floor Tiling Coloured Ceramic Floor Tiles from Saj Co. as supplied by M/s Tile & Carpet Centre, or other equal and approved				
11.1	300 x 300mm Tiles laid on screed (measured separately) and joints filled in approved filler to match colour of tiles	m ²	90		
11.2	Ditto but laid as skirting 100mm high	m	20		
12	PLUMBING AND DRAINAGE Allow for cutting and leaving all necessary holes, notches, mortices, sinkings and chases both in the structure and its finishes and for all making good in connection with the				
12.1	White vitreous china squatting level washdown W.C. suite	nr	6		
12.2	White vitreous china washbasin complete	nr	6		
12.3	Shower unit complete	nr	2		
12.4	Mirror size 3000 x 600mm	nr	2		
12.5	Toilet roll holder	nr	6		
12.6	Recessed soap tray	nr	2		
12.7	Chrome plated shower rail size 25mm diameter x 900mm long complete with fixtures	nr	2		
	Sanitary Appliances All sanitary appliances shall be supplied and installed as complete units with all fittings, fixtures, pipework to manholes, waste grits & traps and shall be as specified or approved equal. Rate to include for all 25 - 50mm dia pipework (PPR and GI pipes), Gate Valves and Taps (Pegler type, English) and connection to water supply and connection				
12.8	White vitreous china squatting level wash down Water Closet suit complete with high level 6 litre cistern and flush pipe.	nr	6		
12.9	Urinal bowl with urinal automatic flushing system complete with cistern and flush pipes	nr	3		
12.10	Wall mounted washbasin as "Twyford's Entice 575" with one tap & 32mm waste grit *basin mixer as "Europath Astra" with aerator & pop -up waste.*32mm CP bottle trap with tail pipe, cap-nut & wall flange as "Cobra" 340 & C-342/1/2/3	nr	6		
12.11	Shower unit complete with shower head and all taps and connections to water tank and connection to foul water drainage	nr	2		
12.12	White vitreous china 1000mm x 1000mm basin	nr	2		
12.13	Mirror size 3000 x 600mm plugged and screwed to wall with chromium plated domed screws complete with 5mm thick foam	nr	2		
PAGE TOTAL CARRIED FORWARD TO NEXT PAGE					

BILL 8F ABLUTION BLOCK					
ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT
	Total B/F From Previous Page				
	<u>Foul/Waste drainage</u>				
12.14	Excavate pipe trench in ordinary ground for 160mm diameter pipe between 0 - 2m	m	25		
12.15	Provide lay and joint uPVC pipes golden brown Class 41 160mm diameter. Include for all fittings and connections to inspection chambers.	m	25		
	<u>Inspection Chambers</u>				
12.16	Excavate for, provide all materials, special shuttering e.t.c and construct 600 x 450mm internal dimensions in situ concrete inspection chambers on sewers diameter 160mm. Include for building in pipes, forming benching to falls, medium duty fibre reinforced frame and cover, depth n.e. 1.5m.	nr	6		
13	<u>WATER SUPPLY</u>				
13.1	Allow a Provisional Sum of Kshs. 30,000 for Connection of Ablution Block to existing water supply sytem including provision	P.S	1		
13.2	Allow a Provisional Sum of Kshs. 50,000 for provision all materials and instal pipework as directed by the Engineer to provide a water selling point with requisite water meters, stand	P.S	1		
13.3	Allow a Provisional Sum of Kshs. 100,000 for supply and installation of the 1 Nr 5000 litres capacity "Roto" or approved water tank complete with provisions for inlet pipe, outlet pipe, overflow pipe and drain pipe to site drainage and requisite chambers. The rate to also include for ball valve 32mm diameter medium pressure ball valve as "PORTSMOUTH" type or approved equivalent with brass stem and plastic float, screwed to threaded socket of tank including union. Provide and install burglar proofing with mild steel frame around the tank as shown in Drawing No	P.S	1		
14	<u>ELECTRICAL WORKS</u>				
14.1	Allow a Provisional Sum of Kshs. 200,000 for connection to nearest KPLC power.	P.S	1		
14.2	Allow a Provisional Sum of Kshs. 250,000 for provision and installation of electric fittings and fixtures to the ablution block including all wiring, cabling, security lights, sockets, switches, Consumer Unit, Meters, lighting fixtures etc as directed by the	P.S	1		
15	<u>SITE AND ANCILLARY WORKS</u>				
	<u>FOOTPATHS</u>				
15.1	Provide, lay and compact 150mm thick murrum base to footpaths as specified (Provisional)	m ²	9		
15.2	Provide and apply approved weed killer to murrum base for footpaths (Provisional)	m ²	9		
15.3	Precast concrete paving in 600mm x 600mm x 60mm slabs jointed and grouted up in lime and sand (1:3)	m ²	9		
15.4	E.O for providing all materials and constructing steps along footpath as directed (treads - 300mm, risers - 150mm)	m ²	5		
	<u>FENCING AND GATES</u>				
15.5	Excavate for post holes, provide all materials and construct Barbed Wire Fence on wattle posts posts at 3m centre to centre including straining posts at every 10th post and additional posts at corners as per the drawing	m	90		
15.6	Provide all materials and construct metal gate 2.0m wide including 2 Nr. Pillars, footings, etc. all as detailed on the drawing.	nr	1		
PAGE TOTAL CARRIED FORWARD TO NEXT PAGE					

BILL 8F ABLUTION BLOCK					
ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT
	Total B/F From Previous Page				
	<u>SURFACE WATER DRAINAGE & GRASSING</u>				
	<u>Earth Drains (Provisional)</u>				
15.7	Excavate trapezoidal earth drains to the lines and levels directed by the Engineer. Allow for trimming of sides to correct slopes and cart excavated material to tips. Depth to invert n.e. 1.0m	m	10		
15.8	-Ditto- but depth to invert n.e. 2.0m	m	5		
15.9	Provide and spread 100mm of approved top soil on the base of sides of the earth drain, rake and level to the required profiles as directed by the Engineer (Provisional)	m ²	20		
15.10	Supply and plant approved grass on base and sides of the earth drain and maintenance until it takes root to the satisfaction of the Engineer (Provisional)	m ²	20		
	<u>Culvert Pipes</u>				
15.11	Excavate trench depth n.e. 2.5 m, supply, lay and joint for 525mm diameter precast concrete ogee pipes including concrete surround, backfill after laying of pipes, compact and cart away surplus material to tips	m	6		
	<u>Headwalls</u>				
15.12	Excavate for, provide all materials and construct 225 mm thick masonry headwalls including concrete Class 15/20 footings, all in accordance with standard drawings	nr	2		
	<u>Grassing</u>				
15.13	Spread Top Soil stacked on site (under item 1.3) in 100mm layers as directed, level and compact (light compaction) and prepare ready for grassing. Provide and plant approved grass and maintain until it takes root. The rate to include provision of manure approximate 0.01 kg per metre squared and spreading as directed by the	m ²	75		
16	<u>MISCELLANEOUS</u>				
16.1	Allow a Provisional Sum of Kshs. 130,000 for provision and installation of furniture for the Ablution Block Office including cleaning Equipment.	P.S	1		
16.2	Allow a Provisional Sum of Kshs. 500,000 for use as directed by the Engineer on other works that may be unforeseen e.g. demolition of existing structures, etc	P.S	1		
BILL 8F TOTAL CARRIED TO SUMMARY PAGE					

BILL NO. 4 DISCHARGE SITE WORKS GRAND SUMMARY PAGE					
ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT
8A	BOX CULVERT				
8B	ADMINISTRATION BUILDING				
8C	ONE BED ROOM HOUSES, 2No.				
8D	ACCESSORY SITE WORKS				
8E	GATE HOUSE				
8F	ABLUTION BLOCK				
BILL 8 TOTAL FOR UNIT SLUDGE DISPOSAL FACILITY					
	2 No . Feecal Sludge handling facilities	2	x		
BILL 8.0 TOTAL CARRIED TO COLLECTION SHEET					

BILL No. 9A Nairobi South Sewerage Works					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	Fencing				
	Earthworks				
9A.1	General site clearance through undeveloped land over the wayleave, include for any additional clearance required	ha	2		
9A.2	Removal of trees, girth 0.5-1m	nr	5		
9A.3	Excavate foundation for Trenches in soft material, as directed by the Engineer.				
	Depth: n.e. 1.5 m	m ³	1,800		
	1.5 - 2.0 m	m ³	190		
	2.0 - 2.5 m	m ³	130		
	2.5 - 3.0 m	m ³	650		
	Extras to Excavation and Backfilling Trenches (Note: Blasting not allowed for any rock excavation)				
9A.4	Excavation of Rock				
	Depth: n.e. 3.0 m	m ³	1,200		
	Reinstatement				
9A.6	Breaking up, temporary and permanent reinstatement of murram roads	m	150		
	Concrete works				
9A.7	Provide and place Mass Concrete Grade 15/20 in 150mm Thick Blinding	m ³	300		
9A.8	Engineer	m ³	1,280		
	Block Works				
9A.9	Provide and place natural stones 225mm wide with cement motor and whoop iron every alternate course as directed by the Engineer.	m ²	5,000		
9A.10	Provide and place machine cut stones 225mm wide with cement motor and whoop iron every alternate course as directed by the Engineer.	m ²	25,000		
	Cut off Drain Works				
9A.12	Clear the route of vegetation boulders and loose material to firm ground level.	m	2000		
9A.14	Excavate in all natural material to the slopes and levels as directed by the Engineer				
	Depth: n.e. 1.5 m	m ³	1,900		
	1.5 - 2.0 m	m ³	2,210		
	2.0 - 2.5 m	m ³	1,510		
	2.5 - 3.0 m	m ³	980		
	Extras to Excavation and Backfilling Trenches (Note: Blasting not allowed for any rock excavation)				
9A.15	Excavation of Rock				
	Depth: n.e. 3.0 m	m ³	3,000		
	Reinstatement				
9A.16	Fill with selected material and compact to 100% maximum dry density(mdd)	m ³	500		
	Concrete works				
9A.18	Provide and fix fair faced form work to the channel	m ²	2,200		
9A.19	Provide and place Mass Concrete Grade 15/20 in 150mm Thick Blinding	m ³	100		
9A.20	Provide, place and compact Reinforced Concrete Grade 25/20 for channel as directed by the Engineer	m ³	900		
9A.21	Provide and place pre-cast concrete culverts 450mm diameter	m	20		
9A.22	Provide and place gabion mattress 300mm thick in the erodible areas	m ²	500		
	Spillway				
	Earthworks				
9A.11	General site clearance through undeveloped land over the wayleave, include for any additional clearance required	ha	1		
9A.14	Excavate in all natural material to the slopes and levels as directed by the Engineer				
	Depth: n.e. 1.5 m	m ³	800		
	1.5 - 2.0 m	m ³	1,232		
	2.0 - 2.5 m	m ³	1,635		
	2.5 - 3.0 m	m ³	700		
	Extras to Excavation and Backfilling Trenches (Note: Blasting not allowed for any rock excavation)				
9A.15	Excavation of Rock				
	Depth: n.e. 3.0 m	m ³	3,000		
	Reinstatement				
9A.16	Fill with selected material and compact to 100% maximum dry density(mdd)	m ³	500		
	Concrete works				
9A.18	Provide and fix fair faced form work to the channel	m ²	2,200		
9A.19	Provide and place Mass Concrete Grade 15/20 in 150mm Thick Blinding	m ³	100		
9A.20	Provide, place and compact Reinforced Concrete Grade 25/20 for channel as directed by the Engineer	m ³	900		
Total C/F to Collection Page					

BILL NO. 9B: 600mm NAIROBI SOUTH SEWERS					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	CLASS A - GENERAL ITEMS				
	Testing of the Works				
A260	Carrying out test on 600mm pipeline as specified or directed by the Engineer. Include provision of all equipment and materials	m	5,550.00		
	CLASS B - SITE INVESTIGATION				
B111	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth ne 1m (Provisional)	nr	5.00		
B112	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 1-2m (Provisional)	nr	5.00		
B113	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 2-3m (Provisional)	nr	5.00		
B114	construction size etc, of pipelines, services or Trial holes where ordered to prove location, existing structures, max depth 3-5m (Provisional)	nr	5.00		
	CLASS D - DEMOLITION AND SITE CLEARANCE				
D100	General site clearance through undeveloped land over the wayleave, include for any additional clearance required	ha	1.83		
D210	Removal of trees, girth 0.5-1m	nr	2.00		
D220	Removal of trees, girth 1-2m	nr	2.00		
D230	Removal of trees, girth 2-3m	nr	2.00		
D310	Removal of stump, diameter 0.5-1m	nr	2.00		
D461	Buildings of indeterminate construction Volume not exceeding 50m3	nr	5.00		
D462	Buildings of indeterminate construction Volume not exceeding 50-100m3	nr	5.00		
D561	Other structures of indeterminate construction Volume not exceeding 50m3	nr	5.00		
D562	Other structures of indeterminate construction Volume not exceeding 50-100m3	nr	5.00		
	CLASS I: PIPEWORK - PIPES				
	PRECAST CONCRETE PIPES TO BS 5911 WITH SPIGOT AND SOCKET FLEXIBLE JOINTS				
	The rates entered against the items in this section shall include for stripping top soil, laying aside and subsequently replacing over refilled trench, excavation in trench in material other than rock, shuttering where necessary, refilling and compacting, spreading surplus soil evenly over and alongside pipe trench compacting, supply lay and joint pipes to correct line and level. Depths are stated from ground level to invert level.				
I 232	Nominal bore 600mm in trenches				
I 233	Depth n.e. 1.5m	m	1,231.00		
I 234	Depth 1.5m - 2.0m	m	945.00		
I 235	Depth 2.0m - 2.5m	m	852.00		
I 236	Depth 2.5m - 3.0m	m	656.00		
I 237	Depth 3.0m - 3.5m	m	623.00		
I 238	Depth 3.5m - 4.0m	m	609.00		
I 239	Depth >4.0m	m	421.00		
I431	Steel pipes nominal internal diameter 450mm for aerial crossings complete with fittings	m	213.00		
	CLASS K: PIPEWORK - MANHOLES AND PIPEWORK ANCILLARIES				
	Excavation quantities are given net. The rates entered are to include for manhole concrete slabs and covers, step irons or ladder, excavation, working				
	room, trimming the base of the excavation, shuttering where necessary, refilling and compacting around the finished manholes, and disposing of surplus				
	spoil local to the trench. Surplus spoil is to be evenly spread.				
	Manholes				
	Manhole type B, size 1200mm, reinforced concrete manhole slab and cover.				
K 151	Depth n.e 1.5m	nr	8.00		
K 152	Ditto- but depth 1.5m - 2.0m	nr	11.00		
K 153	Ditto- but depth 2.0m - 2.5m	nr	16.00		
K 154	Ditto- but depth 2.5m - 3.0m	nr	17.00		
K 155	Ditto- but depth 3.0m - 3.5m	nr	23.00		
K 156	Ditto- but depth 3.5m - 4.0m	nr	22.00		
K 157	Ditto- but depth >4.0m	nr	13.00		
	Manhole type B, size 1200mm, reinforced concrete manhole slab and cover with backdrop.				
K 166	Ditto- but depth 3.5m - 4.0m	nr	4.00		
K 167	Ditto- but depth >4.0m	nr	5.00		
Total C/F to Next Page					

BILL NO. 9B: 600mm NAIROBI SOUTH SEWERS					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	Total B/F From Previous Page				
	Crossings				
	Include for all work associated with the crossings				
	Pipe nominal bore 600mm				
K 631	River, stream and valley crossing and reinstatement;	nr	2.00		
K 642	Hedge crossing and reinstatement;	nr	2.00		
K 652	Wall crossing and reinstatement;	nr	2.00		
K 662	Fence crossing and reinstatement;	nr	2.00		
K682	Underground water mains crossing	nr	4.00		
	Reinstatement				
	Pipe nominal bore 600mm				
K 731	Breaking up, temporary and permanent reinstatement of murrum roads	m	121.00		
K 741	Breaking up, temporary and permanent reinstatement of footpaths with slabs	m	231.00		
K 751	Reinstatement of land	m	231.00		
	CLASS L: SUPPORTS AND PROTECTION ANCILLARIES TO LAYING AND				
	Extras to Excavation and Backfilling				
	(Note: Blasting not allowed for any rock excavation)				
	In Pipe Trenches				
L111	Excavation of rock (Provisional)	m3	2,000.00		
L117	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	456.00		
L118	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	674.00		
	In manholes and Other Chambers				
	(Note: Blasting not allowed for any rock excavation)				
L121	Excavation of rock (Provisional)	m3	2,342.00		
L127	Excavation of soft material below the final surface and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	1,124.00		
L128	Allow for excavation of soft material below final surface of pipe trench and backfill with approved hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	346.00		
	Bed, Haunches and Surrounds				
	Granular Material				
	Pipeline nominal bore 600mm				
L312	Sand as per specifications Beds 150 mm thick	m	424.00		
L322	Selected excavated granular material as per specifications Beds 150 mm thick	m	532.00		
L332	Imported granular material as per specifications Beds 150 mm thick	m	465.00		
	Mass Concrete Grade 15/20 in 150mm Thick Beds, Haunches and Surrounds				
	450mm nominal bore pipeline				
L442.1	Bed and haunch Type A (Concrete 0.1689m3/m)	m	425.00		
L442.2	Bed and haunch Type B (Concrete 0.2645m3/m)	m	446.00		
L442.3	Bed and haunch Type C (Concrete 0.4059m3/m)	m	1,235.00		
L442.4	Bed and haunch Type D (Concrete 0.4818m3/m)	m	1,244.00		
	Total C/F to Summary Sheet				

BILL NO. 9C: 300mm NAIROBI SOUTH SEWERS					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	CLASS A - GENERAL ITEMS				
	Testing of the Works Carrying out test on 300mm pipeline as specified or directed by the Engineer. Include provision of all equipment and materials	m	13,341.00		
	CLASS B - SITE INVESTIGATION				
B111	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth ne 1m (Provisional)	nr	1.00		
B112	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 1-2m (Provisional)	nr	1.00		
B113	Trial holes where ordered to prove location, construction size etc, of pipelines, services or existing structures, max depth 2-3m (Provisional)	nr	1.00		
B114	construction size etc, of pipelines, services or Trial holes where ordered to prove location, existing structures, max depth 3-5m (Provisional)	nr	1.00		
	CLASS D - DEMOLITION AND SITE CLEARANCE				
D100	General site clearance through undeveloped land over the wayleave, include for any additional clearance required	ha	4.40		
D210	Removal of trees, girth 0.5-1m	nr	2.00		
D220	Removal of trees, girth 1-2m	nr	2.00		
D230	Removal of trees, girth 2-3m	nr	2.00		
D310	Removal of stump, diameter 0.5-1m	nr	2.00		
D461	Buildings of indeterminate construction Volume not exceeding 50m3	nr	3.00		
D462	Buildings of indeterminate construction Volume not exceeding 50-100m3	nr	3.00		
D561	Other structures of indeterminate construction Volume not exceeding 50m3	nr	3.00		
D562	Other structures of indeterminate construction Volume not exceeding 50-100m3	nr	3.00		
	CLASS I: PIPEWORK - PIPES				
	PRECAST CONCRETE PIPES TO BS 5911 WITH SPIGOT AND SOCKET FLEXIBLE				
	The rates entered against the items in this section shall include for stripping top soil, laying aside and subsequently replacing over refilled trench, excavation in trench in material other than rock, shuttering where necessary, refilling and compacting, spreading surplus soil evenly over and alongside pipe trench compacting, supply lay and joint pipes to correct line and level. Depths are stated from ground level to invert level.				
	Nominal bore 300mm in trenches				
I 222	Depth n.e. 1.5m	m	4,343.00		
I 223	Depth 1.5m - 2.0m	m	3,432.00		
I 224	Depth 2.0m - 2.5m	m	2,451.00		
I 225	Depth 2.5m - 3.0m	m	1,466.00		
I 226	Depth 3.0m - 3.5m	m	867.00		
I 227	Depth 3.5m - 4.0m	m	235.00		
I 228	Depth >4.0m	m	423.00		
I421	Steel pipes nominal internal diameter 300mm for aerial crossings complete with fittings	m	124.00		
	CLASS K: PIPEWORK - MANHOLES AND PIPEWORK ANCILLARIES				
	Excavation quantities are given net. The rates entered are to include for manhole concrete slabs and covers, step irons or ladder, excavation, working room, trimming the base of the excavation, shuttering where necessary, refilling and compacting around the finished manholes, and disposing of surplus spoil local to the trench. Surplus spoil is to be evenly spread.				
	Manholes				
	Manhole type B, size 1050mm, reinforced concrete manhole slab and cover.				
K 151	Depth n.e 1.5m	nr	12.00		
K 152	Ditto- but depth 1.5m - 2.0m	nr	23.00		
K 153	Ditto- but depth 2.0m - 2.5m	nr	23.00		
K 154	Ditto- but depth 2.5m - 3.0m	nr	23.00		
K 155	Ditto- but depth 3.0m - 3.5m	nr	18.00		
K 156	Ditto- but depth 3.5m - 4.0m	nr	12.00		
K 157	Ditto- but depth >4.0m	nr	3.00		
	Manhole type B, size 1050mm, reinforced concrete manhole slab and cover with backdrop.				
K 166	Ditto- but depth 3.5m - 4.0m	nr	3.00		
K 167	Ditto- but depth >4.0m	nr	5.00		
Total C/F to Next Page					

BILL NO. 9C: 300mm NAIROBI SOUTH SEWERS					
Item No	Description	Unit	Quantity	Rate (KSh.)	Amount (KShs)
	Total B/F From Previous Page				
	Crossings				
	Include for all work associated with the crossings				
	Pipe nominal bore 300mm				
K 631	River, stream and valley crossing and reinstatement;	nr	3.00		
K 642	Hedge crossing and reinstatement;	nr	3.00		
K 652	Wall crossing and reinstatement;	nr	3.00		
K 662	Fence crossing and reinstatement;	nr	3.00		
K682	Underground water mains crossing	nr	5.00		
	Reinstatement				
	<i>Pipe nominal bore 300mm</i>				
K 731	Breaking up, temporary and permanent reinstatement of murrum roads	m	123.00		
K 741	Breaking up, temporary and permanent reinstatement of footpaths with slabs	m	231.00		
K 751	Reinstatement of land	m	312.00		
	CLASS L: SUPPORTS AND PROTECTION ANCILLARIES TO LAYING AND EXCAVATION				
	Extras to Excavation and Backfilling				
	(Note: Blasting not allowed for any rock excavation)				
	In Pipe Trenches				
L111	Excavation of rock (Provisional)	m3	1,255.00		
	Excavation of soft material below the final surface				
L117	and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	150.00		
	Allow for excavation of soft material below final surface of pipe trench and backfill with approved				
L118	hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	900.00		
	In manholes and Other Chambers				
	(Note: Blasting not allowed for any rock excavation)				
L121	Excavation of rock (Provisional)	m3	1,000.00		
	Excavation of soft material below the final surface				
L127	and backfilling with mass concrete, depth not exceeding 1.0m (Provisional)	m3	320.00		
	Allow for excavation of soft material below final surface of pipe trench and backfill with approved				
L128	hardcore, well compacted in layers of 200mm thickness, depth not exceeding 1.0m (Provisional)	m3	294.00		
	Bed, Haunches and Surrounds				
	Granular Material				
	<u>Pipeline nominal bore 300mm</u>				
L312	Sand as per specifications Beds 150 mm thick	m	341.00		
	Selected excavated granular material as per specifications				
L322	150 mm thick	m	542.00		
L332	Imported granular material as per specifications Beds 150 mm thick	m	423.00		
	Mass Concrete Grade 15/20 in 150mm Thick Beds, Haunches and Surrounds				
	<u>300mm nominal bore pipeline</u>				
L442.1	Bed and haunch Type A (Concrete 0.1278m3/m)	m	234.00		
L442.2	Bed and haunch Type B (Concrete 0.1906m3/m)	m	915.00		
L442.3	Bed and haunch Type C (Concrete 0.2966m3/m)	m	1,045.00		
L442.4	Bed and haunch Type D (Concrete 0.3449m3/m)	m	1,047.00		
	Total C/F to Summary Sheet				

BILL NO. 9D: DRILLING OF 1 NO BOREHOLE 300m DEEP					
Item No.	Description	Unit	Qty	Rate (KSh.)	Amount (KSh.)
201.00	Drilling of 254mm (10") diameter borehole from 0 - n.e 100m below surface	m	100.00		
202.00	Ditto but 100 - n.e 200m depth	m	100.00		
203.00	Ditto but 200 - n.e 300m depth	m	100.00		
203A	Ditto exceeding 300 but n.e 380m	m	1.00		
204.00	Supply and installation of n.i.d 203mm (8") diameter plain mild steel casing heavy duty 4.85mm/152 and 5mm/203 to KS 06-259 and BS 1387.	m	250.00		
205.00	Supply and installation of n.i.d 203mm (8") diameter mild steel casing (M/s Plasma cut well screens provision) heavy duty 4.85mm/152 and 5mm/203 to KS 06-259 and BS 1387.	m	144.00		
206.00	Supply and installation of filter gravel pack (2-4mm)	Ton	22.00		
207.00	Development of the boreholes	Hr	12.00		
208.00	Test pumping and recovery measurements to ascertain borehole yield. (Test pumping for 24hr and recovery measurements for 12hr for the borehole)	Hr	36.00		
209.00	Construction of borehole head-works around well head by constructing a concrete plinth and a chamber measuring 1mx1mx1m with class 20/20 mass concrete floor slab and walls. Chamber to have painted Gauge16 steel plate lockable access cover 1mx1m with anti-theft and weather resistant	No.	1.00		
210.00	Supply and fix 8" borehole steel cap.	No.	1.00		
211.00	Supply and fix 10" surface casing	M	10.00		
212.00	Place a bentonite sanitary seal 3m deep.	L.Sum	1.00		
213.00	Clay Disaggregate calgonTM injection as sodium hexametaphosphate to acceleare removal of clay matter / improve on water turbidity : includes cost of injection.	kg	30.00		
214.00	Allow costs for providing water for all requirements of the contract, field camp, drilling works e.t.c.	Sum	1.00		
215.00	Collect water samples and carry out water quality analysis (chemical and bacteriological analysis) in a reputable laboratory acceptable to the Project Manager and submit water quality test report.	No.	2.00		
216.00	Allow costs for collecting formation samples and prepare Geological logging charts.	No.	1.00		
217.00	Complete the prescribed WRMA Borehole drilling completion report and submit to WRMA	No.	1.00		
TOTAL FOR DRILLING 1 NO BOREHOLE CARRIED FORWARD TO COLLECTION PAGE					

BILL NO. 9D: EQUIPPING OF 1 NO NEW BOREHOLE					
Item No.	Description	Unit	Qty	Rate (Kshs.)	Amount (KSh.)
301.00	Provide, install and commission a submersible pump capable of delivering 20m ³ /hr against a head of 250m or as directed by the Project Manager (at the Retreat Center and main House) NB: Indicate the make of the pump and motor. Size of casing is 203mm. Pump Make : GRUNDFOS SP 30-26 Country of Origin: DENMARK Make of Motor: TESLA/GRUNDFOS ITALY/ DENMARK rate 22KW/30HP.	Nr	1.00		
302.00	Provide, install and commission a 3 phase, 415Vac, COL control panel for the above pump comprising of the following:- Provisional a) Appropriate rating contactor b) Appropriate rating thermal overload relay c) Over/under voltage phase failure protection relay d) Voltmeter e) Voltmeter selection switch f) Water level relay g) Appropriate Ammeter h) Appropriate MCCB for the mains i) Appropriate MCCB for the control circuit j) Start, Stop/reset push button (Green marked "START", and Black/Red Marked "STOP/RESET") k) Pilot indicator lights (green marked "PUMP RUN", red marked "OVER LOAD TRIPPED", yellow marked "BOREHOLE LOW, white marked "TANK HIGH" etc l) Hours run counter range 0 - 99999 hours m) Cable looping box of appropriate rating	L.sum	1.00		
303.00	Enhanced MP204 Blackbox unit to integral circuit NB: A schematic and control wiring diagram MUST be supplied with the starter.	No	1		
304.00	3" class B G.I rising main pipe c/w pipe locking clamp including connecting to the existing tank and connecting for both water offices and Main House boreholes.	m	220		
305.00	Supply of 3" crane sockets to the rising main	No.	42		
306.00	Provide and install one 3" bulk flow meter class B (type and make to be approved by the Project Manager) c/w Non Return Valve at the well head. Rate to include all pipe and fittings at the well head.	No.	1		
307.00	Electrode cable(pair)	m	440		
308.00	Electrode pencils (pair)	No.	1		
309.00	25mm Dipper tube complete	m	240		
310.00	1.5mm ² Flat cable for float switch	m	100		
311.00	2"*6" borehole cover c/w sundries	No.	1		
312.00	1.5mm ² 2-CORE underground armoured cable – Electrodes	m	100		
313.00	63A switch fuse "MEM" or equivalent	No.	1		
314.00	Allow a P.C. Sum for electricity supply and connection to the borehole sites. Contractor is responsible for the application of electricity connection; follow up and for prompt supply and connection of electricity by KPLC. Electricity account to be held in the name of the Employer .	PC	1		
315.00	Add a percentage of items 315 for contractor's overheads and profit.	%			
316.00	Allow a sum for testing and commissioning of the borehole equipping works.	Lump Sum	1.00		
319.00	Provide for float switch to existing elevated tank and connect to the control panel and pump	sum	1.00		
320.00	4 FT Copper earth rod complete with clamp	Set	1.00		
321.00	Lead cable 10.0m ² single core (for earthing)	m	10.00		
322.00	Submersible cable rubber sheathed 25mm ² 3 core submersible armored cable	m	240.00		
323.00	Underground armored cable 25mm ² 3 core	m	95.00		
324.00	Construction of a well ventilated pump house 3mx2m internal dimension and 2.2m clear height with reinforced concrete roof slab reinforced with Y11 at 150 c/c both directions. Rate to include provision of steel door of gauge 16 (1.5mm thick) metal plates complete with two anti-theft and weather resistant padlocks all to the approval of the project manager. The walls shall be constructed with 225*225mm natural stone masonry fine dressed. Place hoov iron 3/4" on every course.		1.00		
TOTAL FOR EQUIPPING 1 NO BOREHOLE CARRIED FORWARD TO COLLECTION PAGE					

Bill No. 9D: ELEVATED WATER TANK AND WATER RETICULATION					
ITEM NO	DESCRIPTION	UNIT	QTY	RATE (KSHS)	AMOUNT (KSHS)
	Excavation <u>Excavation shall include strutting,shuttering, stabilizing excavated surface and keeping excavations free of water bailing out, pumping or other means</u>				
101	Excavate to reduced levels in top soil for depth not exceeding 0.25	M3	2		
102	Excavate for tank foundation 0.25-0.5m	M3	10		
103	Ditto but in material other than top soil,rock or hard material depth 0.5-1m	M3	10		
104	Ditto but in material other than top soil,rock or artificially hard material depth 1-2m	M3	10		
105	Ditto but in rock depth 1-2m	M3	2		
	Filling <u>Filling to completed structure including compaction as specified</u>				
106	Fill and compact selected excavated material other than top soil,rock or artificially hard material	M3	20		
	Disposal of Excavated Materials				
107	Dispose excavated materials other than rock as directed by the Engineer	M3	12		
108	Dispose excavated material rock or artificially hard materials on site as directed by the Engineer	M3	2		
	In situ Concrete:Provision and placing. Rate to include for shuttering <u>Mass concrete Class 15/20</u>				
109	Blinding layer 50mm thick	M3	2		
	<u>Reinforced Vibrated Concrete Class 25/20</u>				
110	Footing and stub columns for steel columns	M3	12		
	Reinforcement <u>High yield hot rolled ribbed bars BS4449.Rate to include for</u> Supply,delivering,cutting,bending,supporting and securing in concrete.				
111	High Yield bars	Ton	2		
	Presses Steel Tank Supply and install pressed steel tank 24m ³ capacity complete with roof access hatch,access ladder,float level indicator,pipework and 18m steel Tower frame as per the drawings and specifications.Plate thickness to be 6.0mm for the tank bottom and first level side panels, 4.5mm thick plates for the second and third levels side panels and 2mm for roof. Include for all bolts,jointing material, protection paint and any other necessary materials. Tank panels to be wire brushed and painted externally with one coat of grey primer and two coats of silver aluminium paint. Internally the panels are painted with two coats of non-toxic black bituminous paint. Touch up paint to be applied at site after erection to				
112	Pipework <u>These are pipes in the vicinity of the tank,including connecting the inlet pipe to the pumping</u>	Nr	1		
113	Supply and fix 38mm diameter GI Class "B" Tank inlet pipe	m	15		
114	Supply and fix 63mm diameter GI Class B Tank	m	24		
115	Supply and fix 63mm diameter GI Class B Tank	m	6		
116	Supply and fix 63mm diameter GI Class B Tank	m	15		
	Valves and fittings				
117	Supply and install DN50 PN10 sluice valve for scour	Nr	1		
118	Supply and install DN38 PN10 Sluice valve for the outlet	Nr	1		
119	Supply and fix double flanged DN32 90° Short radius bend	Nr	3		
120	Supply and fix double flanged DN50 -90° Short radius bend	Nr	8		
121	Supply and fix all flanged DN50X50 Tee	Nr	1		
122	Supply and fix all flanged DN38X38 Tee	Nr	2		
123	DN50 Double flange piece, length 1000mm	Nr	2		
124	DN50 Double flange piece, length 300mm	Nr	2		
125	DN50 Double flange piece, length 500mm	Nr	2		
126	Supply and apply recommended disinfectant and test the tank	Sum	1		
127	Construct a standard water kiosk 2.5 m x 2.5 m as per WASREB standards complete with plumbing and 3 No. water drawing points	Sum	1		
128	Provide for 1km water reticulation	Sum	1		
TOTAL FOR 1 NO. ELEVATED TANK CARRIED FORWARD TO COLLECTION PAGE					

COLLECTION FOR WATER WORKS					
BILL	DESCRIPTION				AMOUNT (KShs.)
BILL NO. 9D:	DRILLING OF 1No. BOREHOLES				
BILL NO. 9D:	EQUIPPING OF 1No. BOREHOLES				
BILL NO. 9D:	CONSTRUCTION OF 1No. ELEVATED STEEL WATER TANK WITH WATER KIOSK				
SUB-TOTAL 1 For 1 no. borehole				1	
Sub Total for DRILLING, EQUIPPING & CONSTRUCTION OF 10 No. ELEVATED TANKS AND KIOSKS				10	

BILL NO. 10-KARIOBANGI WORKS SUMMARY SHEET					
ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT (KShs)
9A	Nairobi South Miscellaneous works				
9B	DN450 Trunk Sewer				
9C	DN300 Reticulation Sewers				
9D	Nairobi South Water works				
BILL 09 TOTAL CARRIED TO COLLECTION SHEET					-

COLLECTION SHEET		
Bill No.	Description	Amount (KSh.)
Bill No. 1	Preliminaries and General Items	
Bill No. 2		
	Mwiki Sewers	
	Primary - 450mm	
	Primary - 375mm	
	Primary - 300mm	
	Secondary - 225mm	
	Subtotal	
Bill No. 3		
	Clay Works Sewers	
	Primary - 300mm	
	Secondary - 225mm	
	Subtotal	
Bill No. 4		
	Kasarani and Gatina Sewers	
	Primary - 450mm	
	Primary - 375mm	
	Primary - 300mm	
	Secondary - 225mm	
	Subtotal	
Bill No. 5	Consumer Sewer Household Connetions	
Bill No. 6	Dandora Dumpsite Sewers	
	Primary - 900mm	
	Subtotal	
Bill No. 7	Embakasi North Sewerage	
Bill No. 8	Sludge Disposal Facility	
Bill No. 9	Nairobi South Sewerage	
SUB TOTAL		

GRAND SUMMARY		
Bill No.	Description	Amount (KSh.)
1	Preliminaries and General Items	
2	Mwiki Sewers	
3	Clay Works Sewers	
4	Kasarani and Gatina Sewers	
5	Consumer Sewer Household Connetions	
6	Dandora Dumpsite Sewers	
7	Embakasi North Sewerage	
8	Sludge Disposal Facility	
9	Nairobi South Sewerage	
	SUBTOTAL 1	
ALLOW FOR CONTIGENCIES AT 10% OF THE SUB-TOTAL 1		
SUBTOTAL 2		
ADD 14% V.A.T		
GRAND TOTAL CARRIED TO LETTER OF BID		

Bidder's Authorised representative Name.....

Bidder's Authorised representative Signature and Stamp.....

Date.....

Table: Alternative B

To be used only with Alternative B Prices directly quoted in the currencies of payment. (Clause ITB 15.1)

Summary of currencies of the bid for _____ [insert name of Section of the Works]

Name of currency	Amounts payable
Local Currency: _____	
Foreign currency #1: _	
Foreign currency #2: _	
Foreign currency #3: _____	

Form of Bid Security (Unconditional Bank Guarantee)

_____ [Bank's Name, and Address of Issuing Branch or Office]

Beneficiary: _____ [Name and Address of Employer]

Date: _____

BID GUARANTEE No.: _____

We have been informed that _____ [name of the Bidder] (hereinafter called "the Bidder") has submitted to you its bid dated _____ (hereinafter called "the Bid") for the execution of _____ [name of contract] under Invitation for Bids No. _____ ("the IFB").

Furthermore, we understand that, according to your conditions, bids must be supported by a bid guarantee.

At the request of the Employer, we _____ [name of Bank] hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of _____ [amount in figures] (_____) [amount in words] upon receipt by us of your first demand in writing accompanied by a written statement stating that the Bidder is in breach of its obligation(s) under the bid conditions, because the Bidder:

- (a) _____ has withdrawn its Bid during the period of bid validity specified by the Bidder in the Form of Bid; or
- (b) _____ having been notified of the acceptance of its Bid by the Employer during the period of bid validity, (i) fails or refuses to execute the Contract Form, if required, or (ii) fails or refuses to furnish the performance security, in accordance with **ITB 38**.

This guarantee will expire: (a) if the Bidder is the successful Bidder, upon our receipt of copies of the contract signed by the Bidder and the performance security issued to you upon the instruction of the Bidder; and (b) if the Bidder is not the successful Bidder, upon the earlier of (i) our receipt of a copy your notification to the Bidder of the name of the successful Bidder; or (ii) twenty-eight days after the expiration of the Bidder's bid.

Consequently, any demand for payment under this guarantee must be received by us at the office on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 458.

[Signature]

Form of Bid Security (Bid Bond) N/A

BOND NO. _____

BY THIS BOND [name of Bidder] as Principal (hereinafter called “the Principal”), and [name, legal title, and address of surety], **authorised to transact business in** [name of country of Employer], as Surety (hereinafter called “the Surety”), are held and firmly bound unto [name of Employer] as Oblige (hereinafter called “the Employer”) in the sum of [amount of Bond]¹⁵ [amount in words], for the payment of which sum, well and truly to be made, we, the said Principal and Surety, bind ourselves, our successors and assigns, jointly and severally, firmly by these presents.

WHEREAS the Principal has submitted a written Bid to the Employer dated the ____ day of _____, 20__, for the construction of [name of Contract] (hereinafter called the “Bid”).

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that if the Principal:

- (a) withdraws its Bid during the period of bid validity specified in the Form of Bid; or
- (b) having been notified of the acceptance of its Bid by the Employer during the period of Bid validity; (i) fails or refuses to execute the Contract Form, if required; or (ii) fails or refuses to furnish the Performance Security in accordance with the Instructions to Bidders;

then the Surety undertakes to immediately pay to the Employer up to the above amount upon receipt of the Employer’s first written demand, without the Employer having to substantiate its demand, provided that in its demand the Employer shall state that the demand arises from the occurrence of any of the above events, specifying which event(s) has occurred.

The Surety hereby agrees that its obligation will remain in full force and effect up to and including the date 28 days after the date of expiration of the Bid validity as stated in the Invitation to Bid or extended by the Employer at any time prior to this date, notice of which extension(s) to the Surety being hereby waived.

IN TESTIMONY WHEREOF, the Principal and the Surety have caused these presents to be executed in their respective names this ____ day of _____ 20__.

Principal: _____

Surety: _____
Corporate Seal (where appropriate)

(Signature)

(Signature)

¹⁵ The amount of the Bond shall be denominated in the currency of the Employer’s country or the equivalent amount in a freely convertible currency.

(Printed name and title)

(Printed name and title)

Form of Bid-Securing Declaration N/A

Date: [insert date (as day, month and year)]

Bid No.: [insert number of bidding process]

Alternative No.: [insert identification No if this is a Bid for an alternative]

To: [insert complete name of Employer]

We, the undersigned, declare that:

We understand that, according to your conditions, bids must be supported by a Bid-Securing Declaration.

We accept that we will automatically be suspended from being eligible for bidding in any contract with the Borrower for the period of time of **[Employer to insert number of months or years]** starting on **[insert date]**, if we are in breach of our obligation(s) under the bid conditions, because we:

(a) have withdrawn our Bid during the period of bid validity specified in the Letter of Bid; or

(b) having been notified of the acceptance of our Bid by the Employer during the period of bid validity, (i) fail or refuse to execute the Contract, if required, or (ii) fail or refuse to furnish the Performance Security, in accordance with **ITB 38**.

We understand this Bid-Securing Declaration shall expire if we are not the successful Bidder, upon the earlier of (i) our receipt of your notification to us of the name of the successful Bidder; or (ii) twenty-eight days after the expiration of our Bid.

Signed: [insert signature of person whose name and capacity are shown] In the capacity of [insert legal capacity of person signing the Bid-Securing Declaration]

Name: [insert complete name of person signing the Bid-Securing Declaration]

Duly authorised to sign the bid for and on behalf of: [insert complete name of Bidder]

Dated on _____ day of _____, _____ [insert date of signing]

Corporate Seal (where appropriate)

[Note: In case of a Joint Venture, Consortium or Association, the Bid-Securing Declaration must be in the name of all partners to the JVCA that submits the bid.]

<h2>Technical Proposal</h2>

Technical Proposal Forms

Site Organisation

Method Statement

Mobilisation Schedule

Construction Schedule

Contractor's Equipment

Personnel

Others

Site Organisation

Method Statement

Mobilisation Schedule

Construction Schedule

Contractor's Equipment

FORM EQU

The Bidder shall provide adequate information to demonstrate clearly that it has the capability to meet the requirements for the key equipment listed in Section III, Evaluation and Qualification Criteria. A separate Form shall be prepared for each item of equipment listed, or for alternative equipment proposed by the Bidder. The Bidder shall provide all the information requested below, to the extent possible. Fields with asterisk (*) shall be used for evaluation.

Type of Equipment*		
Equipment Information	Name of manufacturer	Model and power rating
	Capacity*	Year of manufacture*
Current Status	Current location	
	Details of current commitments	
Source	Indicate source of the equipment <input type="checkbox"/> Owned <input type="checkbox"/> Rented <input type="checkbox"/> Leased <input type="checkbox"/> Specially manufactured	

The following information shall be provided only for equipment not owned by the Bidder.

Owner	Name of owner	
	Address of owner	
	Telephone	Contact name and title
	Fax	Telex
Agreements	Details of rental / lease / manufacture agreements specific to the project	

Proposed Personnel

Form PER – 1

Bidders should provide the names of suitably qualified personnel to meet the specified requirements for each of the positions listed in Section III, Evaluation and Qualification Criteria. The data on their experience should be supplied using the Form below for each candidate.

1.	Title of position
	Name
2.	Title of position
	Name
3.	Title of position
	Name
4.	Title of position
	Name
5.	Title of position
	Name
6.	Title of position
	Name
etc.	Title of position
	Name

Resume of Proposed Personnel

Form PER – 2

The Bidder shall provide all the information requested below. Fields with asterix (*) shall be used for evaluation.

Position*		
Personnel information	Name *	Date of birth
	Professional qualifications	
Present employment	Name of Employer	
	Address of Employer	
	Telephone	Contact (manager / personnel officer)
	Fax	E-mail
	Job title	Years with present Employer

Summarise professional experience in reverse chronological order. Indicate particular technical and managerial experience relevant to the project.

[illegible]

Others

Bidder's Qualification

To establish its qualifications to perform the contract in accordance with Section III, Evaluation and Qualification Criteria, the Bidder shall provide the information requested in the corresponding Information Sheets included hereunder

<h2 style="margin: 0;">Bidder Information Sheet</h2>
--

Form ELI - 1.1

Date: _____

Bidding No.: _____

Invitation for Bid No.: _____

Page _____ of _____ pages

1. Bidder's Legal Name

2. In case of Joint Venture, Consortium or Association (JVCA), legal name of each party:

3. Bidder's actual or intended Country of Registration:

4. Bidder's Year of Registration:

5. Bidder's Legal Address in Country of Registration:

6. Bidder's Authorised Representative Information

Name:

Address:

Telephone/Fax numbers:

Email Address:

7. Attached are copies of original documents of:

☐ Articles of Incorporation or Registration of firm named in 1, above, in accordance with **ITB** Clauses 4.1 and 4.2.

☐ In case of JVCA, letter of intent to form JVCA including a draft agreement, or JVCA agreement, in accordance with **ITB** Clauses 4.1

☐ In case of government owned entity from the Employer's country, documents establishing legal and financial autonomy and compliance with the principles of commercial law, in accordance with **ITB** Clause 4.5.

Partner to JVCA Information Sheet

Form ELI - 1.2

Date: _____

Bidding No.: _____

Invitation for Bid No.: _____

Page _____ of _____ pages

1. Bidder's Legal Name:

2. JVCA's Party legal name:

3. JVCA's Party Country of Registration:

4. JVCA's Party Year of Registration:

5. JVCA's Party Legal Address in Country of Registration:

6. JVCA's Party Authorised Representative Information

Name:

Address:

Telephone/Fax numbers:

Email Address:

7. Attached are copies of original documents of:

☐ Articles of Incorporation or Registration of firm named in 1, above, in accordance with **ITB** Clauses 4.1 and 4.2.

☐ In case of government owned entity from the Purchaser's country, documents establishing legal and financial autonomy and compliance with the principles of commercial law, in accordance with **ITB** Clause 4.5.

Historical Contract Non-Performance

Form CON – 2

Bidder's Legal Name: _____ Date: _____
 JVCA Partner Legal Name: _____
 Bidding No.: _____
 Page _____ of _____ pages

Non-Performing Contracts in accordance with Section III, Evaluation and Qualification Criteria)=

Contract non-performance did not occur during the stipulated period, in accordance with Sub-Factor 2.2.1 of Section III, Evaluation and Qualification Criteria. Contract non-performance during the stipulated period, in accordance with Sub-Factor 2.2.1 of Section III, Evaluation and Qualification Criteria.

Year	Outcome as Percent of Total Assets	Contract Identification	Total Contract Amount (current value, US\$ equivalent)
_____	_____	Contract Identification: Name of Employer: Address of Employer: Matter in dispute:	_____

Pending Litigation, in accordance with Section III, Evaluation and Qualification Criteria

☐ No pending litigation in accordance with Sub-Factor 2.2.3 of Section III, Evaluation and Qualification Criteria.

☐ Pending litigation in accordance with Sub-Factor 2.2.3 of Section III, Evaluation and Qualification Criteria, as indicated below

Year	Outcome as Percent of Total Assets	Contract Identification	Total Contract Amount (current value, US\$ equivalent)
_____	_____	Contract Identification: Name of Employer: Address of Employer: Matter in dispute:	_____
_____	_____	Contract Identification: Name of Employer: Address of Employer: Matter in dispute:	_____

Current Contract Commitments / Works in Progress

Form CCC

Bidders and each partner to a JVCA should provide information on their current commitments on all contracts that have been awarded, or for which a letter of intent or acceptance has been received, or for contracts approaching completion, but for which an unqualified, full completion certificate has yet to be issued.

Name of contract	Employer, contact address/tel/fax	Value of outstanding work (current US\$ equivalent)	Estimated completion date	Average monthly invoicing over last six months (US\$/month)
1.				
2.				
3.				
4.				
5.				
etc.				

Financial Situation

Form FIN – 3.1

Bidder's Legal Name: _____ Date: _____
 JVCA Partner Legal Name: _____ Bidding No.: _____
 Page _____ of _____ pages

To be completed by the Bidder and, if JVCA, by each partner

Financial information in US\$ equivalent	Historic information for previous _____ (____) years (US\$ equivalent in 000s)						
	Year 1	Year 2	Year 3	Year ...	Year n	Avg.	Avg. Ratio
Information from Balance Sheet							
Total Assets (TA)							
Total Liabilities (TL)							
Net Worth (NW)							
Current Assets (CA)							
Current Liabilities (CL)							
Information from Income Statement							
Total Revenue (TR)							
Profits Before Taxes (PBT)							

☐ Attached are copies of financial statements (balance sheets, including all related notes, and income statements) for the years required above complying with the following conditions:

- Must reflect the financial situation of the Bidder or partner to a JVCA, and not sister or parent companies
- Historic financial statements must be audited by a certified accountant
- Historic financial statements must be complete, including all notes to the financial statements
- Historic financial statements must correspond to accounting periods already completed and audited (no statements for partial periods shall be requested or accepted)

Average Annual Turnover

Form FIN – 3.2

Bidder's Legal Name: _____ Date: _____
 JVCA Partner Legal Name: _____ Bidding No.: _____
 Page _____ of _____ pages

Annual turnover data (construction only)		
Year	Amount and Currency	US\$ equivalent
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
*Average Annual Construction Turnover	_____	_____

*Average annual turnover calculated as total certified payments received for work in progress or completed over the number of years specified in Section III, Evaluation and Qualification Criteria, Sub-Factor 2.3.2, divided by that same number of years.

Financial Resources**Form FIN – 3.3**

Specify proposed sources of financing, such as liquid assets, unencumbered real assets, lines of credit, and other financial means, net of current commitments, available to meet the total construction cash flow demands of the subject contract or contracts as indicated in Section III, Evaluation and Qualification Criteria.

Source of financing	Amount (US\$ equivalent)
1.	
2.	
3.	
4.	

General Experience

Form EXP – 2.4.1

Bidder's Legal Name: _____ Date: _____
 JVCA Partner Legal Name: _____ Bidding No.: _____
 Page _____ of _____ pages

Starting Month / Year	Ending Month / Year	Years*	Contract Identification	Role of Bidder
_____	_____	_____	Contract name: Brief Description of the Works performed by the Bidder: Name of Employer: Address:	_____
_____	_____	_____	Contract name: Brief Description of the Works performed by the Bidder: Name of Employer: Address:	_____
_____	_____	_____	Contract name: Brief Description of the Works performed by the Bidder: Name of Employer: Address:	_____
_____	_____	_____	Contract name: Brief Description of the Works performed by the Bidder: Name of Employer: Address:	_____
_____	_____	_____	Contract name: Brief Description of the Works performed by the Bidder: Name of Employer: Address:	_____
_____	_____	_____	Contract name: Brief Description of the Works performed by the Bidder: Name of Employer: Address:	_____

*List calendar year for years with contracts with at least nine (9) months activity per year starting with the earliest year

Specific Experience

Form EXP – 2.4.2(a)

Bidder's Legal Name: _____ Date: _____

JVCA Partner Legal Name: _____ Bidding No.: _____

Page _____ of _____ pages

Similar Contract Number: ____ [insert specific number] of ____ [insert total number of contracts required].	Information		
Contract Identification	_____		
Award date	_____		
Completion date	_____		
Role in Contract	<input type="checkbox"/> Contractor	<input type="checkbox"/> Management Contractor	<input type="checkbox"/> Subcontractor
Total contract amount	_____ _____		US\$ _____ _____
If partner in a JVCA or subcontractor, specify participation of total contract amount	_____% _____	_____ _____	US\$ _____ _____
Employer's Name:	_____ _____		
Address:	_____ _____ _____		
Telephone/fax number:	_____ _____		
E-mail:	_____ _____		

Specific Experience (cont.)

Form EXP – 2.4.2(a) (cont.)

Bidder's Legal Name: _____ Page _____ of _____ pages
 JVCA Partner Legal Name: _____

Similar Contract No. __[insert specific number] of __[insert total number of contracts] required	Information
Description of the similarity in accordance with Sub-Factor 2.4.2(a) of Section III, Evaluation and Qualification Criteria:	
Amount	_____
Physical size	_____
Complexity	_____
Methods/Technology	_____
Other features	_____

Specific Experience in Key Activities

Form EXP – 2.4.2(b)

Bidder's Legal Name: _____ Date: _____
 JVCA Partner Legal Name: _____ Bidding No.: _____
 Subcontractor's Legal Name: _____ Page _____ of _____ pages

	Information		
Contract Identification	_____		
Award date	_____		
Completion date	_____		
Role in Contract	<input type="checkbox"/> Contractor	<input type="checkbox"/> Management Contractor	<input type="checkbox"/> Subcontractor
Total contract amount	_____		US\$ _____
If partner in a JVCA or subcontractor, specify participation of total contract amount	_____ %	_____	US\$ _____
Employer's Name:	_____		
Address:	_____ _____ _____		
Telephone/fax number:	_____ _____		
E-mail:	_____ _____		

Specific Experience in Key Activities (cont.)
--

Form EXP – 2.4.2(b) (cont.)

Bidder's Legal Name: _____ Page _____ of _____ pages

JVCA Partner Legal Name: _____

Subcontractor's Legal Name: _____

	Information
Description of the key activities in accordance with Sub-Factor 2.4.2(b) of Section III, Evaluation and Qualification Criteria:	
Amount	
Physical size	
Complexity	
Methods/Technology	
Physical Production Rate	

Section V. Eligible Countries

Eligibility for the Provision of Goods, Works and Related Services in Bank-financed Procurement

A. Provision at Paragraph 1.6 of the Bank's Rules and Procedures for Procurement of Goods and Works

1.6 The African Development Fund permits firms and individuals from all countries to offer goods, works and services for ADF funded projects. However, the proceeds of any Financing undertaken in the operations of the African Development Bank and the Nigeria Trust Fund shall be used for procurement of goods and works, including the related services, provided by bidders from Eligible¹⁶ Countries.¹⁷ Any conditions for participation shall be limited to those that are essential to ensure the firm's capability to fulfil the contract in question. In the case of ADB and NTF, bidders from non-Member Countries offering goods, works and related services (including transportation and insurance) are not eligible even if they offer these from Eligible Member Countries. Any waiver to this rule will be in accordance with the Articles 17(1) (d) of the Agreement Establishing the African Development Bank and 4.1 of the Agreement Establishing the Nigeria Trust Fund.

B. Provision at Appendix 4 of the Bank's Rules and Procedures for Procurement of Goods and Works

Overview

1. The eligibility criteria for participation in the supply of goods, works and related services, to be procured through the ADB and NTF Financing, derive from the requirements of the Agreement Establishing the African Development Bank, Article 17.1.d, and the Agreement Establishing the Nigeria Trust Fund, Article 4.1. The foregoing requirements basically prescribe two types of eligibility criteria:

The eligibility of the bidder;

The eligibility of the goods, works and related services.

Eligibility of the Bidder

2. The eligibility of the bidder shall be based on nationality, in accordance with the following rules:

(a) **Natural Persons**: A natural person is eligible if he or she is a national of a Member Country of the Bank, or a State Participant of the Fund. Where a person has more than one nationality, such a person shall be eligible if the nationality indicated in his or her bid is that of a Member Country of the Bank, or a State Participant of the Fund.

(b) **Corporations**: A corporation is eligible if it satisfies the following criteria:

¹⁶ Refer to Appendix 4 for additional information on Eligibility.

¹⁷ "Eligible Countries" shall mean: (a) in the case of the African Development Bank and the Nigeria trust Fund, the Member Countries of the African Development Bank.

it is incorporated in a country that is a Member of the Bank, or State Participant of the Fund;

it is a national of a country that is a Member of the Bank, or State Participant of the Fund, as determined by the law of its place of incorporation;

it has its principal place of business in a country that is a Member of the Bank, or State Participant of the Fund.

(c) Joint Ventures and Associations: An unincorporated joint venture, partnership, or association, shall be eligible if at least 60% of its individual, or corporate members, satisfy the eligibility requirement for individuals or corporations.

Eligibility of the Goods, Works and Related Services

3. In order to be eligible, the goods to be procured must have been mined, grown, or produced, in the form in which they are purchased, in an Eligible Member Country.

4. For works contracts, which may include civil works, plant construction, or turnkey contracts, the contractor must satisfy the nationality criteria of eligibility, either as a natural person, or corporation, or joint venture and association. Labour, equipment, and materials needed for carrying out the works contract, shall be supplied from Eligible Member Countries.

5. For contracts, which have been awarded on the basis of Cost, Insurance and Freight (CIF), or Carriage and Insurance Paid (CIP), bidders shall be free to arrange for ocean and other transportation, and the related insurance, from any Eligible Member Country. On the other hand, where goods are shipped on FOB basis, and the Bank has agreed to finance transportation and insurance separately, which are arranged by the purchaser, under a separate contract, the Bank shall be satisfied that the services are supplied from Eligible Member Countries.

C. Eligible Countries

All individuals and firms from all countries are eligible.

PART 2 – Employer’s Requirements

Section VI. Requirements

- 1. Scope of Works**
- 2. Specification**
- 3. Drawings**
- 4. Supplementary Information**

TECHNICAL SPECIFICATIONS

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Section 3	Concrete Works - General
Section 4	Pipelines, Pipework and Manholes
Section 5	Buildings and Structures
Section 6	Roads and Surfacing
Section 7	Safety, Health and Environment
Section 8	Contractor's Site Check List
Section 9	Works Components and Construction Environmental Management Plan
Section 10	Mechanical and Electrical Plant
Section 11	Instrumentation and Control

Specifications Background

The specifications outlined hereunder have been adopted from the following BS, Standards, Codes of Practice and Design Manuals:

- Ministry of Water and Irrigation – Practice Manual for Water Supply services in Kenya, October 2006.
- Water Supply – AC Twort et al – 5th Edition
- Basic Water Treatment for application Worldwide – George Smethrust, 1979
- Water and Wastewater Engineering, Volume 1 & 2 – Gordon M. Fair; John C. Geyer; Daniel A. Okun
- Water and Wastewater Technology - Mark J. Hammer and Mark J. Hammer Jr. – 4th Edition
- BS 3505 – Specifications for uPVC pressure pipes for Cold Portable Water.
- BS 3601/AWWA 200 – Specification of Steel Pipes and tubes for Pressure purposes
- KS 06-149 Part 2 – Specification for uPVC Water Pressure Pipes
- WHO Report No. 4 – Selection and Design Criteria for Community Water Supply Projects
- BS 3601 – Specification for Steel Pipes and Tubes for Pressure purposes

The references are used in a complementary manner. Where requirements of two or more codes or standards are found to conflict, the more stringent of them is adopted for the purpose of this project.

As a result, the specifications have been developed, refined, revised and compiled over the years by Howard Humphreys' Design teams. Focus has been on usage of the this specifications in similar projects over the last 20 years which has resulted in sound projects that meet the unique requirements of various Clients. The design life of the various project have been exceeded. The methods have been; application of the codes, feedback form results achieved and improvement.

The Consultant's experience is that strict adherence of the outlined specifications will result in better workmanship and sound implemented systems.

Whenever reference is made to "The Engineer" (or "The Resident Engineer") or "The Engineer's Representative" in the specifications, it shall be construed to mean "The Project Manager" or "The Project Manager's Representative" respectively.

Project Description & Scope of Works

1. BACKGROUND INFORMATION

1.1. The Project Area

1.1.1. Location

The project area lies in Kasarani Sub-County within the Nairobi County. Nairobi is the Capital City of Kenya. It is both an administrative centre and a commercial centre.

The identified project areas as shown in figure 1-1 below are located in the Nairobi County, within Kasarani Sub-County. These settlements are as tabulated below:

Table 1-1 Settlements within the Project Areas

Settlement within Target Project Areas		
Service Area in	Sub-County	Settlement
Clay Works	Kasarani	Police Station, Highrise, Lower ports View, Clay City, Muirigo, Clay Works, City Chick en, Steve Police Hqrs, Little Sisters, Hunters 'A', Hunters 'B', Mwanamkia 'A' ,Mwanamkia 'B', Mwa namkia 'C', Umagara 'A', Umagara 'B', Umagara 'C', Umag ara 'D', Umagara 'E',Cieko Santon 'A', Cieko Santon 'B', Sunton Police
Mwiki	Kasarani	Muturithia Phase 1 'A , Muturithia Phase 1'B, Karura, Mwiki Centre 'B', M wiki Centre'A', Muturithia Phase 111, Red Soil 'A', Red Soil 'B', Red Soil 'C', Red Soil 'D', Gituamba A, Gituamba B, Muturithia Phase 11',Muturithiahase 11 P

Clay Works

Clay works is the area between Thika road, Kasarani Mwiki Road, Gatharaini River and Maji Mazuri River. It covers the whole of Clay City Sub location of Kasarani Location There are both low and high rise buildings. The area is accessed by Thika road and Kasarani Mwiki road.

Mwiki

Mwiki is the area on both sides of Kasarani Mwiki road from Maji Mazuri River to the railway line. The area is accessed by Kasarani – Mwiki Njiru road and a railway line.

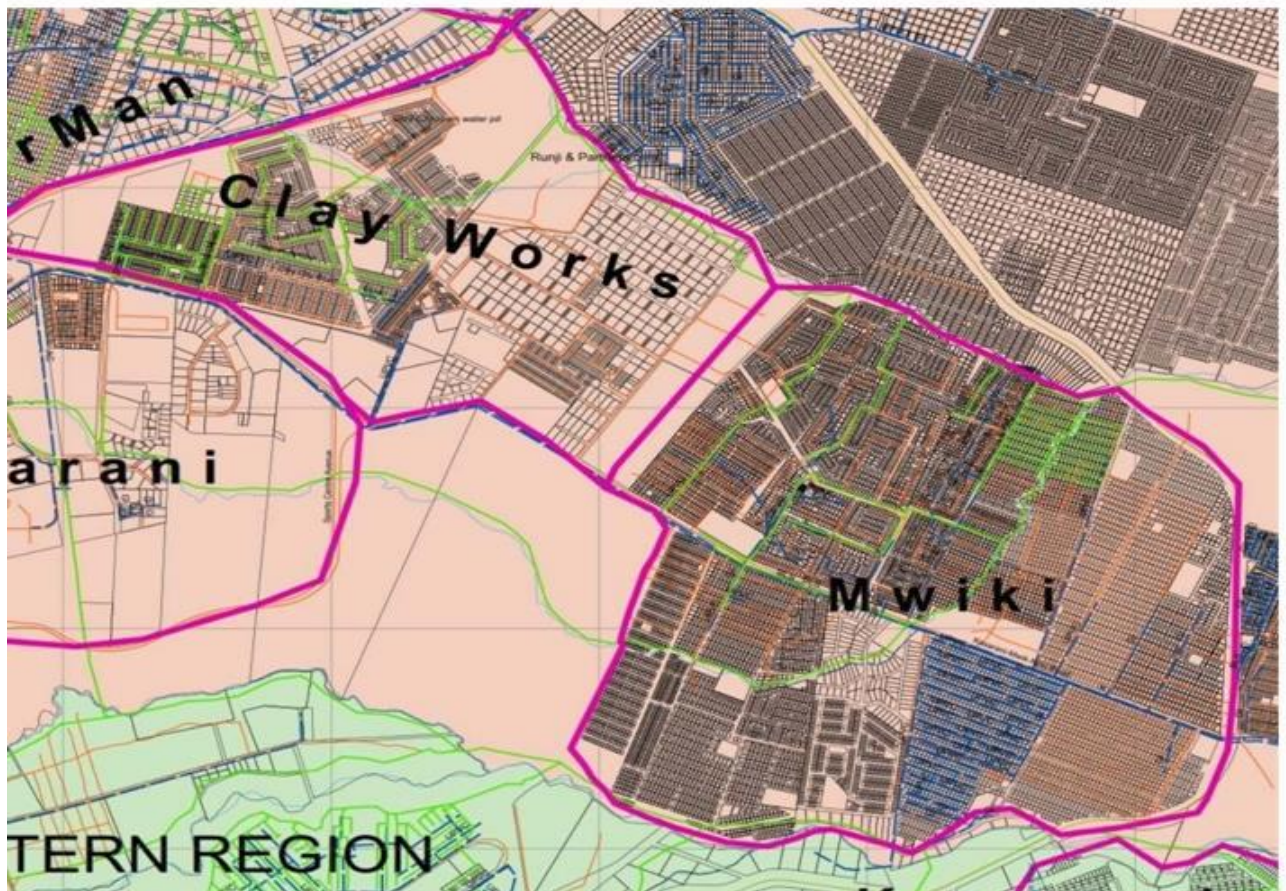


Figure 1-1: Project Areas

Nairobi City, is the administrative and commercial capital of the Republic of Kenya and seat of the Government.

The city is located at latitude 1°17' south and longitude 36°49' east and occupies around 696 km². It is situated about 1660 meters (5450 feet) above sea level.

Nairobi borders Thika and Kiambu to the North, Machakos to the East and Kajiado to the South. It is situated between the cities of Kampala and Mombasa. It is close to the Rift Valley. The Ngong hills are towards the west, Mount Kenya is towards the North and Mount Kilimanjaro is towards the south-east. The three major rivers traversing Nairobi include the Nairobi River, Ngong River and Mathare River. Uhuru Park, Central Park, City Park and Nairobi Arboretum are among several parks of Nairobi. The indigenous Karura forest is in northern Nairobi.

1.1.2. Topography

The terrain in the eastern side of the County is gently rolling but divided by steep valleys towards the City boundaries. To the north, there is the Karura forest which is characterized by steep sided valleys. The Karen - Langata area is characterized by plains surrounded by Nairobi National Park on the east and Ngong Forest on the south.

Several streams with steep-sided valleys covered with vegetation are a dominant landscape feature of the County. The main rivers in the County are Nairobi River, Ngong River and Kabuthi River. These rivers are highly polluted as open sewers and industrial waste is directed towards them. Nairobi dam, which is along the Ngong River, and Jamhuri dam are the main water reservoirs in the County. The main types of soils are the black cotton and the red soils that form patches in different parts of the County.

There are three forests in the County namely Ngong Forest to the south, Karura Forest to the north and the Nairobi Arboretum. The three forests have a total coverage of 23.19 km².

1.1.3. Climate

The County has a fairly cool climate resulting from its high altitude. Temperature ranges from a low of 10°C to a high of 29°C. It has a bi-modal rainfall pattern. The long rains season fall between March and May with a mean rainfall of 899 millimetres (mm) while the short rains season falls between October and December with a mean rainfall of 638 mm. The mean annual rainfall is 786.5 mm.

1.1.4. Geological and Sub-soil Conditions

The Study Area is overlain with an ancient core of crystalline rocks of the Basement Complex which underlies the greater part of the plateau areas of Africa which have been affected by the extensive faulting, displacement and volcanic activity associated with the Rift Valley System. The eroded surface of the pre-Cambrian basement rocks outcrops only on the southern and eastern margins of the area. Elsewhere it is overlain by a variable thickness of volcanic and pyroclastic rocks of Tertiary age.

The Tertiary succession comprises various lava flows, pyroclastic rocks or their weathered derivatives, and also palaeosols, developed intervening periods sub-aerial weathering. Upthrusting and concentration of volcanic activity at the margins of Rift Valley has resulted in a general alignment of lava flows and associated deposits in a southeasterly direction. The sporadic character of the volcanic events both in space and time has dictated the lateral and vertical variability of geological succession.

1.2. Existing Socio-Economic Infrastructure

1.2.1. Demographics

Table 1- below shows proposed project areas various administrative divisions, their population and population densities as per the 2009 Kenya Population and Housing Census (KPHC) report.

Table 1-2: Demographic details of administrative areas within the project area

DISTRICT	MALE	FEMALE	TOTAL	HOUSEHOLDS	AREA IN SQ. KM.	DENSITY
Nairobi West	352,227	332,538	684,765	212,295	261.8	2,616
Nairobi East	582,554	561,862	1,144,416	369,866	226.7	5,048
Nairobi North	545,701	516,385	1,062,086	327,428	109.3	9,721
Westlands	124,708	122,354	247,062	75,427	97.4	2,538
TOTAL	1,605,190	1,533,139	3,138,329	985,016	695.1	4,515

1.2.2. Health Access

Kenyatta National Hospital is the major referral hospital in Nairobi. There are 16 sub- County hospitals, 9 mission, 32 private, 15 nursing homes, 38 public health centres as well as 45 private health centres. The County has 30 public dispensaries, Private dispensaries, 84 private clinics and 22 public clinics. Kenyatta National Hospital has a total bed capacity of 1,800. Level 5 hospitals in the County have a bed capacity of 750. The doctor patient ratio stands at 1:7,816.

1.2.3. Education

The City of Nairobi is very vibrant on the education front. This is demonstrated by high concentration of tertiary and university level institutions with science and technology institutions being 237 as at 2012. It hosts the oldest public university in the country; The University of Nairobi, and 16 university colleges and campuses.

Whereas the city has a high concentration of national schools, it experiences huge challenges on accessing secondary education due to high competition for available vacancies both from within and without the County. Access to basic education at primary and secondary levels remains a major challenge to the urban poor especially in the informal settlements. Civil society organizations continue to play a key role in ensuring that pupils from non-formal settlements access basic education. The requirement for land in registration of public primary schools has been a big barrier to education accessibility since schools operating as community based organizations do not benefit from free primary education. There are 1,235 functional primary schools while the number of secondary schools is 319.

Additionally, there are currently 972,299 students in one form or another in Nairobi.

1.3. Existing Water Supply Infrastructure

The first recorded water source for Nairobi was commissioned in 1899, based on the Ngong River (Nairobi Dam) in the Athi catchment. This produced small quantities of poor quality water and was later abandoned.

During the period 1900 to 1906 the Kikuyu Springs located 18 km from the city were developed to produce approximately 4500 m³/day which was sufficient for Nairobi's needs until the late 1930's.

In 1938, the first phase of development of a source based on the Ruiru River- an intake weir and pipeline was completed. This source was further developed by commissioning a second pipeline in 1946, and a third pipeline then Ruiru Dam in 1949.

The next major source, Sasumua Dam was initially fed by Sasumua River, supplemented by water diverted from the head - waters of the Chania River. The Project included a water treatment plant works adjacent to the dam and a pipeline which deliver treated water to the terminal reservoir at Kabete in Nairobi. This project was completed in 1956. Subsequent developments have included raising the dam, diverting the Kiburu River into Sasumua and increasing the capacity of the treatment works, pipelines and terminal reservoirs.

When Sasumua yield was fully exploited, the next source of water which was developed is the Chania River, initially by pumping from the river at Ngethu, followed by a diversion dam, at Mwagu which transfers water to Ngethu treatment works by gravity via a three meter diameter tunnel and a 1400 mm pipeline. This project was completed in 1984. After completion of the Mwagu Diversion Dam, the associated tunnel and pipeline conveying raw water to Ngethu, the total available water to Nairobi was close to the demand. Then Thika Dam was developed and commissioned in 1994 to feed the Mwagu / Ngethu system.

The Northern Collector Phase 1 and Phase 2 were planned to be implemented in 2001 and 2006 respectively but the implementation of this project stalled, and was subsequently begun in 2015.

In the meantime, Nairobi is faced with chronic water shortage resulting to water rationing in most parts of the City.

1.4. Existing Wastewater Infrastructure

The existing sewer network comprises a trunk sewer system that has a total length of about 162.7 km and covers an area of about 208 km² which essentially covers only 40% of the city area served

with water. The problems in the system are non-functional sewers due to washed away sections, accidental breakages or deliberate vandalism of manhole covers, blockages due to deliberate dumping of solid waste or accidental entry of stones and boulders into open manholes and also blockage of sewer lines by urban farmers to catch sewage for irrigation and overflowing of sewers due to insufficient capacity.

There are number of Sewage Treatment Plants within Nairobi, the main ones being the Dandora Estate STW, Kariobangi STW, Kahawa West STW and Karen STW.

The DESTW has a design capacity of 160,000m³/day and handles an average flow of 73,255m³/day. While the Kariobangi plant has a design capacity of 32,000m³/day and handles an average flow of 11,000m³/day, the plant is in the process of being rehabilitated and all its sewage is currently being diverted to the DESTW.

The sewage treatment plants are operating at very low efficiency, despite the fact that they receive flows below their design capacity. Other treatment plants have broken down with the sewage having to be diverted to other treatment plants. It has been suggested that this may be attributed to poor maintenance, high organic loading and influence of industrial discharges.

Sanitation facilities other than the waterborne system described above in use in Nairobi include Septic Tanks and Pit Latrines.

The main areas that are served by septic tanks in Nairobi are mostly those that are not covered by the sewerage network or sewers have just been built. This includes Muthaiga, Lower Kabete, Karen, Githurai, Zimmerman, Kasarani, Garden Estate, Thome, Ridgeways, Runda, Ruaka, Utawala and Ruai. Pit Latrines are in use in informal settlement areas.

1.5. Current Situation in the Project Areas

Clay Works

Clay Works is located between Thika Super highway, Kasarani Mwiki road and Gathara-in River. It is an area generally occupied by middle class people. It is characterized by apartment mansionettes.

Sanitation

The sanitation situation in the settlement is moderate. Residents usually use both septic tanks and sewer lines. There is a recently constructed Trunk sewer line.

Water supply

Water supply to the area is through pipes laid down by NCWSC. Most of the residential houses are connected to the water supply system.

Mwiki

Mwiki is located along Kasarani Mwiki road. It's an area generally occupied by both low and middle class people. It is characterized by apartment and simple houses.

Sanitation

The sanitation situation in the settlement is poor. Residents usually use both septic tanks and sewer lines. There is a recently constructed Trunk sewer line.

Water supply

Water supply to the area is through pipes laid down by NCWSC. Most of the residential houses are connected to the water supply system.

1.6. Project Component

The sewerage system proposed caters for the already built up areas and those that are in the process of being developed.

The topography offers sufficient drainage of the Project area through gravity in most areas and the sewerage network has been proposed based on this. In most cases, the sewers have been planned to follow the road reserves and recognizable storm water drainage riparian reserves.

Table 1-3: The proposed sewer lines for the settlements consist of the following sewer sizes:-

Sewer	Pipe Diameter(mm)	Proposed Length(m)
Description		
Primary	450	720
Primary	375	1,438
Primary	300	8,188
Secondary	225	55,422

Of the sewer lines some sections will be above ground for aerial crossings, through box culverts, and through tunnels. These sewers are made of steel.

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101 Quality and Approvals

The materials and workmanship shall be the best of their respective kinds and to the approval of the Project Manager. The words “to the approval of the Project Manager” shall be deemed to be included in the description of all items relating to design, construction, installation and materials and workmanship for the due execution of the Works.

The Contractor shall submit all data, details and samples as necessary and as reasonably requested by the Project Manager of all materials that the Contractor proposes to use in the Works. Method statements which adequately demonstrate the Contractor’s proposed method of working, methods of maintaining safety and compliance with the programme shall be submitted for the Project Manager’s approval prior to the commencement of work on any area of the Site.

Where the Contractor is responsible for the preparation of Construction Documents to describe the permanent works such Construction Documents shall be approved prior to the procurement of any materials or commencement of any work to which the documents relate.

No materials, Plant or equipment shall be procured for the Contract and no work, permanent or temporary, shall commence without first obtaining the Project Manager’s approval.

All materials, Plant and equipment supplied shall be designed for operation under the above described

conditions.

102 Construction Documents

Drawings and Documents which are to be submitted by the Contractor to describe the Permanent Works shall become Construction Documents upon their approval.

All drawings, technical specifications, bill of quantities, schedules, cost estimates; programme and other information to be submitted by the contractor shall be in English and shall be submitted for approval in triplicate. Following approval, the contractor shall supply a further five copies to the Project Manager. Construction Documents shall not be departed from without the approval of the Project Manager.

All drawings and documents submitted by the Contractor shall have been checked, signed and be ready for issue and shall bear:

- Title of the drawing or document;
- Scale;
- Date;
- Work item reference number complying with an approved numbering system;
- Name and references of the Contractor;
- Names of the employer and the Project Manager;
- Date of approval by the Contractor and the signature of the person responsible for approval.

Drawings and documents submitted for approval shall be delivered to the Project Manager's office as designated by the Project Manager.

Unless otherwise specified the Contractor shall allow a minimum of 21 days, after the date of receipt by the Project Manager for approval of drawings and documents by the Project Manager.

103 Operation and Maintenance Manuals

The Contractor shall submit to the Project Manager for approval six copies of the Operation and Maintenance (O&M) Manuals as described in Clause 58 of the Contract Data.

The Contractor shall supply the final version of the O&M Manuals prior to the issue of the Taking- Over Certificate for either the whole of the Works or the respective Section or part of the Works. Each set shall be bound together in a stout plastic or other approved cover.

O&M Manuals shall be supplied written in English language, all parts and equipment listings shall be in English.

104 Level Datum

Before the commencement of constructional work the Contractor shall establish, in a position to the approval of the Project Manager, steel datum pegs which shall be securely concreted in. The level of these pegs shall be established and agreed with the Project Manager and all levels used in the construction of the Works shall be referred to these established datum points. The correctness of this datum shall be checked at regular intervals during the construction period as agreed with the Project Manager.

Where possible construction drawings and all levels used for construction shall be referred to the national height datum as defined by the Survey of Kenya. The Contractor shall be responsible for obtaining the location and values of the permanent bench marks. In cases where such bench marks do not exist, the site datum shall be agreed with the Project Manager.

105 Setting Out of the Works

The site layout drawings show indicative site layouts. Prior to commencing construction, the Project Manager will agree with the Contractor the basic information supplementary to that shown on the Drawings such as the position of manholes, chambers, centre-lines and base-lines sufficient for the Contractor to locate the Works.

Project Manager in triplicate for approval. Any modifications to the setting out drawings or data sheets required by the Project Manager shall be made by the Contractor and resubmitted for final approval. Should it be necessary during setting out or during construction for the approved setting out details to be amended, the Contractor shall amend the drawings or data sheets or make new ones for approval as required by the Project Manager.

For pipelines, the Contractor shall in the presence of the Project Manager set-out the pipeline alignments in accordance with the indicative alignments shown on the drawings taking into account physical features on the ground, any existing services, any requirements of relevant Authorities and any changes deemed necessary by the Project Manager, confirming the locations of all valves, air valves, washouts, hydrants and bends.

The Contractor shall prepare and submit to the Project Manager, at an approved scale, plans of the pipeline route and profiles of ground levels after any initial clearing of the wayleave or easement showing the proposed pipe invert levels and precise chainages for all valves and fittings for approval. Following approval the Contractor shall submit to the Project Manager two copies of the agreed alignment and profiles.

106 Boundaries of Works

The Employer shall provide the Site upon which the Permanent Works are to be constructed. Where a drain or pipeline is to be within an existing road or track reservation or is otherwise located in land designated Public Domain the Site width will be restricted to the limit of the public land. The existing

boundary fences and walls shall not be disturbed without prior approval of the Project Manager and, unless road diversions and closure notices are approved and posted, carriageways shall be left available for the safe passage of traffic.

The Contractor shall not enter upon or occupy with men, tools, equipment or materials any land other than the site without the written consent of the owner of such land.

On occupation of the Site or other land the Contractor shall provide such fencing, as required.

107 Work through Private Land

In order that the necessary parts of the Site which are on private land may be obtained the Contractor shall supply the Project Manager with full information of his programme sufficiently in advance of the dates upon which the Contractor proposes to enter upon each areas of the Site. The Contractor shall where required, in consultation with the Project Manager, programme the Works to designate the areas of the Site to which the Contractor is to be given possession and the sequence of taking possession.

The Contractor shall obtain written approval before entering upon any private land or cutting through ditch, bank, hedge, wall, fence or any other form of boundary marking and he shall carry out all reasonable requirements as approved by the Project Manager in the matter of reinstatement.

108 Public Utility Mains and Services

Where the Contract indicates the positions of existing services or apparatus the positions shown are believed to be correct but no warranty is given as to the accuracy or completeness of the information.

It shall be the responsibility of the Contractor to obtain all information available from the Public Utility Authorities regarding the position of existing mains and services and he shall copy this information to the Project Manager as soon as he obtains it.

The Contractor shall carry out excavation works in a manner which safeguards any existing services, including hand excavation as necessary and shall be responsible for the cost of any repair work necessitated by damage caused by him to any main or service and for any costs arising from the disruption.

The Contractor shall obtain all information and assistance from the Public Utility Authorities for the locating of the mains and services and shall agree with the Project Manager any trial excavation which may be necessary to confirm or establish these locations.

The Contractor shall be responsible for locating all existing services, whether known to the Public Utility Authorities or not, and shall conduct his own survey as necessary to accurately locate all services. All efforts to identify these existing services shall be carried out in advance of conducting excavation for the permanent works.

Any temporary or permanent diversion of mains and services shall be agreed with the appropriate Authority.

109 Safeguards to Existing Pipes, Cables, Structures

It shall be the Contractor's responsibility to safeguard by means of temporary or permanent supports or otherwise all existing sewers, pipes, cables, structures or other things which would be liable to suffer damage if such precautionary measures were not taken.

Safeguards shall be to the approval of the Project Manager and of the undertaker or owner concerned.

110 Record Drawings

At all sites and any locations where the Contractor executes work under the Contract, including locations where the Contractor undertakes repair or rehabilitation work, the Contractor shall record the location and nature of all water supply and wastewater works including their ancillaries and any associated services.

Where instructed by the Project Manager for the purpose of producing Record Drawings, the Contractor shall undertake such surveys and investigations to determine the location of existing services. Such surveys and investigations shall be additional to those surveys and investigations undertaken by the Contractor for the purpose of determining the location of services prior to excavation.

The Contractor shall where necessary utilize appropriate equipment and where instructed by the Project Manager excavate trial pits to confirm the location and determine the size and nature of the buried services.

For sites where the Contractor undertakes permanent works Record Drawings shall be submitted to the Project Manager, for approval, in the form of As Built Drawings. In the case of repairs and rehabilitation the Record Drawings shall be submitted for approval within a period of 21 days following execution of the work.

Record Drawings shall be prepared to an approved format, and scale in line with the construction drawing.

111 Connections to Existing Pipes, Cables and Equipment

The Contractor shall be responsible for joining up and making connections between pipes and cables laid by him and existing pipes and cables. The Contractor shall submit to the Project Manager a drawing showing the details of the connection, and shall state the date on which the particular connection is required, and the work shall not proceed until the Project Manager's approval has been given.

The Contractor shall be responsible for ensuring the compatibility of new pipes and cables with existing pipework, cables, tubing and equipment.

112 Lighting, Watching and Traffic Control

Where necessary for safety of the public or where required by the Project Manager, the Works shall be properly fenced and signed. In addition, the Works shall be lighted from half an hour before sunset until half-an-hour after sunrise and at other times when visibility is poor. The position and number of the lamps shall be such that the extent and position of the Works are clearly defined. Each Site shall be provided with watchmen as required.

113 Contractor's Offices

The Contractor shall provide and maintain offices for the use of his representative and staff to which written instructions by the Project Manager can be delivered. Any instructions delivered to such offices shall be deemed to have been delivered to the Contractor.

Offices shall be located to give convenient access to the Works and shall be subject to the approval of the Project Manager. The Contractor shall be responsible for obtaining the land on which to establish any temporary site offices.

114 Project Manager's Office

The offices of the Project Manager shall comprise reception area, two offices, a meeting room, kitchen and separate WC. They shall be served with electric lighting power, telephone line, potable water, networked broadband internet connection, heating and air conditioning. The broadband connection shall be networked throughout the office allow up to six computers to access the network. A wireless network is acceptable.

The Contractor shall make adequate provision for the drainage of rainwater, sink waste (grey water) and foul sewage. Fly screens shall be fitted on every opening window and steps shall be provided where the entrance is elevated above ground level. The Contractor shall arrange for the regular cleaning of the facilities and the removal of the solid waste. He shall maintain all equipment in working order throughout the duration of the contract and arrange for the supply of all consumables including mobile phone vouchers, stationery, etc.

Each of the two offices, office 1 and office 2 shall have a minimum covered floor area of 12 m² and 20

m² respectively and each shall contain the following:

Office 1

1 x double pedestal desk
3 x chairs
1 x 4 drawer lockable filing cabinet
1 x 5 tier shelving unit to take A4 files
1 x plan table
1 x telephone unit

Office 2

2 x double pedestal desks
6 x chairs
2 x 4 drawer lockable filing cabinet
2 x 5 tier shelving unit to take A4 files
1 x plan table
2 x telephone units.

The meeting room shall have a minimum covered floor area of 20m² and shall contain the following:

1 x table (or tables of the same size) to accommodate 8 persons 8 x chairs

1 x wall mounted pin board, 2m x 1m
1 x wall mounted white melamine board, 2m x 1m 1 x AO size vertical plan chest
1 x A3/A4 colour printer/photocopier/scanner/fax 1 x telephone unit

The kitchen shall be equipped with a sink, a 4 burner gas cooker, electric kettle and fridge together with appropriate work surfaces.

The separate WC shall be equipped with a low level WC suite with dual flush. Automatic air ventilation shall be provided where there is no opening window.

Automatic air

Other equipment to be supplied for the sole use of the Project Manager shall include:

Furniture	
Office paper punch	3 Nr
Whiteboard, 2.4m x 1.2m	1 Nr
Whiteboard, 1.2m x 1.2m	1 Nr
Office Tray (3 tier)	3 Nr
Office Stapling Machines	2 Nr
Steel File Cabinet with locks / 4 drawers ('Mecol' or equivalent approved)	3 Nr
'Casio' or similar small portable scientific electronic calculator	3 Nr
'Casio' or similar small portable electronic calculator	2 Nr
First Aid kit (for 10 persons) in Metal Box	2 Nr
Potable Fire Extinguisher (5 litres)	3 Nr
Small office scissors	3 Nr
Waste paper baskets	4 Nr
Electric kettle (capacity to make 12 cups of tea)	2 Nr
Coffee/Tea making facility including crockery for all supervisory staff 6 Nr. and 12 additional guests	1 Nr
Pedestal electric fan, size 400mm	4 Nr
'Sanyo' or equivalent approved Refrigerator (0.2 cu.m. capacity)	2 Nr
Desktop: HP Compaq Elite 8300 - CMT - Core i7 3770 3.4 GHz - 4 GB - 1 TB HDD	3 Nr
Laptop: <u>HP ZBook 15 G4</u> Windows 10 Pro 64 7th Generation Intel® Core™ i7 processor 8 GB memory; 1 TB HDD	4 Nr

Furniture	
15.6" diagonal FHD SVA display	
Printer: HP OfficeJet 7510	1 Nr
Petty Cash Box with security lock	1 Nr
Wall Clock	3 Nr
Flashlights (battery powered)	3 Nr
Digital Camera as specified	2 Nr

The Contractor shall provide a Secretary who can speak English and is conversant in the use of above mentioned software for the duration of the Contract.

Stationery required per month as follows:

Stationery	
Photocopy paper A4	2 Reams
A3 paper	5 Ream
Biro pens blue/black	5 Doz.
Box files	4 Nr
Spring Files	2 Nr
Document Wallets	3 Nr
Cellotape (medium)	1 Nr
Masking tape (medium)	1 Nr
Staples	2 Pac.
Paper clips (various sizes)	2 Pac.
C-DR (Pack of 12)	1 Pac.
CD-RW (Pack of 12)	1 Pac.
Highlighters (set of all colours)	2 Sets
A6 hardcover notebooks	2 Nr
Soft Pencil Erasers (Staedtler or equivalent)	3 Nr
Envelopes (all sizes)	3 Doz.
Batteries for flashlights	3 Sets
Colour and Black ink cartridges for the A3 printer	1 Set
Black ink cartridge/ toner for the A3 printer	3 Nr

Supply of clean towels every day, soap, lavatory paper, disinfectant and cleaning materials is to be provided and maintained throughout the Contract Period.

The cost of all the above services shall be included by the Contractor under item for maintenance and attendance for Resident Engineer's offices. Apart from the consumables, the rest of equipment will revert to the Employer at the end of the Contract.

The Contractor shall provide adequate space and facilities at a convenient location for meetings between the Project Manager and Contractor.

The Project Manager's office shall be in a well-lit, surfaced, fenced and secure compound with sufficient dedicated parking for 6 vehicles.

The compound shall be provided with 24-hour manned gate security to the approval of the Project Manager.

115 Vehicles for the Project Manager

The Contractor shall provide and maintain for the duration of the Contract vehicles for the use of the Project Manager. At the conclusion of the Contract the vehicles will be handed over to the Employer in a fully serviced and roadworthy condition, free from defects. Selection of vehicles shall be agreed with the Project Manager at the commencement of the contract and at minimum will be:

4WD, Twin Cab Pick-up, or approved equivalent, including road licenses, number plates, insurances, etc. The vehicle to revert to Employer after completion of Contract. Minimum specifications include but not limited to the following:

- Engine - 2.5 litres Turbo Diesel
- Rear Differential Gear Lock
- Braking System to include ABS (Anti-Lock Brake System)
- Gear Lock
- Power Steering with adjustable Steering Column
- Electronic Fuel Injection System.
- 5 Speed Manual Transmission
- Power Windows
- Immobiliser and Alarm System
- Fuel tank capacity between 80 litres and 100 litres
- Front Bull Bar

116 Contractor's Yards, Stores and Accommodation for Workmen

The Contractor shall be responsible for obtaining the land and for the provision of all temporary yards, stores, workshops, offices, mess rooms, shelters and for all services in connection therewith. The location of all such facilities shall be agreed beforehand with the Project Manager and shall be such as to avoid obstruction and nuisance to the public.

The Contractor shall construct secure storage compounds and storage building where he shall store at his own risk all equipment and Plant awaiting erection. The Contractor shall also provide secure covered storage for all samples submitted to the Project Manager for approval. Storage building shall be weatherproof and shall be of sufficient size to accommodate all items requiring covered storage.

The Contractor shall provide and maintain suitable and sufficient shelters and mess rooms for his workmen and supervisory staff as are customary and necessary. The Contractor shall provide sufficient closets or latrines to the satisfaction of the relevant authority. They shall be properly screened and maintained in a clean and sanitary state at all times. The Contractor shall be responsible for making all arrangements for the proper disposal of waste.

117 Water and Electricity Supplies

The Contractor shall make all arrangements for and provide adequate supply of potable water to each site as necessary for the execution and testing of the Works and for use by his workmen.

The Contractor shall make arrangements for and provide any electricity supply required for the execution of the Works, including the Tests on Completion.

118 Contractor's Staff and Workmen

The Contractor shall agree to employ Kenyan workers to the maximum extent possible. The Contractor shall provide a competent Site Agent to the approval of the Project Manager to be in charge of the work who shall not be changed except with the consent of the Project Manager.

The Contractor agrees that his workmen and employees shall be considered for all purposes in his direct pay and employ and under his supervision and control. He shall be directly and personally responsible for discharging all obligations, financial or other, which may be or becoming owing to any such workman or employee or to his successors, assignees or personal representatives. There shall be no contractual or legal relations of any kind whatsoever between the Employer and any such workman, employee or any person employed in the performance of the Contractor's obligations under this Contract.

The Project Manager may request and the Contractor agrees to accept the request for the immediate

removal from the site of any employee or worker of the Contractor adjudged by the Project Manager to be incompetent, disorderly, and unreliable or of bad character. Such employee shall not again be employed on the Works.

119 Training of Employers Workmen

The Contractor shall make provision for the on-site training of up to 3 of the Employer's staff.

120 Project Management

121.1 Project Control

The Contractor shall provide within his site organization a project management capability to advise and be directly responsible to the Site Agent. (Contractor's chief site representative). The duties of the section shall include the following:

- a) Planning and programme preparation particularly in relation to the requirements of the Employer and the public authorities, and the requirements to maintain water supply and waste water disposal services where careful detailed arrangements have to be made and adhered to.
- b) Planning the execution of the Works in a manner which minimizes disruption to the water supply system and will permit the efficient and effective commissioning of the water supply system and their respective components.
- c) Ensuring adequate potable water supplies and wastewater disposal services are maintained to all consumers.
- d) Continuous surveillance of progress and anticipation of factors likely to affect the timely performance of the Contract.
- e) Making proposal for modification to forward planning and to the programme at an early stage in the light of factors resulting from (d) above.
- f) Continuous appraisal of the Contractor's methods and routines particularly as to their effect on the community and property.
- g) Forward planning for resource requirements taking due account of possible shortages and delays in the arrival on site of materials, equipment, plant and personnel and their mobilization for effective usage.
- h) Acquisition and process of up-to-date information for progress meetings with the Project Manager. The preparation of monthly progress reports including an update of the detailed programme and cash flow forecast which shall include progress photographs as directed by the Project Manager.

The Contractor's project management staff shall be of adequate ability and experience. Programmes shall be based upon Critical Path Management (CPM) networks in precedence format and shall be prepared using a suitable PC-based project management software package approved by the Project Manager.

Reporting shall be in a manner compatible with the Employers project management procedures and shall use the Earned Value (EV) Technique and shall monitor the actual gross value of work completed against the predicted value.

121.2 Monthly Statements and Certificates

Monthly statements and certificates shall be submitted in an approved manner and format. In addition to the statements submitted in hard copy the Contractor shall submit a computer copy using data base software as prescribed by the Project Manager. The statements and certificates shall detail the measured value of the work completed on each item of the Works in such detail that the

Project Manager can identify location and measurement of each item. A location shall constitute a single structure such as a reservoir, pump station or section of a pipeline or a component of a system such as a pipeline valve complex.

Each item shall be uniquely identified in accordance with the numbering system as instructed by the Project Manager.

121.3 Progress Meetings

The Contractor shall provide a suitable venue, near the vicinity of the Site, and arrange progress review meetings to be chaired by the Project Manager at monthly intervals to coincide with submission of monthly progress submissions. The Contractor shall allow for attendance by the Project Manager and up to 4 representatives of the Project Manager's or Employer. The meetings shall be attended by the Contractor's senior representatives, Site Agent and other members of his senior staff as may be deemed necessary.

122 Equipment for the Employer

The Contractor shall hand over to the Employer on completion of the Works a complete set of tools and equipment together with spare parts and fittings to facilitate the maintenance and operation of the installed works.

123 Facilities for Survey and Inspection by the Project Manager

The Contractor shall make available technicians and such labour, materials and safety equipment as the Project Manager may require for inspections and survey work in connection with the Works. The Contractor shall provide all necessary tackle, test equipment, access, labour, staff and any other thing the Project Manager may reasonably require in order that he may safely, conveniently and quickly carry out such inspections as he deems necessary at any time during the execution of the Works and during the Defects Liability Period. The Project Manager, his representative and assistants, shall not inspect any area of the Works where they deem the safety provision to be inadequate and the Contractor shall undertake any work required by the Project Manager in order to make it safe.

124 Inspections by the Project Manager during Defects Liability Period

The Project Manager will give the Contractor due notice of his intention to carry out any inspections during the Defects Liability Period and the Contractor shall thereupon arrange for a responsible representative to be present at the times and dates named by the Project Manager. This representative shall render all necessary assistance and shall record all matters and things to which his attention is directed by the Project Manager.

125 Protective Clothing and Safety Equipment

The Contractor shall provide for the Project Manager, his Representative and assistants any additional protective clothing and safety equipment necessary for the proper discharge of their duties on the Site.

The Contractor shall provide any necessary protective clothing and safety equipment for the use of authorized visitors to the site including the Employer and his staff and representatives and those of any relevant authority who have reason to visit the Site.

126 Notice Boards

The Contractor shall provide and erect sign boards at the Sites where works are being executed, giving information to the public on the Project and the Employer and further details as will be prescribed by the Employer. The location of the sign boards at the sites will be indicated by the Project Manager. The Contractor shall maintain, alter, move or adapt the sign boards from time to time as may be instructed by the Project Manager. The display of any named Sub-contractors or any other information associated with the Works shall be to the approval of the Project Manager.

127 Language of Correspondence and Records

All communications from the Contractor to the Project Manager shall be in the English language. All

books, timesheets, records, notes, drawings, documents, specifications and manufacturers' literature shall be in

the English language. If any of the aforementioned is in another language a certified translation in English shall be submitted to the Project Manager.

128 Standards and Regulations

Each and every part of the Works shall be designed, constructed, manufactured, tested and installed in accordance with an internationally recognized standard, Code of Practice, or Regulation applicable to that part of the Works.

Such standards and codes shall include:

- a) British Standard Specification last published.
- b) International Electromechanical Commission, where available (IEC).
- c) International Organization for Standardization (ISO).

The Contractor shall provide and keep permanently on site copies of such standards as may be directed by the Project Manager and shall make them available to the Project Manager as required.

129 Equivalency of Standards and Codes

Wherever reference is made in the Contract, including Specifications, Drawings and Bill of Quantities, to specific standards and codes to be met by the goods and materials to be furnished, and work performed or tested, the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise stated in the Contract. Where such standards and codes are national, or relate to a particular country or region, other authoritative standards that ensure a substantially equal or higher quality than the standards and codes specified will be accepted subject to the Project Manager's prior review and written consent. In the event the Project Manager determines that such proposed deviations do not ensure substantially equal or higher quality, the Contractor shall comply with the standards specified in the Contract.

130 Quality Control

The Contractor shall be responsible for his own quality control and shall provide sufficient competent personnel for supervising the Works, taking and preparing samples and for carrying out all necessary tests.

131 Units

The International System of (metric) Units as set out in ASTM E380 shall be used throughout the Contract except where otherwise provided.

132 Inspection and Testing during Manufacture

The performance of each item of Plant or Pipe shall be tested in accordance with the Specification to the requirements of the Project Manager.

Test certificates in triplicate shall be submitted by the Contractor to the Project Manager within 2 weeks of the date of the tests. Type tests are not acceptable. Test certificates shall be supplied for tests carried out on the actual Plant being supplied.

Plant shall not be dispatched from the manufacturer's works until it has passed the specified tests and approval been given by the Project Manager.

The Project Manager shall at his discretion witness tests of individual items of Plant at the manufacturer's works. The Project Manager shall be given three weeks' notice in writing before such tests are to take place.

The acceptance by the Project Manager of any item of Plant or equipment after testing at the manufacturer's works shall in no way relieve the Contractor of his responsibility for the correct performance.

Section 2 Earthworks, Backfilling and Restoration

201 Conditions of Site

Before carrying out work on any Site, the Site shall be inspected by the Contractor in conjunction with the Project Manager to establish its general condition which shall be agreed and recorded in writing and by means of digital photography.

Details recorded shall include the location of all boundary and survey beacons, the condition of buildings, surface, terracing (if any), ditches, watercourses, roads, tracks, fences and other information relating to the Site and elsewhere which may be affected by the works.

In the case of way leaves for pipelines the boundaries of the way leave will be defined by the Employer and the contractor shall where directed provide erect and maintain in position, from commencement to the final completion of the Works, in every section substantial timber stakes or similar approved markers not less than 1.5 m high indicating the position of the boundary at 100m or other such intervals as the Project Manager may direct. In the event of any boundary or survey mark established for the purpose of land title being disturbed or displaced the Contractor shall forthwith replace the beacon. Where necessary the Contractor shall employ the services of an approved licensed surveyor for the purpose of setting out boundaries.

202 Site Clearance and Topsoil Removal

Site clearance shall be carried out over the areas to be occupied by the Permanent Works before beginning excavation or filling or other work, and shall include the clearance of all trees, stumps, bushes and other vegetation and the removal of all boulders between 0.01 and 0.2m³ volumes. Boulders located within 1m of any pipe centreline shall be removed where directed by the Project Manager.

Before beginning clearance in any area the Contractor shall give seven days written notice of his intention to the Project Manager who will determine the extent and limits of such clearance.

Topsoil shall mean the surface layer of soil which by its humus content supports vegetation and is unsuitable, as a formation to roads and concrete structures or as a backfill or bedding material. The extent and depth of topsoil that needs removal shall be agreed with the Project Manager. Topsoil shall be set aside for re-use or disposal as directed by the Project Manager.

Trees to be removed shall be uprooted or cut down as near to the ground level as possible. Bushes, undergrowth, small trees stumps and tree roots shall, where directed by the Project Manager, be grubbed out. All holes left by the stumps or roots shall be backfilled with suitable material in a manner approved by the Project Manager.

The Project Manager may require that individual trees, shrubs and hedges are preserved; the Contractor shall take all necessary precautions to prevent their damage.

In the case of wayleaves for pipelines and the like, the Contractor shall preserve as far as practicable all grass and other vegetation outside the limits of trenches and permanent works and shall not necessarily destroy crops or any vegetation whose removal would not be essential to his operations.

203 Erosion

The Contractor shall take care at all times to prevent erosion on every site and elsewhere on land which may be affected by his operations and the Project Manager may impose such reasonable limitations and restrictions upon the method of clearance and upon the timing and season of the year when clearance is carried out as the circumstances warrant.

204 Ground Levels

Before commencement of any earthworks or demolition the sites shall be surveyed, as necessary, in conjunction with the Project Manager to establish existing ground levels. These agreed ground levels shall form the basis for the calculation of any subsequent excavation and

filling.

205 Trial Holes

The Contractor shall excavate, refill and restore in advance of his programme such trial holes as he may require for determining the nature of the subsoil and the location of existing underground services and obstructions.

206 Excavation Generally

Excavations shall be made in open cutting unless tunnelling or heading is specified or approved by the Project Manager and shall be taken out as nearly as possible to exact dimensions and levels so that minimum of infilling will afterwards be necessary. The Contractor shall ensure the stability and safety of excavations and shall take all measures necessary to ensure that no collapse or subsidence occurs.

Except where described in the Contract or permitted under the Contract excavation shall not be battered. The sides of all excavations shall be kept true and shall where necessary be adequately supported by means of timber, steel or other type struts, walling, poling boards, sheeting, bracing and the like.

Excavations shall be kept free from water and it shall be the Contractor's responsibility to construct and maintain temporary diversion and drainage works and to carry out pumping and to take all measures necessary to comply with this requirement.

In the event of soft or otherwise unsuitable ground being encountered at formation level or if the formation is damaged or allowed to deteriorate the Contractor shall forthwith inform the Project Manager, shall excavate to such extra depth and refill with compacted granular or other approved fill or C15 concrete (minimum compressor strength 15N/mm²) as the Project Manager may require. With respect to the side face of any excavation against which concrete or other work will be in contact the Project Manager may require that the net dimensions of the work be increased.

The Contractor shall be responsible for the disposal of Surplus excavated material off site, which shall be to a location approved by the Project Manager. No excavated material suitable for re-use shall be removed without the approval of the Project Manager.

The Contractor shall not deposit excavated materials on public or private land except where directed by the Project Manager or with the consent in writing of the relevant authority or of the owner or responsible representative of the owner of such land and only then in those places and under such conditions as the relevant authority, owner or responsible representative may prescribe.

207 Excavation in Excess

If any part of any excavation is in error excavated deeper and/or wider than is required the extra depth and/or width shall be filled with Grade C15P concrete or compacted granular or other approved fill to the original formation level and/or dimensions as the Project Manager directs.

In pipe trenches where the pipe is not bedded on or surrounded with concrete, excess excavation shall be filled with compacted granular material. Excess excavation in rock trenches shall be filled with concrete (15N/mm² compressive strength) up to 150mm below the pipe invert.

208 Mechanical Excavation

Mechanical excavation shall be employed only if the subsoil is suitable and only in such manner which will allow adequate support of the excavations. The Contractor shall ensure that there are no pipes, cables, mains or other services or property which may be disturbed or damaged by its use.

209 Excavation for Pipelaying

The width of trench excavation shall be the minimum required for efficient working after allowance has been made for any timbering and strutting, and shall not exceed the widths described in the Contract. At any one spread the maximum length of open trench shall not,

without the prior approval of the Project Manager, exceed 100 metres.

Trenches in rock for pipes up to 100mm bore shall be excavated to provide a minimum clearance of 100 mm around the outside of the pipe and joints. For pipes exceeding 100mm bore the minimum clearance shall be increased to 150mm.

Where the trench is in rock or rocky ground the Contractor shall excavate the pipe trench to a depth of 150mm below the invert of the pipe and refill with compacted granular fill.

The materials for re-use excavated from trenches shall be stockpiled at the sides of the trench except where this would obstruct any road or footpath and prevent the passage of traffic or pedestrians. In such cases the Contractor shall excavate the trench in such lengths and stockpile the excavated materials at such places as the Project Manager may require.

Where excavation for pipe laying is carried out behind thrust blocks on existing pipelines the Contractor shall provide adequate support arrangements to transfer thrusts to the surrounding ground.

210 Headings

Excavation for pipes in heading shall be carried out to the approval of the Project Manager and to dimensions which will permit a proper inspection to be made. The heading shall be properly and securely timbered. The pipe shall be laid on a minimum thickness of 150mm of concrete. After the pipe has been laid, jointed and tested the heading shall be filled in short lengths not exceeding 1 metre with Grade C15P concrete or as directed. The heading shall be completely filled with concrete and hard filling shall then be rammed into the concrete at the crown of the heading.

Special precautions shall be taken to prevent a slump in the concrete and to ensure that no slips or falls of the heading or in the ground above or in the shafts can take place.

211 Excavation for Foundations of Structures

The Contractor shall give sufficient notice to the Project Manager to enable him to inspect and approve foundations in advance of placement of the permanent works. The Project Manager may withdraw his approval if work is not commenced within 48 hours or the formation is subsequently allowed to deteriorate.

If the Project Manager directs a bottom layer of excavation of not less than 75mm thickness shall be left undisturbed and subsequently taken out by hand immediately before concrete or other work is placed.

Formations which are to receive concrete blinding or a drainage layer shall be covered with such blinding or layer immediately the excavation has been completed, inspected and approved by the Project Manager.

Surfaces against which permanent works are to be placed shall be kept free of oil, water, mud or any material.

No concrete or other materials shall be placed until formations have been approved. Adequate notice shall be given to the Project Manager to enable him to examine the formation.

212 Rock Surfaces under Concrete Structures

212.1 Concrete Placed Directly on Rock

Rock under concrete structures shall be prepared by picking, barring and wedging or other methods which will leave the rock in as sound a condition as may reasonably be expected according to the rock quality.

Rock surfaces shall be thoroughly cleaned by compressed air and water jet or such means as

the Project Manager my direct before concrete is placed.

212.2 Concrete Placed on Capping Layer

Where instructed the rock excavation shall be taken down to a depth of 1.0m below the underside of the structure and the excavation backfilled with capping materials to the required formation level. Capping material shall be granular material. The material shall be compacted in 150mm layers to achieve a density of not less than 95% maximum dry density at optimum moisture content + 5% to 2% as determined by the BS heavy compaction tests to BS 1377.

213 Explosives

The Contractor shall at all times take every possible precaution and comply with the Explosives Laws of Kenya and regulations relating to the handling, transportation, storage and use of explosives and shall at all times when engaged in blasting operations post sufficient warning flagmen to the full satisfaction of the Project Manager's Representative.

The Contractor shall also provide a special proper store for explosives in accordance with local regulations and shall provide experienced men with valid blasting licences, for handling explosives to the satisfaction of the Project Manager and the authorities concerned.

The Contractor shall at all times make full liaison with and inform well in advance and obtain such supervision and permission as is required from the Police and all Government Authorities, public bodies and private parties whosoever concerned or affected by blasting operations.

Blasting shall only be carried out on those sections of the Works for which permission in writing shall have been given by the Project Manager and the relevant authorities and shall be restricted to such hours and conditions as may be prescribed. Blasting within 10 metres of existing water mains will not be permitted.

Blasting shall be carried out so as not to weaken existing structures or the foundations or ground adjacent to the existing and proposed works. The Contractor shall take all necessary precautions to prevent loss, injury or accident to persons or property and shall be entirely liable for any accident or damage that may result from the use of explosives.

The Contractor shall submit to the Project Manager for his approval a method statement including details of the intended drilling patterns, depths of holes, the amounts of explosives at each location and the method or sequence of setting off that he proposes to use.

214 Excavated Materials Suitable for Re-use

In so far as they are suitable and comply with the Specification, materials arising from excavations shall be re-used in the Works.

During excavation, the Contractor shall ensure that all material suitable for re-use are kept separate and set aside and protected as necessary to prevent loss or deterioration.

The materials forming the surface and foundations of roads, road verges, tracks and footways shall when excavated, and if required for further use, be carefully separated. All hard materials shall be kept free from soil or other excavated materials.

During excavation of pipe trenches the Contractor shall ensure that all granular or other approved material suitable for filling around and over pipes shall be kept separate and re-used for this purpose.

Paving slabs, bricks and similar surfaces shall be carefully removed and stacked. Prior to the commencement of excavation the number of badly broken and unsuitable paving slabs, bricks etc. on the line of the excavations shall be agreed with the Project Manager.

In verges and other grass surfaces the grass and top soil shall be stripped and separately stacked.

215 Backfilling of Excavations

Backfilling shall be thoroughly compacted in layers not exceeding 150mm compacted thickness and by means which will not damage the Works.

Backfilling of reinforced concrete structures shall be with suitable material approved by the Project Manager.

“Granular material” as backfill is defined as unconsolidated quarry dust, gravel, sand or similar in which the clay or silt content is not predominant. The use of angular crushed stone shall not be permitted.

216 Pipe Beddings

Unless otherwise specified granular material for beddings shall consist of aggregate to BS EN 12620 and shall conform to the following grading.

Pipe Nominal Diameter (mm)	Max Size (mm)	Grading (mm)
<50	sand	N/A
50	10	10 single-size
80	10	10 single-size
100	10	10 single-size
150	15	10 or 14 single-size or 14 to 5 graded
200 to 500	20	10, 14 or 20 single-sized or 14 to 5 graded or 20 to 5 graded
>500	40	10, 14 20 or single-size crushed rock or 14 to 5 graded or 20 to 5 graded or 40 to 5 graded

Granular bedding material where specified shall have a Compaction Fraction not greater than 0.3 as ascertained by the test method described below.

Aggregates for flexible pipes shall consist of sub-rounded or rounded material which will not cause damage to or penetrate the pipe material.

Sand bedding material shall consist of approved local sand which material shall have a Compaction Fraction ascertained by the test method described below of not greater than 0.3.

Class A bedding shall consist of Grade C15P concrete bed and surround.

Class A1 bedding shall comprise a 120 degrees cradle of Grade C15P insitu un-reinforced concrete under the pipe with selected backfill material to a depth of 300mm above the crown of the pipe.

Class B bedding shall comprise a 180 degrees bed of single-size granular material in

accordance with the above table, with selected backfill material to a depth of 300mm above the crown of the pipe.

Class S bedding shall comprise a complete surround of granular material in accordance with the above table to a depth of 150mm above the crown of the pipe.

Class D bedding shall comprise a hand-trimmed natural bottom to the trench with selected backfill material placed around and over the pipe to a depth of 300mm above the crown of the pipe.

Granular bedding and selected backfill material, placed around and to a thickness of 300mm above the crown of the pipes shall be placed simultaneously on both sides of the pipe in layers not exceeding 150mm thickness and compacted by the use of hand rammers taking particular care to compact the material under barrel of the pipe and around joints.

In trenches where there is a continuous accumulation of groundwater, the trench shall after obtaining the approval of the Project Manager, be over-excavated by 150mm and shall be backfilled using compacted granular material in accordance with the above table.

If the quantity of suitable material which can be obtained from the excavations is insufficient, the Contractor shall either screen the excavated material or transport suitable material from other excavated or borrow pits on the Site. In cases where insufficient material exists on the Site, the Contractor shall import suitable material after obtaining the written approval of the Project Manager.

217 Compaction Fraction Test

217.1 Apparatus required:

- 1) Open-ended cylinder 250 mm long and 150mm \pm 5mm internal diameter (150mm diameter pipe is suitable);
- 2) Metal hammer with striking face 38 mm diameter and weighing 1 kg.
- 3) Rule.

217.2 Method

Obtain a representative sample, more than sufficient to fill the cylinder (viz. about 10kg). It is important that the moisture content of the sample should not differ from that of the main body of material at the time of its use in the trench.

Place the cylinder on a firm flat surface and gently pour the sample material into it, loosely and without tamping. Strike off the top surface level with the top of the cylinder and remove all surplus material. Lift the cylinder up clear of its contents and place on a fresh area of flat surface. Place about one quarter of the material back in the cylinder and tamp vigorously until no further compaction can be obtained. Repeat with the second quarter, tamping as before, and so on for the third and fourth quarters, tamping the final surface as level as possible.

Measure down from the top of the cylinder to the surface of the compacted material. This distance in millimetres divided by the height of the cylinder (250mm) is the Compaction Fraction of the material under test.

To obtain a representative sample about 50kg of the proposed material should be heaped on a clear surface and divided with the spade down the middle into two halves. One of these should then be similarly divided, and so on until the required weight sample is left.

218 Selected Backfill Material

Backfill in contact with the pipes shall be selected material and shall not contain large stones, rocks, tree roots or similar objects which through impact or by concentrating imposed loads might damage the pipes. The material shall be capable of being compacted without the use of heavy rammers and should be free of clay lumps or other material larger than 75mm or stones

larger than the maximum particle size specified for pipe bedding.

219 Backfilling of Pipe Trenches

The trench above pipe bedding level (300mm above the crown of the pipe) shall be filled with the approved back fill material obtained from the trench excavations, free from clay lumps, boulders and rock fragments larger than 150mm.

If the quantity of material which can be obtained from the pipe trench excavation is insufficient, the Contractor shall either screen the excavated material or transport suitable material from other excavations or borrow pits on the Site. In cases where insufficient material exists on the Site, the Contractor shall import suitable material after obtaining the written approval of the Project Manager.

The material shall be placed in layers not exceeding 150mm thickness and compacted by the use of rammers to achieve a density of not less than 95% maximum density at optimum moisture content +5% to -2% as determined by the BS Heavy Compaction Test to BS 1377.

For trenches in fields and open areas where agreed by the Project Manager the trench backfill shall be compacted to obtain a density of not less than 85% maximum dry density at optimum moisture content +5% to -2% as determined by the BS Heavy Compaction Test to BS 1377.

The density of the compacted fill shall be determined by the Contractor using the "sand replacement" method as directed by the Project Manager.

Before backfilling trenches the Contractor shall obtain approval from the Project Manager of the methods he proposes to use and shall demonstrate by means of tests that the specified compaction can be achieved. The method of compaction shall at all times be to the approval of the Project Manager.

Where ground water conditions are such that the bedding material would be likely to act as a carrier for ground water from higher or lower ground, the Project Manager may instruct flow barriers of suitable selected earth or concrete to be inserted in lieu of bedding material. Such barriers to be erected at reasonable intervals close to flexible joints in the pipe.

220 Making Good Subsidence after Backfilling

Backfilling, whether in foundations or in pipe trenches, shall be thoroughly compacted by ramming and any subsidence due to consolidation shall be made up with extra compacted material.

Should subsidence occur after any surface reinstatement has been completed the surface reinstatement shall first be removed, the hollows made up, and then the surface reinstatement re-laid.

Any subsidence that occurs adjacent to the Site of the Works which is attributable to the Contractor's activities shall be reinstated to the full satisfaction of the Project Manager.

221 Removal of Timbering from Excavations

Timbering shall be removed from the excavations before or during the process of backfilling except in so far as this removal of timber would be likely to cause damage to adjacent property, structures or structure foundations in which event the Contractor shall leave in the excavation such timbering as he considers necessary or as may be ordered by the Project Manager.

222 Reinstatement of Surfaces

All surfaces whether public or private that are affected by the Works shall be reinstated temporarily in the first instance and when the ground has consolidated fully the Contractor shall reinstate the surfaces permanently.

Temporary reinstatement and permanent reinstatement of all surfaces, affected by the operations of the Contractor shall be carried out and maintained to the satisfaction of the Project Manager and the responsible authority or owner.

Temporary reinstatement shall be carried out immediately the trenches are backfilled. Permanent reinstatement shall not be carried out until the ground has consolidated completely. The Contractor shall inform the Project Manager before carrying out this work. In the event of further settlement occurring after completion of the permanent reinstatement the Contractor shall forthwith make good the reinstatement to the approval of the Project Manager or responsible authority.

For the purpose of temporary and permanent reinstatement in bitumen and surfaced roads the surface

width of trenches shall be increased by 150mm on each side of the trench for a depth of 75mm to provide a solid abutment for the surfacing material.

Reinstatement of surfaced roads shall be carried out to the approval of the relevant authority. The responsible authority shall have the right to carry out permanent reinstatement at the Contractor's expense.

Trenches in open ground shall be reinstated to the condition in which the ground was before excavation was commenced. The final surface of the trench shall be flush with the surrounding ground.

In verges and other grass surfaces and after the backfilling had been thoroughly consolidated the topsoil shall be re-laid rolled and planted with grass or other vegetation as directed by the Project Manager as may be necessary and watered until the grass has become well established. Should the planting fail it shall be replanted as required until satisfactory growth is obtained. If at any time any reinstatement deteriorates the Contractor shall restore it to a proper condition immediately.

Should the Contractor not remedy the defect to the Project Manager's satisfaction forthwith any remedial work considered necessary may be undertaken by the Employer and/or the responsible authority at the Contractor's expense.

All trees, shrubs and plants shall be carefully transplanted and shall be returned to their original location after the refilling of the excavations. Return of old or mature trees may be waived in cases where the age of the tree makes return impracticable, and approved tree seedlings shall be planted in their place. Topsoil shall be carefully set aside and replaced at the surface of the backfilling.

The trenches shall be refilled and rammed solid as specified in the Contract and shall not be topped up above the original surface level to allow settlement.

If any trench becomes dangerous the Project Manager may call upon the Contractor for its reinstatement at three hours' notice and failing this to have the work done by others at the Contractor's expense.

In the case of footpaths the trench shall be refilled and rammed as specified to within 125mm of the surface. A foundation layer of 100mm compacted thickness of approved crushed limestone shall then be laid and compacted. The surface shall be cleaned and primed and the footpath surfacing shall be temporarily reinstated with 25mm compacted thickness of 14 mm nominal size dense wearing course macadam laid and compacted so as to achieve a dense, smooth and even course surface using a roller of 750 to 3000kg mass. Any kerbs shall be reinstated to their original condition.

The trench surface shall be thus maintained until the end of the Period of Maintenance or permanent reinstatement is ordered by the Project Manager. Where permanent reinstatement is ordered by the Project Manager the temporary surface and part of the foundation shall be removed to 50mm depth to permit the construction of a tiled or paved surface to match the original surface. An approved tiled or paved surface shall then be laid and bedded on sand or mortar to an even finish.

223 Safety of Excavations in Roads

Where the surface of the road (other than that which lies immediately above the trench) is damaged either by the concentration of traffic caused by an open trench, by subsidence or other causes arising from the operations of the Contractor, he shall permanently reinstate the whole of the surface so damaged to its original condition.

The Contractor shall ensure that trenches and reinstatement are maintained in a safe condition and shall take immediate action to remedy any deterioration which renders the works unsafe. If in the opinion of the Project Manager any excavation or reinstatement is in a dangerous condition the Contractor shall immediately remedy the defect. Should the Contractor fail to carry out the reinstatement promptly the work any be carried out by others at the Contractor's expense.

224 Temporary Reinstatement of Asphalted Roads

In all asphalted or bitumen sprayed roads the trenches shall be refilled and compacted to the underside of the original road surface. A sub-base layer shall then be laid consisting of approved free drainage granular material conforming to the following grading limits:

100% by weight passing 50mm sieve 75-
 95 by weight passing 25.4mm sieve 40-75
 by weight passing 9.51mm sieve 30-60 by
 weight passing 4.75mm sieve 20-45 by
 weight passing 2.0mm sieve 15-30 by
 weight passing 425mm sieve 5-15 by
 weight passing 72mm sieve.

A base layer shall then be laid consisting of approved crushed limestone material conforming to the following grading limits.

100%	by weight	passing 50mm sieve
60% - 80%	by weight	passing 20mm sieve
25% - 40%	by weight	passing 5mm sieve

The materials shall have a plasticity index of not exceeding 6%. The materials forming the sub- base and foundation shall be laid in layers, brought to optimum moisture content and compacted to 95% of the maximum dry density as determined by Part 4 Clauses 3.3/3.4 BS 1377:1990.

Prior to application of the temporary reinstatement the surface of the road foundation shall be cleared of all dust, debris and other deleterious matter and shall then be primed with one application of prime coat MC-70 or similar approved. All joints with adjacent road surfacing shall be cut straight and vertical and primed.

The road surfacing shall be temporarily reinstated with 25mm finished thickness of asphaltic concrete. The asphaltic concrete shall be laid and compacted so as to achieve a dense smooth and even surface using a roller of not less than 12 tonne mass.

The surface shall be maintained until the end of the period of Maintenance or until instructions are given for the permanent reinstatement to be carried out. The surface shall not be topped up above the original surface level to allow for settlement.

225 Temporary Reinstatement of Unmade Roads

In all unmade roads the trenches shall be refilled and compacted as specified in the Contract to within 150mm of the surface.

The trench shall be surfaced with 150mm compacted thickness of base layer material as

specified above.

The surface shall be maintained until the end of the Period of Maintenance and shall not be topped up above the level of the original surface to allow for settlement.

226 Permanent Reinstatement of Asphaltic Roads

Where instructions are given that permanent reinstatement is to be carried out then the temporary asphaltic concrete surface and part of the foundation layer shall be removed to a minimum depth of 200mm and the surface of the foundation shall be rolled, all dust and debris removed, joints cut straight and vertical.

The permanent reinstatement shall comprise crushed limestone material to a total compacted thickness of 150mm and the wearing course 50mm compacted thickness of 14 mm nominal size dense wearing course asphaltic concrete. The laying and finishing of the coated macadam shall be carried out so as to achieve a dense, smooth and even surface using a roller of not less than 12 tonnes mass.

227 Forming Banks and Filled Areas

The filling to be used in the embankments and filled areas shall be material selected from that arising from surplus excavation (unless otherwise defined in the Particular Specification), the material being placed according to its nature as shall be directed by the Project Manager. The fill shall be placed in layers not exceeding 150mm thick, each layer being thoroughly compacted by an approved roller to the satisfaction of the Project Manager.

228 Restoration of Borrow Areas, Spoil Tips and Quarries

Any spoil tips, quarries or other borrow area developed by the Contractor for the purpose of the Works shall be finished to safe and fair slopes to the approval of the Project Manager.

229 Top soiling and Grassing

Where required surfaces shall be soiled with fine sifted soil or silt not less than 100 mm compacted thickness which shall be raked and brought to a fine tilth.

Surfaces required to be grassed shall be planted with approved local grass at a spacing of 200mm x 200mm. The grassed area shall be replanted if the first or subsequent operation is unfruitful or if for any reason the grass is destroyed. Grassed areas shall be watered and attended until the grass has become well established.

The soiling and planting of the grass in slopes shall be carried out immediately the slope is formed and the grass shall be kept weeded and cut until the work is accepted at the time of the Certificate of Completion.

The Contractor shall supply attendance during the Defects Liability Period to ensure that all planted grass is kept weeded and cut, and if necessary watered.

230 Free Draining Fill

Free draining fill for use as backing to wall shall consist of sound hard stone or broken rock or concrete derived from demolition of structures. The particles shall be roughly cubiform and shall be between 75mm and 25mm in size. All smaller particles, Dust, rubbish and organic matter shall be excluded.

231 Hardcore

Hardcore shall consist of sound hard stone or broken rock or concrete derived from excavations or demolition of structures and shall be graded from 150mm to 50mm in size, except that sufficient but not excessive blinding materials of smaller sizes may be permitted at the discretion of the Project Manager.

Section 3. Concrete Works – General

301. Scope

The standard of materials and of workmanship shall not be inferior to the recommendations of the current:

- (a) British Standard Code of Practice BS 8110)
The Structural Use of Concrete

)
Or

)
British Standard Code of Practice BS 8007 Design of
concrete structures for Retaining
Aqueous Liquids
)
)
(c) Appropriate British Standards
(d) Approved Kenyan Standards
Or
(e) Other equivalent and approved international standards
- Whichever is applicable
to the particular structures

The requirements outlined in the above documents must be read with those of this Section of the Specification and where any conflict exists between the recommendations of the above and of this Specification, the requirements of the Specification shall prevail. As and when required by the Project Manager the Contractor shall prepare and submit, before commencing the work, a time chart (additional to the general programme) detailing the various operations for concrete work.

No material shall be used in the Works until prior approval for its use has been given by the Project Manager; neither shall any change in the nature, quality, kind, type, source of supply or manufacture be made without the Project Manager's permission.

Names of manufacturers and test certificates for materials not supplied by the Employer shall be supplied as soon as possible to the Project Manager.

The cost of providing samples and the cost of carrying out tests required by Clause 306 (except as otherwise provided in the Conditions of Contract) together with the cost of supplying equipment for sampling and site testing indicated in columns 3 and 4 of Table 3.8 of this Section of the Specification shall be borne by the Contractor.

During the progress of the Works, consignment notes for materials not supplied by the Employer shall be supplied to the Project Manager giving details of each consignment.

The Contractor shall provide all samples required by the Project Manager as soon as possible after contract award. No deliveries in bulk shall be made until the samples are approved by the Project Manager. All condemned material shall be removed from the site within 24 hours.

A competent person approved by the Project Manager shall be employed by the Contractor whose duty will be to supervise all stages in the preparation and placing of the concrete. All cubes shall be made and site tests carried out under his direct supervision, in consultation with the Project Manager.

All materials which have been damaged, contaminated or have deteriorated or do not comply in any way with the requirements of these Preambles shall be rejected and shall be removed immediately from the site at the Contractor's expense. No materials shall be stored or stacked on suspended floors without the Project Manager's prior approval.

The use of the word "approved" in this Specification refers to the approval of the Project Manager or his delegates.

Cross-references between certain clauses of this Specification have been shown in brackets following the particular item.

302 Concrete

302.1 Requirements

The mix proportions shall be selected to ensure that the workability of the fresh concrete is suitable for the conditions of handling and placing, having regard to the structural element being constructed, the disposition of reinforcement, and taking full account of the environment to which it will be subjected.

The minimum cement contents and maximum water/cement ratios of designed mixes shall be as given in Table 3.1.

The maximum cement content in any mix shall not exceed 425 kg/m³ for normal structures and 500 kg/m³ for liquid retaining structures.

In all cases of mix proportioning, the added water shall be included with due allowance for the moisture contained in the aggregates and shall be the minimum consistent with the workability requirements.

Table 3.1 Minimum Cement Contents

Normal Conditions

Type of Structural Element	Exposure Conditions (BS 8110)	Minimum Cement Content (kg/m ³)	Maximum Aggregate Size	Maximum Water/Cement Ratio

Additional Requirements when Exposed to Sulphate Conditions (All Structural Concrete)

Concentration of Sulphates (expressed as SO ₃)		Minimum Cement Content (kg/m ³) Maximum Aggregate Size				Maximum Water/Cement Ratio
In soil (Total SO ₃)	In ground water Parts per 100,000	Type of Cement	40 mm	20 mm	10 mm	
≤ 0.2	≤ 30	No Special Precautions				-
0.2 - 0.5	30 - 120	OPC or CEM1,II or IV per KS1725	300	330	370	0.50
		SRPC	250	280	320	0.55
0.5 - 1.0	120 - 250	OPC or CEMI, II or IV per KS1725	Not permitted			-
		SRPC	300	330	370	0.50

1.0 - 2.0	250 - 500	OPC or CEMI, II or IV per KS1725	Not permitted			-
		SRPC	340	370	410	0.45
□□2.0	□□500	SRPC	Ditto but with protective coating			0.45

OPC - Ordinary Portland Cement
SRPC - Sulphate Resisting Portland Cement

302.2 Strength

The characteristic strength of concrete means that value of the 28-day cube strength below which 5% of all possible test results would be expected to fall.

The relationship between grade of the concrete and its characteristic strength shall be as given in BS 5328. The grade of concrete to be used in particular locations shall be as given in Table 3.2 unless noted otherwise on the drawings.

Table 3.2 Concrete Strength Requirements

Location	Maximum Coarse Aggregate Size (mm)	Grade of Concrete (BS 5328)
Blinding Concrete - General Structures - Liquid Retaining Structures	20 or 40 20	C15P
Blinding Concrete - Sulphate Condition	20	C20P
Substructure thickness less than 400 mm	20	C25D
Substructures, walls and slabs more than 400 mm	20 or 40	C25D
Superstructures, Normal Concrete	20	C25D
Liquid Retaining Structures	20	C30D
Fine Concrete	10	C25D
Precast Concrete	10 or 20	C30D

In the above table suffix P means a prescribed mix, D means a designed mix and A means a design mix complying with the requirements of BS 8007.

302.3 Mixes

(a) Designed Mixes

Proportions shall be determined in accordance with the "Design of Normal Concrete Mixes" published by the United Kingdom Department of The Environment and obtainable from:-

Building Research Establishment and Bookshop Garston
Watford
WD2 7JR
ENGLAND

Tel: +44 1923 894040

Fax: +44 1923 664010

Or other approved methods, for the requirements set out in this Specification.

For the purpose of determining the design mean strength of the concrete a margin shall be added to the characteristic strength for the particular grade of concrete. This design margin shall be assessed on the degree of control reasonably to be expected in the manufacture of the concrete and shall neither be less than 5.0 N/mm² nor less than 1.64 times the standard deviation. Until such time as the standard deviation has been assessed the margin shall be not less than 7.5 N/mm².

Details of the designed mixes shall be forwarded immediately to the Project Manager for his approval.

(b) Prescribed Mixes

Proportions for the several grades of concrete shall conform to the requirements of Tables 3.3 and 3.4.

(d) Chloride Content

The total chloride content of the concrete mix shall comply with the requirements of BS 8500: Part 2: Section 5

302.4 Quality Control

The principal basis of control shall be by comparison of the results of the compression cube tests at 28 days, except for small quantities of concrete whose strength can be otherwise derived and which is permitted for use by the Project Manager. 40 sample cubes shall be made initially in eight samples each day for five days of concreting and thereafter one sample per 25 m³ of concrete but not less than one sample for each day's concreting.

Where materials are of an unfamiliar grading or type, compression cube tests shall be carried out at 7 days and adjustments made in advance of the main control methods outlined above.

Cube test results will be examined individually in 10 consecutive sets of four and the standard deviation and mean strength of each set calculated. The concrete mix proportions will only be acceptable if all of the following requirements are complied with: -

- (i) Not more than two results in 40 are less than the characteristic crushing strength.
- (ii) No value of the average for any set of four results is less than the characteristic strength plus one-half of the design margin (Clause 302).
- (iii) When 40 results have been obtained and the mean strength and standard deviation are calculated, the mean strength minus 1.64 times the standard deviation shall be greater than the characteristic strength.

Where the results do not conform to the above requirements the following action shall be taken:-

- Adjustments to the mix shall be made to obtain the strength required.
- In the case where any result is less than 80% of the characteristic strength the structural implications shall be considered and action taken as ordered by the Project Manager (as provided for in Clause 305).

For those Prescribed Mixes required to be tested, requirements (i) and (ii) only will be applicable.

302.5 Production

Aggregates and cement shall be proportioned by weigh-batching, and water shall be proportioned by volume. Subject to the prior approval of the Project Manager volume-batching of aggregates may be used for small sections of works, but volume batching of cement will in no case be accepted. The Contractor may, however, so proportion the mix that each batch shall use a whole bag or bags of cement, the weight of which is known precisely. Where permission has been given for volume batching of aggregates, all gauge boxes shall be accurate and due allowance shall be made for the bulking of the aggregates in assessing the correct volume to be used.

The aggregates and the cement shall be thoroughly mixed in a clean mechanical mixer for a period of time agreed with the Project Manager and the water added on the basis of the

approved design.

The amount of water added shall conform to the requirements of Clause 302.

Batching mixing machines shall comply with the requirements of BS 1305. They shall be provided in such numbers and of such capacity as to ensure a continuous supply of freshly mixed concrete at all times during construction.

Target strength for trial mix = 1.3 x Characteristic Strength

Target strength for works = 1.2 x Characteristic Strength

Continuous mixing machines shall be used only with the written permission of the Project Manager.

Not less than 30 days prior to the installation of the Contractor's plant and equipment for processing, handling, transportation, storing and proportioning ingredients, and for mixing, transporting and placing concrete, the Contractor shall submit drawings for approval by the Project Manager, showing proposed general plant arrangements, together with a general description of the equipment proposed for use.

After completion of installation, the operation of the plant and equipment shall be subject to the approval of the Project Manager.

Where these Preambles, the Bills of Quantities or the Drawings require specific procedures to be followed, such requirements are not to be construed as prohibiting use by the Contractor of alternative procedures if it is approved by the Project Manager, prior to use of such alternatives.

Approval of plant and equipment or their operation, or of any construction procedure, shall not operate to waive or modify any provision or requirements contained in the Preambles governing the quality of the materials of the finished work.

Table 3.3 Prescribed Mixes - Mass of Dry Aggregate to be Used With 100 kg of Cement

Grade of concrete	Nominal maximum size of aggregate (mm)	40		20		14		10	
	Workability	Medium	High	Medium	High	Medium	High	Medium	High
	Range for standard sample (mm)	50-100	80-170	25-75	65-135	5-55	50-100	0-45	15-65
C7.5P C10P C15P C20P C25P C30P	Total aggregate	kg	kg	kg	kg	kg	kg	kg	kg
		1080	920	900	780	N/A	N/A	N/A	N/A
		900	800	770	690	N/A	N/A	N/A	N/A
		790	690	680	580	N/A	N/A	N/A	N/A
		660	600	600	530	560	470	510	420
		560	510	510	460	490	410	450	370
		510	460	460	400	410	360	380	320

N/A not applicable

Table 3.4 Prescribed Mixes - Percentage by Mass of Fine Aggregate to Total Aggregate

Grade of concrete	Nominal maximum size of aggregate (mm)	40		20		14		10	
	Workability	Medium	High	Medium	High	Medium	High	Medium	High
C7.5P } C10P } C15P }		30-45		35-50		N/A		N/A	
C20P } C25P } C30P }	Grading Zone 1	35	40	40	45	45	50	50	55
	2	30	35	35	40	40	45	45	50
	3	30	30	30	35	35	40	40	45
	4	25	25	25	30	30	35	35	40

N/A implies 'Not Applicable'

Notes on the use of Tables 3.3 and 3.4

NOTE 1. The proportions given in the tables will normally provide concrete of the strength in N/mm² indicated by the grade except where poor control is allied with the use of poor materials.

NOTE 2. For grades C7.5P, C10P and C15P a range of fine-aggregate percentages is given; the lower percentage is applicable to finer materials such as zone 4 sand and the higher percentage to coarser materials such as zone 1 sand.

NOTE 3. For all grades, small adjustments in the percentage of fine aggregate may be required depending on the properties of the particular aggregates being used.

NOTE 4. For grades C20P, C25P and C30P, and where high workability is required, it is advisable to check that the percentage of fine aggregate stated will produce satisfactory concrete if the grading of the fine aggregate approaches the coarser limits of zone 1 or the finer limits of zone 4.

302.6 Cement

Cement shall, as a minimum, meet the requirements of CEMI-32.5, CEMII-32.5 or CEMIV-32.5 in accordance with Kenya Standard KS 1725 Part 1 (Composition, Specifications and conformity criteria for common cements) and Part 2 (conformity Evaluation). Concrete for power floated floors shall as a minimum meet the requirements of CEMI-42.5, CEMII-42.5 or CEMIV-42.5.

Approval to the use of cement manufactured to the above standards or any other approved standards shall be subject to the Contractor demonstrating that the resulting concrete shall meet the strength requirements as given in the drawings and the relevant sections of the Concrete Specifications.

Pulverised-fuel ash shall have a maximum colour index of 6 (Colour comparator disc reference No. 296570) when measured using the Lovibond Colour Comparator system as recommended in BS 3892: Part 1 Appendix H, Clause H8.

Cement shall be fresh when delivered to Site and the consignments shall be used in the order of their delivery. The Contractor shall mark the date of delivery on each consignment and each consignment shall be stored separately and in such manner as to be easily accessible and identifiable.

No cement in bags or other containers shall be used unless these and the manufacturer's seals are

intact at the time of mixing.

If the cement is delivered in bags it shall be stored in a waterproof shed or building at a temperature of not less than 8°C and the bags shall be placed on dry boards above the floor to prevent deterioration or contamination from any cause.

Bulk cement may be used provided it is stored in an approved container.

The Contractor shall not use cement which has hardened into lumps, but subject to removal of the lumps by screening, the Project Manager may allow such cement to be used in non-structural concrete mixes.

Cement of different types shall be kept separate in storage and shall not be mixed together in the production of concrete.

302.7 Aggregates

The Contractor shall investigate the proposed aggregate sources in detail and shall submit a comprehensive report with technical information and data which shall include the following:

- (a) Location. Only Sources equipped with facilities adequate for the production of the materials as specified and in such quantities as shall be required for the prompt execution of the Contract shall be approved.
- (b) Petrology of sources and possible or likely variability during the Contract period.
- (c) Method of production
- (d) Schedule of available and proposed processed aggregates by size, including details of actual screen sizes to produce each aggregate.
- (e) Test data as applicable for each aggregate type and size based upon representative samples and tested in accordance with the appropriate British Standards.
- (f) A detailed statement of the aggregate proposed for use in each grade of concrete.

Samples of all aggregate, including fine aggregates and sand shall be submitted to the Project Manager for his approval. All samples shall be taken in accordance with BS 812 and shall weigh not less than the minimum weight indicated on Table 1 of that Standard.

The Contractor shall produce with each consignment or at intervals directed by the Project Manager a certificate signed by the Supplier, or other approved analyst, giving fully detailed chemical and physical properties of all aggregates together with a sieve analysis carried out in accordance with the appropriate British Standard.

Any changes in the particulars of the aggregates which occur during the course of the Contract must be notified to the Project Manager without delay.

The aggregates shall be stored on Site in separate stockpiles so arranged as to prevent the intermingling of the various aggregate sizes. The stockpiles shall be suitably protected to prevent contamination of the aggregates from the ground, rubbish or by leaves, dust or other windblown materials.

Aggregates shall conform to the requirements of "Acceptable Standards" of Table 3.8.

Building sand for mortar and similar uses and aggregates for concrete shall comply to BS 882 and shall be perfectly clean and free from all foreign matter and shall not consist of, nor contain argillaceous limestone or shells.

Where the nominal size specified exceeds 37.5 mm the grading shall be subject to the Project Manager's approval or in accordance with his directions.

Unless otherwise agreed with the Project Manager, single-sized aggregates shall be used in batching and mixing concrete.

The following impurities in both fine and coarse aggregates shall not exceed the limits stated in the following clauses.

The total chloride content of the concrete mix arising from the aggregate together with that from any admixtures and any other source, expressed as a percentage of chloride ion shall not in any circumstances exceed 0.1%.

Note: Marine aggregates and some inland aggregates contain chlorides. Both should be selected carefully and marine aggregates necessitate efficient washing to achieve the 0.1% chloride ion limit. Wherever possible, the total chloride content should be calculated from the mix proportions and the measured chloride content of each of the constituents.

Concrete made with some aggregates exhibit Alkali-Silica Reaction (ASR). This phenomenon is particularly detrimental in structures subject to wetting and their use will not be allowed in such structures.

Prior to acceptance of an aggregate as inert to alkali reaction the report of a qualified geologist, appointed by the Project Manager on the suitability or otherwise of materials shall be obtained following examination of all types of material that the proposed sources will yield during the course of the contract. The Project Manager may require that samples be taken from boreholes and if the contract extends over a long period then more than one report shall be obtained.

The Project Manager may order further tests to be carried out on the aggregates proposed by the Contractor for the structures in connection with this Contract before permission is given to use the aggregates proposed by the Contractor.

Where allowed by the Project Manager to use reactive or potentially reactive aggregates in certain structures the Contractor shall take all suitable measures to prevent deterioration of concrete due to alkali-silica reaction. Such measures shall include the use of cement with an acid soluble equivalent of sodium oxide content ($\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$) of less than 0.6%. The reactive alkali content of the concrete mix shall in no circumstances exceed 3 kg/m³.

The Alkali-Silica Reaction (ASR) in hardened concrete is also affected by the water-cement ratio. Therefore, where ASR aggregates are used, with the permission of the Project Manager, the water-cement ratio shall be kept to a minimum (in the region of 0.4).

Aggregates required for use in the construction of concrete water retaining, water excluding and other similar structures shall have a low drying shrinkage and the water absorption shall not exceed 3%.

The absorption of the aggregates shall be measured in accordance with BS 812, Part 2.

Aggregates of rounded shape or otherwise capable of producing a concrete of good workability with the minimum addition of water shall be preferred.

Dust or flour resulting from crushing the aggregate shall not be allowed to contaminate the stockpiles. When, in the opinion of the Project Manager such contamination has taken place it shall be removed by an approved means or otherwise the aggregate shall be rejected.

For mass concrete, in order to improve the consistency of the mix, dust or flour resulting from crushing the aggregate, which may be subjected to test, be included in controlled quantities to supplement the fine aggregate.

Except where aggregates have been otherwise specified on the Drawings the grading of aggregates shall be as follows:

- (i) Coarse Aggregate:
 - (a) 10 mm max. size, graded, for all "fine" concrete.
 - (b) 20 mm max. size, graded, for all reinforced concrete in beams and for walls and slabs not greater than 400 mm thick.
 - (c) 40 mm max. size, graded, for all reinforced concrete walls and slabs in excess of 400 mm thick.
- (ii) Fine Aggregate:
 - (a) Where aggregates conforming to Zones 2 or 3 of BS 882 are available they shall be used.
 - (b) For Prescribed Mixes, Zones 1, 2, or 3 aggregates only shall be used.

Fine and coarse aggregates shall be as defined by and be of the quality and nature required by BS 882. In addition they shall be chemically inert to alkali reaction.

302.8 Water

The Contractor shall supply all water, make all arrangements and pay all charges in respect of such supply. Where water can be obtained from a public water supply it shall be used.

Where water cannot be obtained from a public supply it shall be tested in accordance with BS 3148 and if necessary shall be treated to assure compliance therewith.

Water for washing and curing shall be such that it will impair neither the strength of the finished concrete nor its appearance.

302.9 Admixtures

(i) General : The quantity and method of using admixture's shall be in accordance with the manufacturer's recommendations and in all cases shall be subject to the approval of the Project Manager. Unless otherwise specified or approved by the Project Manager, an admixture shall comply with one of the following :-

BS 1014 (Pigments for Portland cement and Portland cement products). BS 5075

(Concrete admixtures except chloride based admixtures).

In all cases the Contractor shall provide the following information for the Project Manager's approval :-

- (a) the quantity to be used, in kilograms per kilogram of cement and in kilograms per cubic metre of concrete;
 - (b) the detrimental effects caused by adding a greater or lesser quantity in kilograms per cubic metre of concrete;
 - (c) the chemical name (s) of the main active ingredients;
 - (d) whether by the Project Manager, the Contractor shall demonstrate the action of an admixture by means of trial mixes.
- (ii) Calcium chloride. The use of calcium chloride in any form is prohibited.

302.10 Control of Alkali-Silica Reaction

The risk of cracking and expansion due to alkali-silica reaction shall be minimised by compliance with the specification and guidance notes set out in Technical Report No. 30 of the Concrete Society, Riverside House, 4 Meadows Business Park Station Approach, Blackwater, Camberley, Surrey, GU17 9AB Fax: +44 (0) 1276 607141, Website: www.concrete.org.uk.

303 Reinforcement

303.1 Steel

Reinforcement shall be:

- (a) Plain round mild steel or High Yield steel bars conforming to BS 4449.
- (b) Cold worked steel bars conforming to BS 4449: 1988.
- (c) Fabric reinforcement made of cold drawn high tensile bars conforming to BS 4483.

The Contractor shall obtain from his suppliers certificates of the mechanical and physical properties of the reinforcement and shall submit them to the Project Manager for approval, except where reinforcement has been supplied by the Employer. The frequency of sampling and the method of quality control shall be in accordance with Table 4 and Clause 20 respectively of these British Standards. All high yield and cold worked bars (except in welded fabric reinforcement) shall be deformed bars complying with Classification Type T2 for bond strength in accordance with BS 4449. Where galvanised reinforcement is specified, galvanising shall comply with the requirements of BS 729, Part 1.

303.2 Storage

Reinforcement shall be stored on Site under cover and supported clear of the ground and in such manner as to make identification easy. Supports shall be such that distortion of the steel is avoided and contamination and corrosion prevented.

303.3 Bending and Fixing

The Contractor shall provide on Site facilities for cutting and bending reinforcement whether he is ordering his reinforcement bent or not and shall ensure that a token amount of straight bar is available on Site for bending as and when directed by the Project Manager.

Reinforcement shall be wire brushed and cleaned at the Contractor's expense, before and/or after it is placed in position, if required by the Project Manager.

The bars shall be cold bent in strict accordance with the drawings and the Contractor shall be responsible for the accuracy of the bending. Bending dimensions shall be worked to the tolerances indicated in BS 4466 and BS 8110 table 3.28. Bars in which any errors in bending are beyond the limits of the foregoing tolerances shall be replaced at the Contractor's cost by correctly bent new bars, or, may be straightened and rebent cold subject to the Project Manager's prior approval. Any discrepancy or inaccuracy found in the drawings shall be notified to the Project Manager immediately.

After bending, reinforcement shall be securely bundled and labelled with weather-proof tags or shall be marked with other approved signs by which it can readily be identified.

Before assembling or fixing the reinforcement the dimensions to which it has been bent shall be checked by the Contractor against the drawings.

The reinforcement shall be fixed in strict accordance with the drawings as regards cover, spacing and

position, and suitable precautions shall be taken by the Contractor to prevent the displacement of reinforcement during the placing and compaction of concrete.

During concreting a competent steel fixer must be in attendance to adjust and correct the positions of any reinforcement which may be displaced. The vibrators are not to come into contact with the reinforcement.

Where required to support and retain the reinforcement in its correct position the Contractor shall provide templates, stools or other supports at his own cost. He shall allow for cutting to correct length all corner lacer bars included in the bar schedules as standard lengths.

Precast concrete support blocks for reinforcement shall be manufactured from Grade C30D "fine" concrete to ensure the correct cover thickness. They shall be well cured before use and carefully stored on Site to avoid contamination. Plastic and metal supports, chairs, etc. may be used and shall be subject to the Project Manager's prior approval.

In the case of mild steel, a lap of not less than 40 diameters of the smaller bar shall be provided at the junction of two bars for which the lap is not specifically detailed on the Drawings and, in the case of High Yield steel, a lap of not less than 50 diameters.

All intersections of bars in walls and slabs and all connections between binders or links and main bars in columns or beams shall be tied with soft iron wire ties or with fixing clips which shall not be allowed to make contact with the formwork or to project materially into the specified cover.

Unless permitted by the Project Manager, welding of bar reinforcement at intersections or for the joining of bars is prohibited. Where permission is granted, welding shall be carried out in accordance with the recommendations of the Institute of Welding for the welding of reinforcing bars for reinforced concrete construction.

When fixed reinforcement is to be left exposed for more than eight weeks, it shall be thoroughly cleaned and painted with neat cement grout.

Where galvanised reinforcement is used any damage suffered by galvanising shall be made good by the application of an approved galvanising formulation, before concrete placing is commenced.

No concreting shall be commenced until the Project Manager has inspected the reinforcement in position and until his approval has been obtained and the Contractor shall give adequate notice of his intention to concrete.

303.4 Couplers

Couplers for reinforcement shall be either Standard Swaged Splices or Type II Alpha Couplers manufactured by CCL Systems, Unit 4, Park 2000 Millennium Way, Westland Road, Leeds, LS11 5AL, Telephone: +44 (0) 113270 1221, Fax: +44 (0) 113 277 8977, email: sales@cclstressing.com or similar approved. Where bars of different diameters are to be joined a CCL Reducer Sleeve or similar shall be used.

Couplers shall be suitable for the type and size of reinforcing bars and shall be capable of developing 115% of the characteristic strength of the smaller of the reinforcing bars being joined in both tension and compression. Couplers shall be installed in accordance with the manufacturer's recommendations. Square twisted reinforcing bars shall not be used with couplers.

304 Formwork

304.1 Requirements

The term "formwork" shall be taken to include centering, formwork, strutting, bracing and the like.

When called upon to do so by the Project Manager the Contractor shall submit his formwork proposals for checking and approval by the Project Manager in advance of the concreting.

Formwork shall be of such accuracy, strength and rigidity as to carry the weight and pressure from the concrete to be placed on or against it, together with all constructional, wind or other loads likely to be imparted to it, without producing deformation of the finished concrete in excess of the tolerances outlined in Clause 304 and Table 3.5.

All formwork shall be sufficiently tight, without plugging, to prevent loss of grout during the vibration of the concrete. When required by the Project Manager, joints between formwork facing boards shall be sealed with foam rubber, sealing strips or other approved material. A foam rubber or polyurethane strip shall be provided around the tops of all walls and columns before affixing the forms for the next lift.

Faces of formwork shall be clean, free from projecting nails, adhering grout and other imperfections or defects which would prevent the specified surface finish from being attained. They shall be treated with approved mould oil before positioning. Great care shall be exercised to prevent reinforcement or steelwork from being contaminated by the oil during erection of the formwork.

Formwork, which as a result of prolonged use or general deterioration does not, in the opinion of the Project Manager, conform to the particular requirements set out in this clause, shall not be used.

Through-bolts or ties will not be permitted in liquid-retaining structures. The Contractor shall use only such bolts or ties as are capable of being removed in whole or in part so that no part remaining embedded in the concrete shall be nearer the surface of the concrete than the specified thickness of cover to the reinforcement.

Beam soffits shall be erected with an upward camber of 5 mm for each 3 metres of span. Top

formwork shall be counterweighted or otherwise anchored against flotation.

Boxes for forming holes shall be constructed so as to be easily removable without damaging the concrete during removal. They shall be properly vented to permit the escape of entrapped air, and shall be capable of being sealed, subsequently to prevent the loss of grout. The use of polystyrene blocks for the forming of holes, sinkings, etc. will not be allowed except by express permission of the Project Manager.

On all external edges risers of the concrete 20 mm chamfers shall be formed.

Openings for inspection of the inside of beam, wall, column and similar formwork and for cleaning-out purposes shall be formed so that they can conveniently be closed before the placing of concrete.

All props shall be supported on adequate sole plates and shall not bear directly on or against concrete. They shall be capable of being released gently and without shock from the supported formwork. No appliance for supporting the formwork shall be built into the permanent structure without the Project Manager's prior approval. Props for upper level support shall be placed directly over those at lower levels, and the lowermost props shall bear upon work sufficiently mature to carry the load.

Formwork shall be such as to allow for its removal without damaging the concrete, and in the case of suspended floors, for the removal of the beam sides and slab soffits without disturbing the beam-bottom boards and their props.

Before concreting, the areas which are intended to receive the concrete shall be cleaned by jetting with compressed air, and all water and extraneous material removed.

Where timber is used for formwork it shall be properly cured, free from warp, straight, clean and free from loose knots.

Where metal forms are used for formwork they shall be of the type strengthened by intermediate ribs or cross bracing.

Moving formwork may be used where in the opinion of the Project Manager it is appropriate.

304.2 Sawn Formwork

Sawn formwork shall produce an ordinary standard of finish consistent with normal good practice for use where the face of the finished concrete will not be exposed. The face in contact with the concrete shall consist of sawn timber boards, sheet metal or other approved material.

304.3 Wrought Formwork

Wrought formwork for use on exposed faces and water retaining faces shall produce a high standard of finish consistent with the best practice. The face in contact with the concrete shall consist of wrought and thickened boards tongued and grooved of not less than 30 mm finished thickness, framed plywood or metal panels or other approved material. Joints between boards and/or panels shall be arranged in a uniform pattern.

304.4 Special Wrought Formwork

Special wrought formwork shall provide the highest standard of finish where the face of the finished concrete is to form a particular feature. The face in contact with the concrete shall consist of large smooth sheets, unless otherwise specified, arranged in an approved uniform pattern, with joints coinciding with possible architectural features, sills, window heads, or changes in direction or surface. Accurate alignment of all joints shall be maintained. Wrought boarding and standard steel panels shall not be used unless specially faced.

304.5 Tolerances

Unless otherwise indicated on the drawings, the tolerances of the finished concrete with respect to the dimensions shown on the drawings shall not exceed the limits set out in Table 3.5.

Table 3.5 Tolerances of Dimensions for Finished Concrete

Items	Tolerances (mm)
Overall dimensions and Levels	±5
Column sizes) Beam sizes) Wall sizes)	±5
Vertical lines out of plumb	5 mm ± 15 mm in every 15 m height

Except that in the case of Sawn Formwork the dimensions of the finished concrete shall be not less than those shown on the drawings.

304.6 Striking and Removal

The recommendations set out in Table 3.6 are given as a minimum requirement for striking formwork:-

Table 3.6 Striking of Formwork

Item	Sulphate Resisting and Ordinary Portland Cement CEM I to KS 1725 Normal Weather (16°C and above) Days	Rapid Hardening Cement Normal Weather (16°C and above) Days	Portland Pozzolana Cement or CEM IV to KS 1725
Beam Sides, Walls, Columns	1	1	1
Slabs (props left under)	4	3	5
Beam Soffits (props left under)	7	5	9
Removal of props to slabs	8	5	10
Removal of props to beams	16	8	18.5
Shafts and Tunnels	1	1	1.5

The removal of props to slabs and beams shall, if directed by the Project Manager, be subject to satisfactory results of the relevant 7 day cube crushing tests.

The above striking times are for normal conditions and before deciding on the actual time for each case, the Contractor shall consider and extend the period as tabled if:-

- (a) the span of the structural member under consideration exceeds 6 metres for beams and 3 metres for slabs. An additional period of one day for each 500 mm of additional span shall then be allowed;
- (b) the dead load of the structural member under consideration forms a large proportion of the total design load;
- (c) constructional loads coming on to the structural member under consideration are being placed soon after the concreting operations and these loads form a large proportion of the total design load;
- (d) the setting of the concrete has been retarded for any reasons;
- (e) the temperature falls below 8°C. An additional period of half a day shall be added for each day on which the temperature falls below 8°C. For temperatures falling below 3°C the additional period to be added shall be one day for each day on which the temperature falls below 3°C;
- (f) any combination of the above points and other considerations which would call for such a precaution to be taken.
- (g) the span concerned is part of a continuous spanning system and the adjacent two spans have not been cured sufficiently.

Information regarding paragraph (b) above will be supplied by the Project Manager; any other design information relevant to the above shall be obtained by the Contractor from the Project Manager.

305 Concreting

305.1 Requirements

The finished concrete shall be dense, durable, impervious to the ingress of water, free from cracks and honeycombing, and resistant to wear and mild chemical attack. Special concretes will be the subject of their own particular sections of Special Concrete.

305.2 Transporting

Concrete shall be transported to the place of final deposit by approved means.

Barrows, spades and other equipment used in the process of transporting concrete shall be thoroughly cleaned before each day's work or after a long interruption and they shall be free from hardened concrete.

Concrete shall be transported as soon as possible after mixing, by methods which will prevent the segregation, loss or contamination of the ingredients.

Proper bridging arrangements for traffic over reinforcement shall be provided so that the reinforcement is not distorted, damaged or displaced.

Where approval is obtained for concrete to be conveyed by chutes, these shall have a slope (not exceeding 1 vertical to 2 horizontal) such as to ensure a continuous flow of concrete. Additional water shall not be introduced to assist the flow. If deposition is to be intermittent the chute shall be arranged to discharge into a storage hopper. In no case will a clear fall of more than 1 m be permitted at the discharge end of the chute.

Where approval is obtained for pumping the concrete, the pump manufacturer's recommendations shall be followed. The pumps used shall be of adequate capacity and power to ensure delivery of a continuous supply. The Contractor shall provide adequate alternative arrangements for transporting the concrete in case of a breakdown of the pumping equipment.

Wherever transport of concrete is interrupted for any length of time (periods of over half an hour shall be treated as such) the chutes, pumps, pipes and any other means of distribution shall be thoroughly flushed out and cleaned. These shall also be flushed out immediately prior to resumption of concreting and shall be kept free from hardened concrete. All washwater used shall be discharged outside the formwork and clear of any freshly placed concrete.

305.3 Placing and Compaction

No concrete shall be placed until the Contractor has obtained approval to do so from the Project Manager. When the Contractor intends to place concrete he shall inform the Project Manager in sufficient time to enable him to inspect the reinforcement, formwork and surface on which the concrete is to be placed and the Contractor shall provide all facilities for such inspection.

This approval shall be sought by presenting two copies of the completed "Structural Concrete Approval Form" (SCAF) to the Project Manager's Representative at least 24 hours before intending to concrete. (See sample page 23).

Concrete shall be placed within 30 minutes of mixing, to uniform level, in layers not exceeding 500 mm deep in such manner as to avoid segregation, and each layer shall be compacted by means of approved vibrators to form a dense material free from honeycombing and other blemishes. Compaction by hand may be used only with the prior approval of the Project Manager.

At least one internal vibrator shall be operated for every four cubic metres of concrete placed per hour and at least one spare vibrator for every three shall be maintained on Site in case of breakdown during concreting operations.

Vibration time, the effective radius and other vibration characteristics shall be in accordance with the vibrator manufacturer's recommendations.

If internal vibrators are used, they shall be withdrawn immediately when a thin film of mortar begins to appear on the surface of the concrete. Withdrawal shall be carried out slowly to avoid cavitation.

Internal vibrators shall not be inserted between layers of reinforcement less than one and one half times the diameter of the vibrators apart. Contact between vibrators and reinforcement and vibrators

and formwork shall be avoided.

Vibrators shall not be used to move concrete from place to place in the formwork.

Where two distinct batches of concrete, placed at different periods of time and forming part of the same concreting operation are required to be formed monolithically with each other, the more mature concrete shall be penetrated by the vibrator to a sufficient depth to effect plastic movement between the two batches. Where the concrete does not respond to the action of the vibrator, it shall be deemed to have set, and no further disturbance will be permitted. Unless otherwise instructed by the Project Manager the condition shall be treated as for a "stoppage of work" and the marrying up of the two concretes shall be effected only when both concretes have properly set.

If external vibrators are used, the formwork shall be strong enough to withstand the forces of vibration.

Temporary or permanent stoppages of work shall be made only against stop ends (Clause 305).

Unless otherwise specified, before placing new concrete against concrete which has already hardened, the face of the older concrete shall be prepared by the removal of any laitance and loose aggregate, and shall be cleaned by a jet of compressed air.

When displacers are permitted to be used they shall be so placed that no displacer is within 300 mm of any finished face or within 500 mm of any other displacer. On completion of any lift, displacers shall be so arranged that they project for half their height above the surface.

STRUCTURAL CONCRETE APPROVAL FORM (SCAF)**(To be filled in duplicate before any concrete pour)**

Contract Details

Job _____ Job No _____

Contractor _____ Site Engineer _____

Section and Concrete Details

Section / Block _____

Level _____ Member _____

Date / Time of Request _____ Date / Time of Pour _____

Concrete Class _____ Mix: Design / Nominal (delete one) Batching: Site / Ready Mix (delete one)

Check List

Description of Check	Checked	Remarks
Reinforcement Fixing		
Chairs / Links, etc.		
Reinforcement Cover		
Shutters / Stop ends		
Shutter Props		
Tie Bolts		
Plumbness / Slope		
Dimensions		
Line and Level		
Preparation hacking of joints		
Water Stops		
Moulds for Cubes		
Materials for Curing		
Any other checks (specify)		

Approval

Approved ☐ Not Approved ☐

Date: _____ Signature: _____

Note: Approval by the Project Manager or his Representative does not relieve the Contractor of any of his contractual obligations.

305.4 Concreting in Deep Lifts

(i) Limitations

Any height exceeding 2.5 m from which concrete is poured into formwork to form sections of wall will be considered within the terms of this Clause.

Concrete in columns may be placed to a height of 4.0 m with careful placing and vibration and satisfactory results. Where the height of the column exceeds 4.0 m suitable openings must be left in the shutters so that the maximum lift is not exceeded.

Deep lift construction will not be permitted where the reinforcing bars are to be placed closer than 100 mm to one another in any direction or, where the clear width at the point of admitting the concrete between one layer of reinforcement and another (or in the case of singly reinforced walls between reinforcement and formwork) is less than 200 mm.

The method shall only be used where trial sections revealed that, in the Project Manager's opinion it can be satisfactorily employed, in which case the requirements of this Specification shall apply except where they are in conflict with the requirements of this particular clause, when the latter shall prevail.

(ii) Concrete

In order to prevent segregation of aggregates, concrete mixes shall be designed for increased cohesion, or, where suitable, on a gap-graded basis. The use of approved admixtures may be made to achieve this end (302).

At the same time, the mix shall be such as to limit the amount of bleeding in the concrete, and where in the opinion of the Project Manager the quantity of free water rising to the surface is excessive, the mix shall be corrected before further concreting is undertaken.

In order to offset any increase in the water-cement ratio at the upper levels, the Project Manager may require the concrete mix to be modified for the upper depositions.

A slump of 80 mm shall not be exceeded.

(iii) Reinforcement

In order that reinforcement is not distorted or displaced during construction as a result of it being used for gaining access in or out of the formwork, all intersections of vertical and horizontal steel shall be properly fastened.

All obstructions caused by spacer blocks or chairs shall be eliminated so as to permit an unobstructed passage for the concrete to the bottom of the formwork. The Contractor may use sliding timber spacers instead of fixed concrete or plastic spacer blocks to position the reinforcement.

(iv) Formwork

In view of the high pressures to be expected from this form of construction extra attention shall be paid to the strength and stability of the formwork, to the prevention of loss of grout, and to the prevention of displacement of adjacent panels.

The use of through-bolts and other accessories which might interfere with the free passage of concrete between and around the reinforcement shall be reduced to a minimum by the use of properly designed formwork.

(v) Concreting

Particular attention shall be paid to the concreting of the initial sections at the bottom of the formwork to prevent segregation caused by rebound from the hard surface of the kicker, base and/or lower sections. The initial depositions shall therefore be made by using trunking methods, or by placing the concrete through openings formed in the sides of the formwork. Such openings shall not be higher from the hard surface than 2.5m.

In order to reduce differential settlement, and consequently, cracking between two sections of concrete placed at different intervals of time, concreting between one section and another shall be carried out on a gap-construction basis (Clause 305). The gap shall subsequently be concreted in distinct lifts each not exceeding 2.5m in height. For the same reason, when concreting two adjacent sections placed at the same time but of different heights (e.g. where boxing out is included), the difference in height shall not exceed 15% of the height of the deeper section.

Concreting from the upper level of the formwork shall be carried out in such manner as to ensure that concrete is admitted centrally between the faces of the formwork. For this purpose the Contractor shall make use of trunking or shall use funnel-shaped hoppers extending for a distance of not less than 1.5 m into the formwork. A sufficient number of such hoppers shall be provided, and/or they shall be capable of movement along the length of the formwork, to enable the concrete to be placed in contiguous heaps at the base of the pour. Such heaps shall not exceed 460 mm in height.

Where excessive bleeding is in evidence, the excess water shall be removed before placing further concrete.

(vi) **Compaction**

Compaction shall be carried out where possible by manual operation of poker vibrators within the formwork. Where this is not possible poker vibrators shall be suspended in sufficient numbers to ensure uniform compaction along the length of wall receiving the concrete, without the need for their withdrawal and re-insertion. The means of suspension shall be such that the vibrators may be progressively and systematically lifted as the concreting proceeds to ensure that every section of placed concrete is married into adjacent and underlying sections.

The use of vibrators to reposition deposited concrete is prohibited. Surface vibrators attached to the formwork may be used only to supplement the main means of compaction.

305.5 Continuous Concreting

Where the Contractor desires to use continuous concreting method in large sections (rafts and walls), he shall submit a written request to the Project Manager for approval. In the request he shall attach details which shall include but not be limited to the following :-

- Total amount of concrete to be placed in the shift.
- Stock of approved concrete materials on site.
- Capacity of the batching plant.
- Number and type of truck mixers to be deployed for the exercise and movement logistics.
- Number of skilled and other manpower to be deployed for the exercise in shifts.
- Number and capacity of plant to be used in placing concrete (pumps, vibrators, buckets, etc).
- Method(s) of monitoring and dealing with the heat of hydration.
- Details of protection against rain and floodwaters and how to cope with it.

The Project Manager shall consider the above details and other parameters (e.g. weather, satisfactory records of cube test results, availability of adequate working sections where reinforcement placement and the necessary formwork have been approved etc), before making his decision. The Project Manager may order that additional concrete cube moulds be made available as well as arrangements be made for cube crushing with an approved laboratory to cope with the increased demand.

The Project Manager may order that the concreting works be stopped immediately if in his opinion the

quality of the works is threatened for whatever reason.

305.6 Hot Weather Concreting (for temperatures above 20 Degrees Centigrade)

Concreting shall not be permitted if its temperature at placing is in excess of 35°C. In order to maintain the temperature of the concrete below this value the following precautions shall be taken wholly or in part as instructed by the Project Manager:-

- (i) All aggregate stockpiles, water lines and tanks as well as the mixer shall be protected from the direct rays of the sun;
- (ii) Coarse aggregate shall be cooled by constant watering where possible;
- (iii) Mixing water shall be cooled by the addition of ice to the storage tanks where necessary;
- (iv) Rapid-hardening cement shall not be used;
- (v) Where the above precautions are inadequate concreting shall be carried out during the cooler parts of the day or during the night as may be directed by the Project Manager.

When the air temperature is above 20°C loss of mixing water by evaporation shall be considered in arriving at the amount of water to be added to the mix (Clause 302). In order to maintain the water/cement ratio within permissible limits an approved water-reducing agent shall be included in the mix (Clause 302).

The maximum water/cement ratios indicated in Clause 302 may be increased with the Project Manager's permission by 0.05 (or 2.5 litres/50 kg of cement) during mixing, but on no account shall water be added to concrete directly or indirectly once it has left the mixer.

In order to reduce premature drying of the concrete during transporting and placing, all chutes, formwork and reinforcement shall be cooled by watering when possible, or shall otherwise be protected from the direct rays of the sun. Any water so used shall be removed by jetting with compressed air before placing the concrete in close contact.

As soon as possible after concreting, the formwork shall be stripped (Clause 304) and the surface of the concrete shall be treated in accordance with Clause 305.

Where drying winds are encountered, wind shields shall be positioned as directed by the Project Manager to protect exposed surfaces of the curing concrete.

305.7 Wet Weather Concreting

Concreting during periods of constant rain shall not be permitted unless aggregate stockpiles, mixers and transporting equipment, and the areas to be concreted are adequately covered.

During showery weather, the Contractor shall ensure that work can be concluded at short notice by the provision of stop ends. On no account shall work be terminated before each section, between one stop end and another, is complete. Adequate covering shall be provided to protect newly placed concrete from the rain.

305.8 Holes, Cavities and Fixings

The Contractor shall be responsible for the co-ordination of all requirements of his Sub-contractors as regards provision of holes, chases, cavities and fixings and shall, if required by the Project Manager, prepare drawings giving details of his and his Sub-contractor's requirements and shall send copies of such drawings to the Project Manager prior to construction.

Holes, etc. shall be accurately marked and boxed-out for before concreting operations commence and, without the Project Manager's prior approval, no such holes, etc. shall be formed after the concrete has set.

Where bars, if placed to specified spacing would foul holes of size less than 250 mm x 250 mm the full length of the bar shall be moved to one side and in the case of holes exceeding 250 mm x 250 mm the bars shall be cut on site and lapped with additional equivalent bars, or as otherwise indicated on the drawings.

Wherever possible, the Contractor shall build in all pipework, ironwork, etc. which passes through walls and floors, and the pipework, ironwork, etc. shall first be thoroughly cleaned and freed from any deleterious matter, and every care shall be taken to ensure that it is thoroughly encased in concrete.

Unless otherwise instructed by the Project Manager all electrical conduits to be positioned within the reinforced concrete shall be fixed inside the steel cages of beams and between the top and bottom steel layers in slabs and similar members.

The proposed position of all conduits 25 mm and over in diameter which are to be enclosed in the concrete shall be shown accurately on a plan to be submitted to the Project Manager, whose approval shall be obtained before any such conduit is placed.

Bolts, hooks and other fixings shall be embedded in concrete, or holes shall be drilled and fitted with threaded expanding anchors to receive the bolts. The Contractor shall ensure that bolts, hooks, etc. are accurately positioned. Holding down bolts for machinery shall be set by means of a template.

Where brick or stonework is to form a facing to the concrete or where the end of a brick or stone wall butts against a concrete face, galvanised metal ties of approved manufacture to BS 1243 shall be incorporated. The distance between ties shall be gauged with due regard for the bonding of the walls, and at intervals required by the Project Manager.

305.9 Protection and Curing

Newly placed concrete shall be protected by approved means from rain, drying winds, sun and contact with substances which can adversely affect it.

No traffic or constructional loads shall be permitted on newly placed concrete until it has hardened sufficiently to take such traffic or load, and only then with the approval of the Project Manager.

Concrete shall at no time be subjected to loading (including its own mass) including compressive stress until it has reached 0.40 of its specified 28 day strength.

Any concrete surfaces, risers and treads of stairways which might be damaged during the construction of the Works shall be adequately protected.

All structural concrete shall be cured using methods approved by the Project Manager.

The method of curing shall prevent loss of moisture from the concrete. Immediately after compaction and for 7 days thereafter concrete shall be protected against harmful effects of weather, including rain, rapid temperature changes and from drying out.

The curing time shall be the number of days given in Table 3.7 unless the average temperature of the concrete during the required number of days falls below 10oC in which case the period of curing shall be extended until the maturity of the concrete reaches the value given in the table.

Table 3.7 Normal Curing Methods

Minimum period of protection for different types of cement

Conditions under which concrete is maturing	Number of days (where the average temperatures of the concrete exceeds 10°C during the whole of the period)			rs calculated ete in hours of degrees the average te exceeds -	
	Type IV	Type I or Type V	Type III	Type IV	Type I or Type V
1. Hot weather or drying winds	7	4	2	3500	2000
2. Conditions not covered by 1.	4	2	1	2000	1000
Type IV - Low Heat Portland Cement/Portland - Pozzolana Type I - Ordinary Portland Cement Type V - Sulphate-resisting Portland Cement Type III - Rapid-hardening Portland Cement Hot weather - Temperature over 16oC					

Curing shall be carried out using either of the following basic methods, or any other method agreed with the Project Manager. Methods involving the use of dampened hessian coverings shall not be used. The method adopted for any particular situation shall be agreed with the Project Manager.

A. Membrane Applied by Spray

Liquid membrane compounds shall be applied to moist concrete surfaces as follows:-

(i) Unformed Surfaces

The compound shall be applied immediately after the free water has left the surface.

(ii) Formed Surfaces

The compound shall be applied immediately after removing the forms. If there is appreciable drying, the surface shall be mist sprayed with water to produce a uniformly damp appearance before the compound is applied.

The compound shall be applied in one or two separate applications to produce complete and uniform coverage of the surface. If the compound is applied in two increments, the second application shall follow the first within 30 minutes. The method and rate of application shall be in accordance with the compound manufacturer's instructions.

If rain falls on the newly coated surface before the film has dried sufficiently to resist damage, or if the film is damaged in any other manner, a new coat of compound shall be applied to the affected area equal in curing value to that originally applied.

Compound applied to construction joint surfaces, or to other surfaces to which concrete is to be bonded, shall be removed prior to placing the fresh concrete.

Depending on the surface to which it is to be applied the compound shall conform to the following requirements of AASHTO M148.

- (i) Exposed and vertical concrete surfaces - Type I-D (clear compound with fugitive dye).
- (ii) Unexposed top surfaces of foundations and superstructures - Type 2 (white pigmented).

B. Polythene Sheeting

The concrete surfaces shall be covered with white polythene sheeting as follows:-

(i) Unformed Surfaces

The sheeting shall be laid over the surface as soon as possible without marring the surface, and not until initial stiffening has taken place if a brushed or tamped finish is required.

(ii) Formed Surfaces

The surfaces shall be covered immediately after the removal of the forms.

The sheeting may be in contact with the concrete or made into portable shelters on light weight frames. In both cases, the sheeting shall be jointed and sealed against the concrete surfaces to prevent wind blowing between the sheeting and the concrete.

The white polythene sheet shall conform with the requirements of AASHTO M171. On no account shall clear or any other colour of sheeting be used.

C. Other Curing Methods

These shall be agreed with the Project Manager. Methods involving the use of damped hessian coverings shall not be used, unless at least 2 layers of continuous hessian are used and they are kept continuously wet and protected from winds which cause accelerated drying.

Where the thickness of concrete placed exceeds 1.5 m, the Contractor shall submit for the Project Manager's approval proposals to ensure that, during the curing period:-

- (a) the rate of rise of temperature in the concrete does not exceed 15°C per hour for the first 3 hours;
- (b) thereafter the rate of rise and fall of temperature in the concrete does not exceed 35°C per hour;
- (c) the maximum temperature in the concrete does not exceed 70°C; and
- (d) the maximum difference in temperature between the core and the surface of the concrete does not exceed 20°C.

The proposals shall include consideration of:-

- (a) concrete mix design;

temperature of mix at time of placing;

- (c) method of curing.

Where required by the Project Manager, the Contractor shall carry out temperature measurements in the concrete. The method and procedure of temperature measurement shall be agreed with the Project Manager.

305.10 Joints

(i) Construction Joints

The position of construction joints, when not shown on the Drawings or otherwise required by this Specification, shall be decided on site having regard to the plant and labour made available by the

Contractor for the manufacture, placing and compaction of the concrete as well as its curing, the climatic conditions prevailing at the time of concreting, the nature and size of the formwork, and the conditions of operation of the work. Waterstop shall be provided to all construction joints on water retaining or excluding structures. The Contractor shall submit his proposals to the Project Manager for his approval at least fourteen days before commencing the work.

Construction joint surfaces shall be treated by the "wash-off" method explained below, except where it cannot be practically effected, in which case they shall be treated in accordance with Clause 305 as for the placing of new concrete against hardened concrete.

When expanded metal lathing is used for the formation of construction joints a rebate will not be required to be formed. The expanded metal lathing shall be left in the work and shall not extend closer to the finished surface of the concrete than 25 mm. It shall be securely fixed to the reinforcement.

The following particular requirements shall also be observed:-

* Slabs supported on the ground

In order to ensure control in the placing of concrete the Contractor shall provide control boards to form panels not larger than 15 m² in area. These shall be lifted as the concreting proceeds except where they are of expanded metal in which case they may be left in position as part of the permanent works, provided that they shall not extend closer to the finished surface of the concrete than 25 mm. In the event of a breakdown in the supply of concrete the Contractor shall ensure that an alternative supply of concrete is made available (to finish the work against the control boards acting as stop ends). The joint so formed shall then be treated as a construction joint. Where Ready-mixed concrete is permitted the control boards shall be positioned so as to enclose a volume of concrete equal to that delivered by each truck.

Construction joints and control joints shall be formed normal to the surface of the retained concrete.

* Suspended Beams and Slabs

T-beams shall be formed to their full depth integrally with the adjacent slab and without horizontal joints.

* Columns

Where kickers are indicated on the drawings these shall be cast together with the slab or beam below. On no account shall kickers be cast as a separate operation. Alternatively, the Contractor may adopt "kickerless construction" methods providing he can satisfy the Project Manager that his system is reliable and does not compromise workmanship.

* Walls

Horizontal construction joints in walls shall be formed along straight lines coinciding with the full height of the formwork. The height of the formwork thus controlling the height of the pour shall be determined with reference to the availability of concrete, the size and amount of reinforcement and the means of compaction available.

Unless otherwise indicated on the drawings or otherwise permitted by the Project Manager for the construction of circular tanks, concreting shall be carried out continuously for the full circumference without vertical joints. Where permission is granted for the use of vertical joints the Project Manager may order, at no extra cost to the Employer, the inclusion of an approved type of water stop.

In the case of rectangular tanks, vertical joints shall not be positioned closer to any corner than one metre. They shall be formed with properly rebated stop ends or, where conditions permit, by the use of expanded metal lathing. Unreinforced manholes shall be constructed without vertical joints.

(ii) The "Wash-off Method" of preparing Construction Joints

As soon as possible after concreting, and while the surface is still green, the surface of the concrete forming the joint shall be freed of loose aggregate and sprayed with a fine spray of water to prevent the formation of laitance. Subsequently all excess water shall be removed by a jet of compressed air and the surface left clean to receive further concrete.

Where expanded metal lathing is used for construction joints, this method of surface preparation shall be used in every case.

(iii) Movement Joints

These shall include contraction and expansion joints and shall be as indicated on the drawings.

Contraction joints will be either full contraction joints or partial contraction joints. Where partial contraction joints are specified a period of at least five days shall elapse between the concreting of the section on each side of the joint.

Where the drawings indicate a contraction gap to be formed in any panel (this gap will not exceed one metre), concreting on either side of the gap shall be carried out so as to form partial contraction joints at each side of the gap. Prior to the concreting of the gap section, the joint surfaces shall be cleaned but otherwise left untreated. The concreting of the gap section shall not be carried out until a period of at least five days has elapsed after completion of the adjacent sections.

Alternate panel construction (other than contraction gap construction outlined above) will be permitted only with the approval of the Project Manager, or in those cases where either the reinforcement is not continuous through the joint or where the panels are separated by expansion or contraction joints.

Unless otherwise specified or permitted by the Project Manager all waterstop shall consist of rubber or PVC. Jointing of waterstop shall be by vulcanising, except where PVC is specified or permitted in which case joints shall be by fusing or welding. Materials shall be obtained from an approved manufacturer whose recommendations as to jointing shall be fully complied with.

(iv) Waterstop and Jointing Materials

Waterstop and jointing materials shall be obtained from an approved manufacturer.

All waterstop and jointing materials which are not required for immediate use shall be stored at all times in a cool damp place.

Waterstop shall be manufactured of rubber or PVC (polyvinylchloride) as shown on the drawings, and shall be of the type and size shown on the drawings. Site joints shall be made strictly in accordance with the manufacturer's instructions and all intersections and junctions shall be obtained prefabricated from the approved manufacturer.

Joint filler shall be manufactured of natural bonded cork or other approved material which remains serviceable when wet. Joint filler shall be cut and trimmed accurately to suit the joint profile and shall be maintained accurately in position by means of an approved adhesive. The compressibility of the filler shall be such that it can be compressed to 50% thickness with a pressure of not less than 0.07 N/mm square and no greater than 0.4 N/mm square. After 50% compression, the material should recover to at least 70% original thickness within 30 minutes. On no account shall fibreboard or similar be used as filler.

Joint sealing compounds shall be approved polysulphide based compounds suitable for sealing joints in horizontal and vertical/sloping concrete surfaces as appropriate. Sealing compounds shall be applied strictly in accordance with the manufacturer's instructions and shall completely fill the joint recess. Surface primers shall be from the same manufacturer as the sealants themselves. Joint sealing compounds shall be entirely suitable for contact with potable water where these are used in water retaining structures.

Waterstop shall be located and maintained accurately in position and details of the proposed method of fixing shall be submitted to the Project Manager for approval. On no account shall waterstop be secured by nails or by any other means involving puncture of or damage to the waterstop material unless purpose made nailing flanges are incorporated in the design of the waterstop.

(v) Slip Membrane

The slip membrane shall be "slipstrip" as supplied by Serviced Limited, Ajax Avenue, Slough, Berkshire, UK or similar approved material. The slip membrane shall be not less than 1.5 mm thick and shall be a plastic preformed strip with low coefficient of friction specifically manufactured for use as a separating membrane in sliding joints between concrete surfaces. Each sliding joint shall comprise two layers of the membrane unless otherwise shown on the drawings.

The concrete surface to which the slip membrane is to be fixed shall be finished with a steel float to provide a smooth true surface free from dust and loose particles.

(vi) Expandafoam

Expandafoam shall be as supplied by Expandite Limited, 1-9 Chase Road, London, NW10 6PS, UK or similar approved material. Expandafoam is a closed cell flexible polyethylene joint filler used where a readily compressible low load transfer joint filler is required. Expandafoam shall be fixed in position using a suitable adhesive.

305.11 Finishes - General

All exposed faces of concrete unless otherwise specified shall be hard, smooth and free from honeycombing, air and water holes and other blemishes.

All projecting imperfections shall be rubbed down with carborundum stone or by other approved means and grit and dust therefrom shall be thoroughly washed off with clean water.

Surface Finishes

(a) Wood float finishes shall be formed by smooth floating the accurately levelled and screeded surface. Care shall be taken to ensure that the concrete is worked no more than is necessary to produce a uniform surface free from screed marks.

(b) Steel trowel finishes shall be formed while the concrete is still wet by means of a steel trowel applied to an accurately levelled and screeded surface (see also Clause 307).

(c) Granolithic finishes shall conform to the recommendations laid down in "Specification for Granolithic floor toppings laid in-situ concrete", as published by the UK Cement and Concrete Association with special reference to monolithic construction.

(d) Screeded finishes shall be formed by levelling and screeding the concrete to produce a uniform, plain or ridged surface as specified; surface hardeners shall be applied strictly in accordance with the manufacturer's recommendations.

(e) Bush-hammered or pattern-worked finishes.

When exposed aggregate is to be the surface texture, the Contractor shall ensure that a uniform distribution of the coarse aggregate takes place at the face. The formwork shall be removed as soon as possible from the face to be treated; the surface shall be thoroughly wetted and wire brushed, and bush-hammered or pattern-worked as and when instructed. Surface retarders shall be used only when permitted by the Project Manager.

Bush-hammering or pattern-working shall not be relied upon to obscure any defects in the concrete face which arise from formwork imperfections.

Making Good

On no account shall any faulty honeycombed or otherwise defective concrete be repaired or patched until the Project Manager has made an inspection and issued instructions for the repair.

Honeycombed or damaged surfaces of concrete, which in the opinion of the Project Manager, are not such as to warrant the cutting out and replacement of the concrete, shall be made good as soon as possible after removal of the formwork as follows:-

1:1.5 Portland Cement and sand mixture shall be worked into the pores over the whole surface with a fine carborundum float in such a manner that no more material is left on the concrete face than is necessary to fill the pores completely so that a uniformly smooth and dense surface of uniform colour is finally presented.

Removal and Replacement of Unsatisfactory Concrete

The Contractor shall on the Project Manager's instructions to do so cut out and replace any concrete in any part of the structure if in the Project Manager's opinion:-

- (a) the concrete does not conform to the Specification, or
- (b) deleterious materials or materials which are likely to produce harmful effects have been included in the concrete, or
- (c) the honeycombed or damaged surfaces are too extensive, or
- (d) the finished concrete sizes are not in accordance with the drawings within permissible tolerances, or
- (e) the setting-out is incorrect, or
- (f) the steel cover has not been maintained, or
- (g) the protection, including curing, of the concrete during the construction was inadequate, resulting in damage, or
- (h) the work of making good or other remedial measures the Project Manager may indicate are not carried out to his satisfaction, or
- (i) undue deformation of or damage to the works has taken place due to inadequate formwork, or to premature traffic or to excessive loading, or
- (j) any combination of the above points has taken place resulting in unsatisfactory work.

306 Testing

306.1 Sampling and Testing - (see also Clauses 301 and 302)

The Contractor shall provide on the Site equipment, staff and labour for carrying out the sampling and testing outlined in columns 3 and 4 of Table 3.8, and he shall carry out any or all of these tests at such times and with such frequency as may be requested by the Project Manager.

All equipment shall be calibrated and checked from time to time by an approved agency, as the Project Manager may require.

The Contractor shall provide all samples required by the Project Manager. Those samples to be tested in an offsite laboratory shall be carefully forwarded by the Contractor to an approved

laboratory. Results of laboratory and site tests shall be kept on site and copies of all test reports shall be forwarded in duplicate to the Project Manager.

Each cube shall be marked with a distinguishing number (numbers to run consecutively) and the date, and a record shall be kept on Site giving the following particulars:-

- (a) Cube No.
- (b) Date and time made
- (c) Temperature and weather conditions
- (d) Location in work
- (e) 7-day Test

Date :

Strength

- (f) 28-day Test

Date :

Strength

Cubes shall be forwarded, carriage paid, to an approved Testing laboratory in time to be tested two at 7 days and two at 28 days. No cube shall be dispatched within 3 days of casting.

Authentic copies of all Work Test results shall be forwarded to the Project Manager directly from the testing laboratory and one shall be retained on the site. The test certificates shall indicate all properties as required by BS 1881.

The Contractor must allow in his rates for concrete test cubes for all expenses in connection with the preparation and conveyance to the Testing Laboratory and testing of test cubes and no claim in respect of his failure to do so will be entertained.

Any batch of concrete which fails to achieve the required characteristic strength shall be removed and made good in accordance with this Specification. The Contractor shall carry out all such work at his own cost.

Frequency of tests and the number of samples required will be governed by the results of the previous tests, the quality of the materials revealed during the tests, and the uniformity of that quality (see Clause 302). Should it become evident that the quality of concrete is deteriorating the Project Manager may require additional samples to be taken and test cubes to be made and tested to determine the cause.

306.2 Loading Tests

The Project Manager may direct that a loading test be made on the works or any part thereof if he deems such test to be necessary for one or more of the following reasons:-

- (a) failure of "Site Cubes" to attain the strength requirements of Clause 302;
- (b) premature removal of formwork;
- (c) overloading of structure during construction;

(d) improper compaction and/or curing of concrete;

(e) any other circumstances attributable to alleged negligence on the part of the Contractor, which, in the opinion of the Project Manager, may result in a structure being of less than the required strength;

If the loading test is ordered to be made solely or in part for reasons (a) to (d) the test shall be made at the Contractor's own cost.

If the loading test is ordered to be made for reason (e), the Contractor shall be reimbursed for the cost of the test if the result is satisfactory. No extensions to the Contract Duration shall be granted for delays and disruption resulting from these tests.

Loading test shall be carried out in accordance with the requirements of BS 8110 – 2 Section 9.

If the results of the test are not satisfactory, the Project Manager will direct that the part of the work concerned be taken down or removed and reconstructed to comply with the Specification, or that such other remedial measures as he may think fit be taken to make the work acceptable and the Contractor shall carry out such work at his own cost.

Table 3.8 Sampling, Testing and Acceptance Standards

Materials	Test	Site Sampling	Testing	Accepted Standards	Remarks
1	2	3	4	5	6
Cement	Ordinary Portland Rapid Hardening Sulphate Resisting		BS 4550	BS 12 BS 12 BS 4027 KS1725	Manufacturer's Test Certificate
Aggregates	Description and Classification		BS 812 Sec 2	BS 882	
	Particle Size	BS 812 Sec 1	BS 812 Sec 3	BS 882)
	Particle Shape	BS 812 Sec 1	Visual and BS 812 Sec 3)) Mix
	Specific Gravity	BS 812 Sec 1	BS 812 Sec 3) Design
	Density	BS 812 Sec 1	BS 812 Sec 3) Requirements
	Voids	BS 812 Sec 1	BS 812 Sec 4)
	Absorption	BS 812 Sec 1	BS 812 Sec 4	BS 8007 Cl 6.2.2	See Freeze-thaw Test in this table
	Organic Impurities	BS 812 Sec 5			
	Moisture Content	BS 812 Sec 5			For adjustment of added water for concrete making
	Mechanical Properties	BS 812 Sec 6	BS 882		Ten per cent fines value
Water	Suitability	BS 3148	BS 3148	BS 3148	Not required for potable water
Concrete	Compacting Factor	BS 1881 Pt 101	BS 1881 Pt 103)
	Slump		BS 1881 Pt 102) Workability Test))
	Crushing		BS 1881	BS 5328, BS 8110	Cube test
	Water Absorption		BS 1881 Pt 122	BS 7263	Precast concrete Clause 308
	Freeze-thaw	BS 1881	BS 812 Sec. 1		Durability test for aggregate not complying with moisture absorption requirements of BS 5337 Cl.

Materials	Test	Site Sampling	Testing	Accepted Standards	Remarks
1	2	3	4	5	6
					21.2
	Electrolytic Efflorescence				As required for salt-containing aggregate or saline water
	Cores	BS 1881 Pt 6 BS 1881 Pt 120	BS 1881 Pt 6 BS 1881 Pt 120	BS 1881 Pt 120 with ref to concrete strengths this Specification	See Clause 306
Admixers	Compatibility with cement	As required by Laboratory			Tests to be carried out by independent Laboratory as required

The Project Manager may also instruct the Contractor before a loading test takes place to take out cylindrical core specimens from the structures concerned and have them tested. The cutting equipment and the method of doing the work shall be to the Project Manager's approval. The specimens shall be dealt with in accordance with BS 1881. Prior to testing, the specimens shall be available for examination by the Project Manager. If the cores are ordered to be taken solely or in part for reasons (a) and (d) above, the work involved and the testing shall be made at the Contractor's own cost. If the cores are to be taken for reasons (b), (c) and (e) above, the Contractor will be reimbursed the cost if the loading test described in the previous paragraphs proves satisfactory.

307 Special Concrete

307.1 No-fines Concrete

No-fines concrete for use in subsoil drainage shall consist of a 1:8 cement/aggregate mix by volume. Aggregate shall be 20 mm to 10 mm graded with no more than 5% passing the 10 mm sieve. Only sufficient water shall be added to ensure complete coating of the aggregate. One half of this water shall be placed into the mixer first, after which the aggregate and cement shall be admitted. After partial mixing the balance of the water shall be added until a consistency of mix is achieved.

Preliminary tests shall be carried out on the site to prove the suitability of the finished concrete, and adjustments made to the proportions and or grading as may be required by the Project Manager.

307.2 Air-Entrained Concrete

Concrete for roads and those structures where specified, shall include an approved air-entraining agent capable of producing a 5% air-entrainment with a tolerance of 0.5% (Clause 302).

The mix shall be purposely designed, having regard for the nature of grading of the aggregates and air-entraining agent being used.

Preference shall be given to the use of air-entraining agents which can be administered in fixed calibrated amounts through a dependable mechanical dispenser or sachet, and which are added to the mixing water.

Frequent air meter tests shall be carried out and the consistency of the air-entrainment maintained to the above tolerances by adjustments in the mix, as may be necessary.

307.3 Concrete in Benching

Concreting for benching in manholes, pumping stations and works structures shall consist of Grade C25P concrete unless otherwise specified. It shall be placed with low workability to the approximate shape required and, while still green, shall be finished with not less than 50 mm of Grade C25P concrete to a steel trowelled finish and to the contours indicated on the drawings.

307.4 Ready Mixed Concrete

Unless otherwise stated the relevant clauses of BS 5328 shall apply.

Ready mixed concrete shall only be used with the prior approval of the Project Manager. The Contractor shall not be relieved of his obligation to provide concrete to the standard laid down in this Specification by virtue of any approval given for the use of concrete supplied by others, and the Project Manager reserves the right to withdraw his approval at any time consequent on any deterioration in the quality of the Concrete, or unsatisfactory delivery or any other reason he considers detrimental to the Works.

Ready mixed concrete manufactured off the site shall be transported in a revolving drum and shall be continuously agitated until it is used in the work unless otherwise approved. The time interval between adding water to the drum and placing shall not exceed 90 minutes. The time interval between completion of mixing and placing shall comply with Clause 305.

307.5 Granolithic Concrete

Refer to Clause 305.

307.6 Pneumatically Applied Mortar (Guniting)

(i) Requirements

The pneumatic application of mortar shall be carried out only by Contractors experienced in this type of work and who are in possession of proper Plant and equipment. Nozzlemen employed on the works shall be skilled operators.

The finished product shall be dense, of even texture and colour, and to the requirements of strength, tolerance and finish set out in this Specification.

(ii) Strength

After curing, the mortar shall be capable of producing cored samples with a 28-day characteristic strength of not less than 27.5N/mm².

(iii) Materials

Sand, cement and water shall comply with the requirements of Clause 302 of this Specification except that the sand shall conform to the grading of Zone 2 of BS 882.

(iv) Proportions

The proportions to be used in the mix shall be determined with reference to the requirements outlined in sub-clause 307(i) and the mix shall be not weaker than one part of cement to four parts of sand by volume, having regard to the adjustments for bulking of the sand.

(v) Operation

Air and water pressures shall be such as to permit the proper application of the mortar, and shall be determined with reference to hose lengths and nozzle diameter.

Mortar rebound, recovered, cleaned and uncontaminated with extraneous matter, may be re-used but not for water-retaining structures. It shall be regarded as an equivalent volume of sand which shall not exceed 20 per cent of the total sand requirement. Rebound which has lodged in the formwork or between reinforcement shall be removed by compressed air.

Reinforcement shall be completely embedded in the mortar by the proper direction of the nozzle and the mortar shall be applied as a steady and uninterrupted flow from the nozzle.

Mortar application shall be discontinued at any section of the work where sagging of the mortar is in evidence.

(vi) Joints

These shall be formed by sloping the surface to a thin edge. Before applying new mortar, the surface shall be thoroughly wetted. Laitance shall be removed by the initial discharge of fresh mortar.

(vii) Tolerances

The thickness of applied mortar shall be not less than the dimensions shown on the Drawings nor greater than 10 mm over those dimensions, unless otherwise indicated on the Drawings or otherwise permitted.

(viii) Protection and Curing

Shall be carried out in accordance with the requirements of Clause 305.

(ix) Finishes

Unless otherwise specified all surfaces shall be brought to a granular textured finish by means of a wooden float.

(x) Cold Weather Work

No application of mortar shall be made against frozen surfaces nor when the air temperature is below 5oC.

(xi) Making Good

Any defective work shall be cut out immediately and made good with fresh mortar pneumatically applied.

307.7 Cement Grouts

Cement grout shall be mixed in the relevant proportions indicated in the following table using the minimum quantity of water to ensure the necessary fluidity and to render it capable of penetrating the work.

Class	Nominal Mix by Mass	
	Cement	Sand
G1	1	-
G2	1	3
G3	1	10

Cement grout shall be used within one hour of mixing, except where containing a retardant admixture.

307.8 Pumped Concrete

Where pumping of concrete is permitted to be used no relaxation of the requirements of this Specification will be permitted. Particular attention shall be paid to the proper grading of aggregates to prevent bleeding and/or segregation during the pumping operations. The inclusion of water-reducing additives or other materials, including flyash, to improve the flow characteristics of the concrete will only be permitted where it can be shown that they do not adversely affect the concrete either in the plastic phase or in the finished work.

308 Precast Concrete Units

308.1 Requirements

Unless otherwise agreed in writing by the Project Manager, all precast concrete units shall be manufactured on site and shall be true to dimension and shape, with true rises and with perfectly smooth exposed faces free from surface blemishes, air holes, crazing and other defects, whether developed before or after building-in. They shall comply with the appropriate BS. (Note: Coping blocks and similarly exposed units are particularly susceptible to crazing when the concrete is manufactured using high water/cement ratios)

The maximum size of coarse aggregate in precast concrete shall not exceed 20 mm except for thicknesses less than 75 mm where it shall not exceed 10 mm.

The compacting of precast concrete shall conform with requirements given elsewhere in this Specification except for thin slabs where use of immersion type vibrators is not practicable. The concrete in these slabs may be consolidated on a vibrating table or by any other methods approved by the Project Manager.

Steam curing of precast concrete will be permitted. The procedure for steam curing shall be subject to the approval of the Project Manager.

The precast work shall be made under cover and shall remain under the same for seven days. During this period and for a further seven days the concrete shall be shielded by sacking or other approved materials kept constantly wet. It shall then be stacked in the open for at least a further seven days to season before being set in position. Where steam curing is used these times may be reduced subject to the approval of the Project Manager.

Precast concrete units shall be constructed in individual forms. The method of handling the precast concrete units after casting, during curing and during transport and erection shall be subject to the approval of the Project Manager, providing that such approval shall not relieve the Contractor of responsibility for damage to precast concrete units resulting from careless handling.

Repair of damage to the precast concrete units, except for minor abrasions of the edges which will not impair the installation and/or appearance of the units, will not be permitted and the damaged units shall be replaced by the Contractor at his own expense.

Except where precast work is described as “fair face” or as having “exposed aggregate” or terrazzo finish the moulds shall be made of suitable strong sawn timber true in form to the shapes required. Unless otherwise described, faces are to be left rough from the sawn moulds.

Where precast work is described as “fair face” the moulds are to be made of metal or are to have metal or plywood linings or are to be other approved moulds which will produce a smooth dense fair face to the finished concrete suitable to receive a painted finish direct and free from all shutter marks, holes, pinnacles, etc. Where precast work is to have an “exposed aggregate” or terrazzo finish the moulds shall be constructed to the requirements given for moulds for “finished fair” work.

The method of achieving the exposed aggregate finish shall be “aggregate transfer” or other approved method.

308.2 Kerbs

Precast concrete kerb shall conform to BS 7263: Part 1: 1990, except that coarse aggregate shall conform to BS 882: 1983. Fine aggregate shall consist of sand resulting from the natural disintegration of rock.

Approved air-entraining agents may be permitted to be used providing that approved adjustments are made to the mix with regard to water and fine aggregate proportions (Clause 302). In such cases the moisture absorption limits set out in BS 340 may be neglected subject to the concrete satisfying the freeze thaw test laid down under the heading "Weir Blocks and Sills".

308.3 Paving Slabs

Paving slabs shall conform to BS 368 and shall be 50 mm thick unless otherwise specified.

308.4 Other Blocks

Blocks used for building work and filter bed walls shall conform to BS 6073: Part 1: 1981.

308.5 Wall Units

L-shaped wall units shall conform to the requirements of BS 8110. Where it is not intended to use coping blocks for the protection of the upper exposed surface of the units, the uppermost 150 mm, for the full width of the unit, shall be formed with concrete composed of aggregate complying with BS 882: 1992. Such concrete shall be formed integrally with the main body of the concrete.

308.6 Other Items

Manhole ring units, tapers, cover slabs, segments and concrete pipes are referred to under their particular heading.

309 Site Books And Standards

309.1 Instructions to be Recorded

The Contractor shall provide and keep permanently on the Site a numbered triplicate book wherein the Contractor shall record all instructions relating to concrete work issued by the Project Manager. One copy of every entry therein shall be sent to the Project Manager on the same day as the entry is made.

309.2 Site Diary

The Contractor shall provide and keep permanently on the Site a continuous entry diary wherein the Contractor shall record details of formwork, construction, placing of reinforcement, concreting and curing operations, striking of formwork, making good and daily temperature and weather conditions. This diary shall always be available for inspection by the Project Manager.

309.3 Copies of Standards and Codes

The Contractor shall provide and keep permanently on the Site copies of the following Standard Codes of Practice:-

BS 812
BS 882
BS 1881
BS 4466

BS 5328
BS 5628
BS 8007
BS 8110
KS1725

The Contractor shall in addition provide and keep permanently on the Site copies of such other Standards, Codes, Notes and Specifications as may be required by the Project Manager.

310 Water Retaining Structures - Special Clauses

Note: In the event of any differences between the "Special Clauses" and the previous Specification under Section 2.3 the provisions of these "Special Clauses" shall have precedence.

310.1 Making Good

The cement mortar used in filling recesses in the concrete formed by bobbins in connection with formwork shall contain an approved expanding admixture.

310.2 Construction Joints in Water Retaining Structures

In water retaining structures PVC waterstops not less than 130 mm wide manufactured by an approved manufacturer shall be built into all construction joints in external walls and construction joints in roofs of potable water retaining structures. Construction joints shall be formed at positions agreed by the Project Manager.

The cost of forming construction joints shall be included by the Contractor in his general concrete rates.

310.3 Watertightness of Structures

The Contractor shall be solely responsible for the watertightness of structures and any remedial measures necessary.

310.4 Hydrophilic Rubber Sealer

Hydrophilic rubber sealer shall be co-extruded from chloroprene and hydrophilic rubbers into a cellular strip approximately 25 mm x 7 mm thick which expands as it absorbs water. The strip shall incorporate an expansion delay coating to prevent activation during setting of the surrounding concrete.

Hydrophilic rubber sealer shall be applied to the perimeter of all pipes to be built into concrete structures, to existing concrete walls and slabs at or below water levels which have been demolished and require extension, and to other locations as indicated on the Drawings.

The strip sealer shall be bonded to the pipe diameter or on to the face of demolished structures on to which new concrete is to be placed so as to be at least 100 mm from the wall surface. Where dowel bars are incorporated in bonding new concrete to old, the sealer shall be placed above the dowel bars on the "wet" side of the structure. Bonding shall be accomplished using proprietary neoprene or epoxy adhesives to ensure the sealer is not disturbed during placement of the concrete.

The sealing strip shall be from an approved supplier and application shall be strictly in accordance with the manufacturer's recommendations.

310.5 Waterproof Membranes for Concrete Roofs and Gutters

Concrete roofs and gutters shall be waterproofed by the provision of a membrane to be laid on top of the slab. The membrane shall be a cold applied preformed waterproof laminated layer comprising a HDPE carrier film with a solar reflective surface and a self-adhesive rubber bitumen compound complying with the requirements of BS 8102. The membrane shall exhibit a tear resistance of at least 250 N/mm when tested in accordance with ASTM D1004. Adhesion to primed concrete to itself shall exceed 1.75 N/mm when tested in accordance with ASTM D100, and a puncture resistance of 290 N 65 mm when tested in accordance with ASTM E154. Membranes shall exhibit a water resistance of not more than 0.14% after

24 hours when tested in accordance with ASTM D574. The contractor shall submit proposals for waterproof membranes for approval, together with manufacturer's catalogues and technical literature.

Waterproof membranes shall be installed entirely in accordance with the manufacturer's instructions. Membranes shall be continued up the internal face of the parapet wall and finished centrally under the coping. Adjacent strips of membrane shall be overlapped to provide a waterproof joint. The provision of a waterproof membrane on the roof slab shall not relieve the Contractor of his responsibilities to produce a waterproof roof slab which shall have successfully passed a watertightness test before the membrane is installed.

Section 4 Pipelines, Pipework

401 General

401.1 Equivalency of Goods, Materials and Plant

Wherever reference is made in the Contract, including Specifications, Drawings and Bill of Quantities, to specified manufacturers or suppliers for the supply of goods, materials and plant for the Works, goods, materials and plant from alternative manufacturers and suppliers will be permitted, unless otherwise expressly stated in the Contract, providing these other goods, materials and plant are substantially equal or of a higher quality than those of the specified manufacturer or supplier and are approved in writing by the Project Manager. Differences between the specified goods, materials or plant and the proposed alternative shall be described in writing by the Contractor and submitted to the Project Manager, together with such manufacturer's or supplier's technical literature and samples as the Project Manager may reasonably require. At least 28 days prior to the date when the Contractor desires the Project Manager's consent. In the event the Project Manager determines that such proposed alternative goods, materials or plant do not ensure substantially equal or higher quality, the Contractor shall obtain the goods, materials or plant from the manufacturer of supplier specified in the Contract.

401.2 Materials

Any material which will come into contact with potable water or water to be used for potable supply shall comply with the UK regulations on the use of materials for potable water supply. Water Supply (Water Quality) Regulations 1989 and 15th Statement of the Department of Environment Committee on Chemical and Materials of Construction for use in public water supplies and swimming pools, published by the Department of the Environment, UK or national standards adopted for use in Kenya.

401.3 Approval

As soon as possible after commencement of the Contract, the Contractor shall submit to the Project Manager for his approval a list of his proposed suppliers, sources of materials and proposed standards. No materials, plant or equipment shall be procured for the Contract without first obtaining the Project Manager's approval. Samples of materials shall be submitted to the Project Manager for approval as required by the Project Manager. Materials subsequently supplied shall conform to the quality of the samples which have been approved by the Project Manager. No standards, method of manufacture or specification shall be changed without the approval of the Project Manager. Where possible, plant shall be supplied to the same standards or to compatible standards.

The Contractor shall provide secure storage for all samples submitted to the Project Manager.

401.4 Dimensions

Plant and materials shall be supplied to the general arrangements and dimension, or to suit the dimensions, shown on the Drawings or otherwise indicated in the Contract. Where no such dimensions are shown the Contractor shall be responsible for sizing the Plant. Any redesign, extra design, additional construction or any other costs resulting from the use of Plant to other arrangements or to other dimensions shall be the responsibility of the Contractor.

401.5 Packaging and Protections

All items shall be adequately crated or packaged to withstand damage and prevent deterioration due to shipping, handling and storage. The methods of protection and shipping shall be to the approval of the Project Manager.

401.6 Marking

All Plant shall be marked in accordance with Clause 5 of BS EN 545 and Clause 37 of BS 5163. Before shipping, all items shall be clearly marked. Crates or packages shall be marked on two sides with indelible paint with the name of the project, the Employer and the Contract number shall bear marks indicating the contents.

401.7 Receipt, Storage, Handling and Transportation

Plant, equipment and materials shall be stored in such a manner as to preserve its quality and condition to the standards required by the Contract. The Project Manager shall refuse to accept or shall reject any materials of Plant that in his opinion is defective or otherwise fails to comply with the standards required by the Contract. All such defective items shall be removed from the Site as directed by the Project Manager. Repairs shall be carried out in accordance with procedures approved by the Project Manager and shall be completed to the Project Manager's satisfaction.

401.8 Manufacturer's Certificates

The Contractor shall furnish the Project Manager with a manufacturer's certificate conforming compliance to the specification in respect of all items of Plant, equipment and materials. The original and one copy of the manufacturer's certificate shall be delivered to the Project Manager not later than 14 days prior to the intended date of delivery of the item to Site.

401.9 Proprietary Materials

Proprietary materials shall be supplied in suitable containers and in appropriate batch sizes for the work to be undertaken. The containers shall be marked with the following information:

- i. Storage instructions
- ii. The manufacturer's name
- iii. Shelf life and dates of manufacture
- iv. Material identification
- v. Batch reference number
- vi. Net weight
- vii. Mixing instructions
- viii. Any warnings or precautions concerning the contents and their safe use.

The Contractor shall supply with each consignment of proprietary material delivered to the Site, certificates furnished by the manufacturer or his agent stating:

- i. The manufacturer's name and address
- ii. The agent's name and address where applicable
- iii. Material identification
- iv. Batch reference numbers, size of each batch and the number of containers in the consignment
- v. Date of manufacture.

401.10 Rejected Materials

Should any item of plant, materials or manufactured articles be in the judgment of the Project Manager, unsound or of inferior quality or in any way unsuited for the purpose in which it is proposed to employ them, such items, materials or manufactured articles shall not be used upon the Works but shall be branded, if in the opinion of the Project Manager this is necessary, and shall forthwith be removed from the Site.

402 Samples and Storage of Materials

Where required by the Project Manager the Contractor shall submit to the Project Manager for approval samples of pipes, fittings and materials prior to procurement. The Contractor shall only store pipe, fittings and other material at places approved by the Project Manager and shall at all times provide adequate supervision and watchmen to prevent theft or damage. Any loss or damage incurred will be the Contractor's responsibility.

Pipes shall not be stacked higher than recommended by the manufacturer. The area on which the pipes are to be stacked shall be free draining, the grass or other vegetation shall be kept cut and suitable timber

cradles shall be provided on which the pipes shall be laid. End stops to all stacks shall be provided.

Fittings and valves shall not be stacked more than one tier high and they shall be supported off the ground by suitable timbers.

Air valves, rubber joint rings, gaskets, bolts and similar fittings and materials shall be kept in approved locked premises and such fittings and materials shall not be distributed to the trench side until immediately prior to laying, fitting, jointing or assemble thereof. All rubber joint rings and gaskets must be stored in a cool damp location and all fittings and materials shall at all times be stored in the shade under cover and protected from the weather to the satisfaction of the Project Manager.

403 Flanges

Flanges shall be faced and drilled to conform to the dimensions specified in BS 4504. Flanges shall be compatible with the pressure rating of the adjacent pipework or as stated on the drawings. Bolts, nuts and washers (two washers per bolt) shall be to BS EN 1092-3; 2003. No bolt shall project less than two full threads beyond its nut after tightening. In no circumstances shall the shortening of excessively long bolts by cutting be allowed.

Gaskets shall comply with replaced by BS EN 1514 (1997) and replaced by BS EN 681-2 (200) and BS 681-1 (1996) Type W. Flanges shall be painted with two coats of epoxy resin paint. Puddle flanges shall be fitted to all pipework passing through water-retaining structures and manholes greater than 2.5m deep.

404 Mechanical Couplings

Unless otherwise specified or shown in the Drawings pipes and fittings shall be supplied with flexible joints. Mechanical couplings shall be of the Dresser, Viking Johnson type without a centre register. Joints rings used shall be of the ethylene propylene rubber (EPDM) or other material approved by the Project Manager. All mechanical couplings and flange adapters including nuts, bolts and washers shall be supplied with 'Rilsan' nylon thermoplastic polyamide applied by fluidized bed dipping or similar approved.

405 Materials for the Assembly of Flexible Joints

Lubricant shall be of a kind not conducive to the growth of bacteria and shall have no deleterious effects on either the joint rings or pipes. Lubricants for water supply shall not impart to water, taste, colour, or any effect known to be injurious to health.

406 Ductile Iron Pipes

406.1 General

Ductile iron pipes and fittings for water supply shall comply with BS EN 545 (1995). Pipes and fittings shall have spigot and socket joints unless otherwise specified. Pipes shall be class K9. Spigot and socket flexible joints shall be of the push-fit type with gaskets of ethylene propylene rubber (EPDM). The Contractor shall supply 5% of the straight pipes suitable for cutting on site and these shall be clearly marked.

406.2 Corrosion Protection

Pipes and fittings shall be protected externally with an extruded polyethylene or polyurethane coating complying with DIN 30674 Part 1. Pipes and fittings shall be lined internally with centrifugally applied cement mortar and complying with DIN 30674. Joint areas shall be coated with epoxy or polyurethane to DIN 30674. All lining and coating materials shall be approved for contact with potable water by an internationally recognized body like the Drinking Water Inspectorate of UK.

407 Galvanised Steel Pipes

Galvanised steel pipes shall be medium duty manufactured to BS 1387.

408 Steel Pipes

408.1 General

Steel pipes shall be manufactured to BS EN 10224 or AWWA C200 and shall be suitable for the pressure ratings required by the Contract. Fittings shall conform dimensionally to BS EN 10224, AWWA 208-59 or AWWA M11. Unless otherwise specified or necessary to meet the requirements of the Contract steel pipes shall be manufactured as follows:

- a) DN300mm and below shall be manufactured to minimum of Grade L235 or API 5L Grade B
- b) DN350mm and above shall be manufactured to a minimum of Grade L275 or API 5L Grade X42. The pipes and fittings of diameter 600mm or less shall be supplied with push-fit spigot and socket type joints with integral gasket of EPDM rubber or similar to BS EN 10224 or BS CP 2010. Pipes greater than 600mm shall be supplied with ends cut square suitable for use with flexible couplings and the external weld ground back sufficiently.

The Contractor shall supply 5% of the straight pipes as half length pipes (not exceeding 6m). Each pipe shall be supplied complete with a coupling for jointing.

408.2 Corrosion Protection

Steel pipes and fittings shall be protected externally at the manufacturer's works with fusion bonded epoxy resin in accordance with AWWA C213. Pipes greater than 600mm and all fittings shall also be lined internally with fusion bonded epoxy to AWWA C213. Pipes 600mm or less shall be lined with cement mortar to AWWA C205 or BS EN 10298. All lining and coating materials shall be approved for contact with potable water by an internationally recognized body like the Drinking Water Inspectorate of UK.

Where required by the Bills of Quantities, the Supplier shall also price for the provision of an alternative 3LPE coating to DIN 30670 or AWWA C215 of a triple wrap system of fusion bonded or sprayed epoxy primer, an intermediate polymer adhesive layer and an extruded high density polyethylene coating in general conformance with ISO/DIS 21809-1 Class B as appropriate.

409 Glass Reinforced Plastic (GRP) Pipes and Fittings

Glass reinforced plastic (GRP) pipes and fittings for pressure water supply shall be high stiffness and shall comply with the relevant provision of BS 5480. The minimum pipe stiffness shall be 5,000 N/m².

Pipes and fittings shall be marked in accordance with Clause II g. BS 5480.

Pipes shall only be cut by techniques which can be shown not to impair the pipes pressure regression performance. Where any pipe is cut the exposed fibres at the cut pipe end shall be resealed to prevent potential long term degradation. Methods of cutting and resealing exposed fibres shall be submitted to the Project Manager for Approval. Elastomeric sealing rings and foils shall comply with BS EN 681.

On delivery to site and immediately prior to installation each pipe shall be visually inspected both externally, and where possible, internally for damage such as star cracking of the gel coat layer. Where any damage extends through the pipe wall the pipe shall be rejected or the damaged section cut out and replaced in accordance with repair methods approved by the Project Manager. If in the Project Manager's opinion the pipe is not suitable of repair it shall be rejected and removed from site.

410 uPVC Sewers and Pressure Pipes and Fittings

Unplasticised PVC pipes and fittings for water supply pressure pipes shall comply with British Standards 3505 current but also superseded by BS EN 1452 and 4346. They shall be obtained from an approved manufacturer and shall be minimum pressure rated (12 bars) unless otherwise stated.

Unplasticised PVC pipes and fittings for gravity sewers and drains shall comply with British Standards

4660 or 5481 and shall be obtained from an approved manufacturer. Restrained rubber ring type push fit flexible joints shall be used unless otherwise stated. Solvent weld joints will not normally be permitted. Pipes and fittings shall be protected from the direct rays of the sun at all times by means of reflective cover sheets.

411 Concrete Pipes, Bends and Junctions

Concrete pipes, bends and junctions for use in sewers shall be made with sulphate-resisting cement. Pipes, bends and junctions shall conform to the requirements of BS 5911 for the particular class of pipe required to be used. The internal dimensions shall be true and regular and the internal surface smooth and free from surface blemish. The actual diameter of the pipe shall be not less than the nominal diameter. All joints shall be of the gasket type with flexible spigot and socket approved by the Project Manager. Gaskets shall be elastomeric complying with BS EN 681.

The main pipe and branches of all junctions shall be of the same strength classification and shall have the same internal dimensions as the pipes with which they are to be used.

The pipes, bends and junctions delivered to the Site shall be certified by the pipe manufacturer to have complied with BS 5911, or other approved standard and one copy of the certificate shall be delivered to the Project Manager before the goods are unloaded.

Unless otherwise specified pipes are required to be of Extra Strength; they may, unless otherwise specifically called for, be reinforced either with cast-in steel or by an external wrapping of fibre glass and resin, applied by an approved manufacturer.

The Contractor shall provide all facilities for and shall carry out jointly with the Project Manager (if so required) a full visual inspection of all pipes, bends and junctions for manufacturer's defects and other faults or damage. Before any pipe, bend or junction is laid it shall again be carefully examined and sounded with a wooden mallet. Any pipe found to be cracked or otherwise defective shall not be used on the Works.

Concrete pipes shall be internally coated with a 100 percent solids coal tar epoxy lining 70 percent minimum epoxy content. Coat thickness 300 micron minimum.

412 HDPE Pipes and Fittings

412.1 General

Polyethylene pipes up to nominal size 63mm for below ground use shall be coloured blue and comply with the relevant provisions of BS 6572. Polyethylene pipes for use in nominal diameters greater than 63mm shall be as specified below.

The pipes shall be clearly and indelibly marked to show the name of the manufacturer, diameter, pressure class and date of manufacture.

House connection pipework downstream of the manifold shall be PE80; all other HDPE pipework shall be PE100.

412.2 Compound Material

The material from which the pipes are made shall be in accordance with ISO 4427-1. All pipes shall be manufactured using pre-compounded carbon black, bimodal, high density polyethylene MRS 10.0 material (PE100). The use of natural PE100 with a Carbon black master batch is strictly not allowed.

Carbon black should be well dispersed to give outstanding UV resistance, and should have a minimum carbon content of 2%. Pipes should be manufactured from certified PE100+ material with batch certification available with pipe delivery.

412.3 Identification compound

The compound used for identification stripes shall be manufactured from a PE polymer manufactured from the same type of base polymer as used in the compound for pipe production.

412.4 General appearance

When viewed without magnification, the internal and external surfaces of pipes shall be smooth, clean and free from scoring, cavities and other surface defects such as would prevent conformity of the pipe to ISO 4427. The pipe ends shall be cut cleanly and square to the axis of the pipe.

412.5 Color

The pipes shall be black with coloured identification stripes.

412.6 Dimensions

The dimensions of the pipe shall be measured in accordance with ISO 3126. Manufacturing shall be to ISO 4427 Standard, as per the approved dimensions chart.

Pipes should be manufactured in machinery capable of ultrasonic wall thickness detection with production reports provided with delivery of pipes. Where coiling is possible, the minimum internal diameter of the coil shall not be less than 18d.

The lengths shall be supplied to minimize the number of joints to be done in the field, and the size that is allowed to be legally transported on Kenyan roads by the traffic department.

412.7 Markings

All pipes shall be permanently and legibly marked in such a way that the marking does not initiate cracks or other types of failure and such that normal storage, weathering, handling, installation and use does not affect the legibility of the marking.

The colour of the printed information shall differ from the basic colour of the product. The marking shall be such that it is legible without magnification. The frequency of marking shall not be less than once per metre. Markings should be made using a hot embossed foil stamp printing.

Each pipe shall have a minimum of 3 equispaced blue longitudinal stripes indicating medium of fluid transported in the pipes. A summary of marking requirements are given in the table below.

Minimum required marking

<u>Aspect</u>	<u>Marking</u>
Standard Number	ISO 4427
Manufacturer's identification	Name or symbol
Dimensions ($d_n \times e_n$)	e.g. 125X11.4
SDR series (for DN > 32)	e.g. SDR 11
Material and designation	PE 100
Pressure rating in bar	e.g. PN 16
Production period (date or code)	e.g. 0204 ^a
Country of Production	Kenya

Aspect	Marking
Coils shall be sequentially marked with the metreage, indicating the length remaining on the coil.	
a - In clear figures or in code providing traceability to the production period within year month and, if the manufacturer is producing at different sites, the production site.	

412.8 Jointing of Pipes

Unless otherwise specified or approved by the Project Manager, Polyethylene pipes shall be electro fusion welded. Joints between polyethylene pipes supplied from different manufactures or not manufactured from the same grade of polymer shall only be jointed by electro fusion or by push fit mechanical couplings. Mechanical couplers and compression type fittings shall incorporate a serrated internal liner to support the pipe against compression loads exerted by the fitting and to prevent pullout under axial load.

Butt or socket fusion joint techniques shall only be applied between pipes supplied from single source and manufactured from the same grade of base polymer. Fusion welding of polyethylene pipes shall only be undertaken by skilled operatives using appropriate specialized tooling. Pipes to be jointed shall be free from contamination and care shall be used to protect fusion jointing operations from wind and against the effects of inclement weather. Mechanical jigs or other approved methods shall be used to ensure correct alignment of the pipe when making butt fusion joints. Details of fusion welding procedures including details of tools, operatives, materials and method statements shall be submitted to the Project Manager for approval prior to any jointing.

Steel and iron pipe fittings shall comply with the relevant provision of BS EN 545 (1995) replaced by BS EN 10224 but also current.

412.1 General

Polyethylene pipes up to nominal size 63mm for below ground use shall be coloured blue and comply with the relevant provisions of BS 6572. Polyethylene pipes for use in nominal diameters greater than 63mm shall be coloured blue High Density Polyethylene (HDPE) suitable for a working pressure of 12 bars.

The pipes shall be clearly and indelibly marked to show the name of the manufacturer, diameter, pressure class and date of manufacture.

House connection pipework downstream of the manifold shall be PE80; all other HDPE pipework shall be PE100.

412.2 Joints

Unless otherwise specified or approved by the Project Manager Polyethylene pipes shall be electro fusion welded. Joints between polyethylene pipes supplied from different manufactures or not manufactured from the same grade of polymer shall only be jointed by electro fusion or by push fit mechanical couplings. Mechanical couplers and compression type fittings shall incorporate a serrated internal liner to support the pipe against compression loads exerted by the fitting and to prevent pullout under axial load.

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effects of inclement weather. Mechanical jigs or other approved methods shall be used to ensure correct alignment of the pipe when making butt fusion joints. Details of fusion welding procedures including details of tools, operatives, materials and method statements shall be submitted to the Project Manager for approval prior to any jointing.

Steel and iron pipe fittings shall comply with the relevant provision of BS EN 545 (1995) replaced by BS EN 10224 but also current.

413 Gate Valves

413.1 General

Valves for normal duty on water pipelines with pressure ratings up to PN25 shall be key operated cast iron flanged gate valves for waterworks purposes generally complying with the requirements of BS 5163 (Type B). All Gate Valves shall be supplied with a 10 year manufacturer's warranty.

Cast iron gate valves for pressure ratings to PN14 shall be cast iron flanged valves complying with BS 5150 replaced by BS EN 1171 (both BS 5150 and BS 5151) or cast iron parallel slide valves complying with BS 5151.

Butterfly valves for pressure ratings of up to PN14 shall be double flanged wafer type butterfly valves complying with BS 5155.

Unless otherwise specified valves for use on steel pipes shall be flanged, where butt-weld ends are specified valves shall comply with BS EN 1984, or BS EN 13709.

413.2 Wedge Gate Valves for Manual Operation

Valves up to and including DN 300 shall be of the resilient seal type and valves larger than DN 300 shall have metal seals.

Spindles shall be of the non-rising type and screwed so as to close the valves when rotated in the clockwise direction. The direction of closing shall be clearly cast on the valve cap or hand wheel as appropriate. The valves shall be constructed of the following materials:

body	-	cast iron;
spindle	-	forged bronze or stainless steel;
metal faces and seal	-	Gunmetal.

The valves shall be suitable for the unbalanced head as specified or indicated in the schedules.

Suitable gearing and anti-friction devices such as ball bearing thrust collars shall be provided as necessary to enable opening and closing by manual operation at the pressure stated, using an effort no greater than 26kg on the tee key or hand wheel supplied. Hand wheels shall not exceed 500mm diameter. A bypass with gate valve forming an integral part of the valve shall be provided where recommended by the valve manufacturer for the pressures specified.

Gearing on valves of DN 300 and less shall be enclosed in a sealed gearbox suitable for buried installation and operated with a tee key. Except where shown in the Drawings, all valves exceeding DN 300 shall be provided with bevel gearing and hand wheels. Valves to be used for washouts and isolating air valves shall have screwed seats.

Extension spindles shall be galvanized or stainless steel adequately supported with cast iron brackets,

and of sufficient diameter to prevent any whiplash effect through twisting when being used to operate the valves. The spindles shall be capped for key operation. Valve caps shall be fitted with hexagonal set screws.

Valves shall be coated with an approved epoxy complying with DIN 30674. Keys for valve operation shall be of sufficient length so that the valves can be operated by a man standing, but shall not exceed 1.2m in length, and shall have a detachable cross bar.

414 Butterfly Valves

414.1 General

Butterfly valves shall conform to BS EN 593. All Butterfly Valves shall be supplied with a 10 year manufacturer's warranty.

414.2 Construction

Butterfly valves shall have a high grade cast iron body to BS EN 1561 designed to the specified working and test pressures. The pressure rating valve shall be cast in the valve body. The disc shall be of high grade cast iron to BS EN 1561 or nodular cast iron to BS 2789 to the defined working and test pressures. It shall have a convex shape designed to achieve low head loss characteristics. The valve shafts shall be of stainless steel operating in self-lubricating bushes in the body.

The valve seat shall be of gunmetal to BS 1400. The sealing ring shall be a renewable Ethylene Propylene Diene Monomer (EPDM) rubber attached to the disc edge by a sectional bronze retaining ring to form a resilient and durable seal.

The valves shall be fitted with hand wheel actuators not exceeding 500mm diameter incorporating gearing to allow opening and closing by manual operation at the pressure stated using an effort no greater than 36kg on the hand wheel supplied.

In all cases the gearing shall be designed to close the valve, from fully open to fully close in a period of not less than ten minutes with this effort. Actuators shall be designed so as to close the valves when the hand wheel is turned in a clockwise direction; the direction of closing shall be clearly cast on the hand wheel. Position indicators shall be fitted to all actuators.

Where required valves shall be electrically actuated with a manual override. Remote actuation shall be provided with a visual indication of valve open, valve closed and percentage opening together with fault indication.

414.3 Valve Performance

A performance curve, relating percentage valve travel, open area and discharge coefficient shall be submitted to the Project Manager. The head loss coefficient with valve fully open shall be defined.

414.4 Testing

All valves shall be tested in accordance with BS EN 593 and pressure and material test certificates shall be submitted to the Project Manager for approval.

415 Air Valves

Air valves shall be either:

- a. Single (small) orifice valves (SAV), for the discharge of air during the normal operation of the pipeline.
- b. Double orifice valves (DAV), consisting of a large orifice and a small orifice. These shall permit the bulk discharge of air from the main during filling and air inflow when emptying in addition to

the discharge of small quantities of air during normal operating conditions.

Air valves shall be supplied with an independent isolating butterfly valve (DAV) or cock (SAV) which permits the complete removal of the air valve from the main, without affecting the flow of water in the main.

Each air valve assembly shall be suitable for connection to a flange on the pipeline.

At the connection between the air valve and its isolating valve a BSP tapping shall be made suitable for fitting of a pressure gauge. All tapings shall be sealed by a brass plug and copper compression ring gasket.

Air valves shall operate automatically and be constructed so that the operating mechanism will not jam in either the open or closed positions.

416 Non-Return Valves

416.1 Swing Check Valves

Non-return valves shall be suitable for waterworks purposes and shall be manufactured to comply with the general requirements of BS EN 12334. They shall be double flanged type, non-slamming and recoilless on flow reversal.

Valves of DN 700 and larger shall be of the multi-disc type or tilting disc type. The valves shall have a high grade cast iron body and cover to BS EN 1561 Grade 220/260 with gun metal nickel bronze alloy door seating. The hinge pin shall be of stainless steel carried on non-corrodible bearings.

416.2 Nozzle Check Valves

Nozzle check valves shall be slam free closing with a streamlined cross section as manufactured by Mannesmann Demag or similar.

417 Flow Control Valves

Flow controls unless otherwise specified shall be butterfly valves. They shall be installed complete with a headstock and position indicator showing the degree of opening.

418 Pressure Reducing Valves

Pressure reducing valves shall automatically reduce a higher inlet pressure to a steady lower downstream pressure regardless of changing flow rate or varying inlet pressure. The valve shall be a hydraulically operated pilot controlled diaphragm type, globe or angle valve.

The main valve shall have a single removable seat and a resilient disc.

419 Ball Float Valves

Ball float valves which are to be installed within reservoirs shall be the delayed action type to eliminate inflow at small valve openings. They shall be fitted with a stilling chamber, auxiliary float valve and inlet bellmouth with regulating valve. The main valve shall be fitted with a long actuating lever to provide a long float travel for slow valve closure.

Valves shall be of the right angle pattern type with flanged inlet and have a resilient synthetic rubber disc which forms a drop tight seal against a removable seat insert. Valves shall be free of cavitation and vibration under the specified working conditions. Flanged tapers shall be provided on the inlets as necessary to suit the size of valves proposed.

Valves shall be capable of withstanding the maximum static pressure and of passing the maximum flow rate shown. Orifice plates shall be provided as necessary to absorb excess working pressure at the initial flow rates indicated.

The pressure rating of the valve shall be cast into the body of the valve.

420 Constant Flow Valves

Constant flow valves shall maintain a constant rate of flow regardless of fluctuations in upstream pressure.

Valves shall be hydraulically operated, diaphragm actuated globe pattern. They shall have a resilient synthetic rubber disc which forms a drop tight seal against a removable seat insert. The diaphragm assembly and valve stem shall be fully guided at both ends by bearings in the valve cover and valve seat. The diaphragm shall consist of nylon fabric bonded with synthetic rubber. Packing glands and stuffing boxes are not permitted and there shall be no pistons operating the valve or pilot controls.

The pilot control shall be direct acting diaphragm valve designed to close when the actuating differential increases beyond the spring setting. The actuating differential pressure shall be produced by a thin edged orifice plate installed in an orifices flange downstream of the valve.

Any necessary repairs to the valve shall be accomplished without removing the valve from the main.

Valves shall be sized to pass the maximum continuous flow stated on the drawings at the working pressure given. The pressure rating of the valve shall be cast into the body of the valve.

421 Surface Boxes and Chamber Covers

Surface boxes and chamber covers shall be either cast iron or ductile iron and coated with black bituminous solution.

Surface boxes over gate valves shall be hinged and chained and shall generally comply with BS 5834. In roads,

tracks, verges: Heavy duty with 150 x 150mm nominal clear opening.

In fields and areas subjected to light wheeled or pedestrian traffic: Medium duty with 150 x 150 mm nominal clear opening.

Surface boxes for hydrant chambers shall have a 150 x 150mm clear opening and shall comply with BS 750 and shall be suitable for heavy traffic loading.

Covers to air valve and other chambers shall be to the dimensions and loading requirements shown on the Drawings or as stated in the Bill of Quantities.

Covers shall be suitable for the following maximum safe centre static loads:

Light duty	- 250kg
Medium duty	- 1500kg
Heavy duty	- 5000kg

Where applicable, covers shall comply with BS EN 124 or other appropriate Standard.

Lifting keys shall be provided for each type surface box or cover supplies. One set of keys shall be provided for every ten surface boxes or covers subject to a minimum of ten sets of keys or the actual number of covers if less than ten.

422 Gully Gratings and Frames

Road gully gratings and frames shall be of approved type and manufacture in cast Grey Ductile Iron and shall be of Heavy Duty Non-rocking Pattern designed for wheel load of 11.5 tonne and generally in accordance with BS EN 124. Single gullies of nominal size 1050mm x 750mm. Inlet gratings of other plan dimensions shall have a minimum water way area of 49% of the total inlet grating area.

Gully frames shall be set in cement mortar and haunched with Class C25 concrete. It shall be the

Contractor's responsibility to establish the finished road levels from the appropriate authority and fix the gratings accordingly.

423 Manhole Safety Chains

Mild steel chain shall be 8 mm nominal size Grade M (4) non-calibrated chain, Type 1, complying with BS withdrawn. After manufacture, mild steel safety chains shall be hot dip galvanized in accordance with BS EN 124.

424 Manhole and Chamber Access Covers

The manhole and chamber access covers shall comply with BS 497 Part 1 and be obtained from an approved manufacturer and shall be to the internal minimum clear opening as detailed in the Contract.

All manhole and chamber access covers in road shall be to an approved Heavy Duty pattern and in footpaths shall be medium/heavy duty unless otherwise specified. The frame and lid shall have key holes formed with sealed pockets underneath to prevent ingress of sand, grit and surface water and shall be of an approved non-rocking pattern. The covers and frames shall have accurate seating faces to prevent rocking and the ingress of sand or water, and it shall be tight fitting to resist overflow conditions or unauthorized removal. The seating faces shall be coated with graphite grease before installation of the cover.

A supply of keys for use with every type of manhole cover and surface box shall be handed over by the Contractor at the completion of the Contract on the basis of one set of keys for each 50 covers or part thereof.

Manhole and chamber cover frames shall be set in cement mortar and haunched with Class C30/10 concrete and shall be set to the camber or fall of the finished road surface. It shall be the Contractor's responsibility to establish the finished road surface levels from the appropriate authority and to fix the covers accordingly.

425 Manhole Step Irons

Manhole step irons shall be of galvanized malleable iron and shall conform in all particulars to BS EN 13101.

Section 4B. Pipeline Construction

426 General

The requirement of this section shall apply to the construction of potable and raw water pipelines and pipework.

Within this section 'Plant' refers to pipe fittings, valves, surface boxes and chamber covers, and other such materials required for pipelines, mains and pipework at reservoirs and elevated tanks.

All Plant shall be suitable for waterworks purposes for the conveyance of potable water in the climatic conditions prevailing in Kenya and in particular at the location of the Works.

The Project Manager shall provide details of each pipeline diameter, pressure rating, hydraulic characteristics and the approximate alignment. The Contractor shall, in consultation with the Project Manager set out the proposed pipeline alignments, making any changes that the Project Manager may deem necessary, confirming also the exact locations of all manholes, valves, air valves, washouts, hydrants, and the like.

427 Topographic Surveys

Topographic surveys along pipeline routes shall be either:-

- Plan and profile surveys, or
- Line and level traverse surveys, as

instructed by the Project Manager.

Plan and profile surveys shall cover a strip of 10.0m wide centrally on the proposed centre line of the pipeline. The survey shall be carried out in accordance with the specification detailed in Clause 106.

Line and level surveys shall comprise a traverse line along the centre line of the pipeline as established by the Project Manager.

428 Handling and Transport of Pipes and Fittings

The loading, transporting, unloading and handling of pipes and fittings shall be carried out such that no damage is caused. All in accordance with the recommendations of the manufacturer and to the approval of the Project Manager. The use of lifting hooks is not permitted. Pillows shall be provided between lashing (ropes, wires or chains) and the pipes. All cradles and lashings shall be of such widths as to prevent damage to the coating of the pipe, or distortion of the pipes.

Valves and fittings shall be transported in timber packing and where possible in the manufacturer's original packaging.

Protective cover and other protective materials provided by the manufacturer shall not be permanently removed until immediately prior to installation.

In the event of any damage being caused to a pipe, the Project Manager shall determine whether damaged piece shall be replaced or repaired. Repair to coating only shall be allowed and shall be as directed by the Project Manager.

In all instances when along trench sides, ferrous pipes shall be supported within 1 metre of either end on sand filled bags such that no part of the wall of the pipe touches the ground, and in the case of pipes over 6 metres long with additional central sand bags.

When pipes are being loaded into vehicles care shall be taken to avoid their coming into contact with any

sharp corners such as cope irons, loose nail heads, etc. Whilst in transit, pipes shall be well secured over their entire length and not allowed to project unsecured over the tailboard of the lorry.

Pipes may not be offloaded from lorries by rolling them, suitable carnage shall be used. Pipes shall not be rolled or dragged along the ground.

429 Stringing and Examination of Pipes Prior to Laying

All DI and Steel Pipes and their coatings and linings shall be carefully inspected on Site prior to laying.

Inspection of the pipe will be made by the Project Manager after delivery and again immediately prior to laying. Any pipe shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall immediately be removed from the site.

All pipe or fittings shall be examined before laying and no piece shall be installed which is found to be defective. Any damage to the pipe linings or coatings shall be repaired as directed by the Project Manager. Handling and laying of pipe and fittings shall be in accordance with the Manufacturer's written instructions and as specified herein.

Before lowering into the trench or placing in position each ductile iron pipe or casting shall be slung and sounded with a mallet to test for hair cracks. Pipes that do not ring true will be discarded.

All cement mortar linings shall be visually inspected for defects such as cracking or spalling and crack widths shall be measured to confirm that width is such that natural re-sealing will occur once put into service; otherwise cracks as well as any spalling shall be made good before laying in accordance with the manufacturer's written instructions.

All epoxy linings and all coatings shall be subjected to holiday detection tests, in accordance with NACE RP 0490, the voltage of the holiday detector being selected appropriate for the material and its thickness. No pipe shall be laid having failed the holiday tests until the defective area is made good in accordance with the manufacturer's written instructions and retested satisfactorily before use.

All pipe and fittings shall be thoroughly cleaned before laying, and shall be kept clean until they are used in the work, and when laid, shall conform to the lines and grades required. Pipe shall not be laid unless the trench is free of water and in a satisfactory condition. Ductile iron pipe and fittings shall be installed in accordance with the requirements of AWWA C600 except as otherwise provided herein. If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner by the Contractor, at his own expense.

When laying is not in progress, including any work break exceeding 30 minutes, the open ends of the pipe shall be closed by watertight plugs or other approved means. Good alignment shall be preserved in laying. The deflection at joints shall not exceed that recommended by the Manufacturer. End caps shall not be removed until such time as the pipe is to be inspected and laid.

Where the pipeline crosses roads, tracks or any other access or where directed by the Project Manager, the Contractor shall place the pipes so that access to the public is not in any way prohibited.

Shortly before laying or fixing any valve, pipe or fitting, the Contractor shall examine each valve, pipe and fitting to ascertain that there is no damage or defect. The Contractor shall give the Project Manager not less than 48 hours notice of his intention to undertake such examination. The Contractor shall not lay such pipes and fittings until he has received approval from the Project Manager.

Linings shall be inspected prior to laying and any defect made good.

430 Laying Pipes

Immediately before any pipe is lowered into the trench the plug shall be removed from the end of the last pipe laid and the new pipe shall be carefully lowered into the trench.

Each pipe and fitting shall be laid true to alignment curve and gradient in accordance with the Drawings or as directed by the Project Manager. The minimum gradient shall not be flatter than 1 in 500.

Pipes shall be boned to gradient and sight rails shall be provided for this purpose at intervals not exceeding 50m and at all changes in grade. No dips or summits shall be permitted other than as shown on the Drawings.

430.1 Embedment and Compaction

All ductile iron and steel pipes shall be embedded using a sand or coarse grained soil with less than 12% fines, which if necessary shall be imported if excavated material is found to be unsuitable:

In areas prone to water logging or where specifically called for on the Drawings or in the Bills of Quantities a single size or graded gravel shall be used as a special lower bedding, with grading as indicated below.

Nominal Pipe Diameter (mm)	Grading for Special Lower Bedding [to ASTM Sieve Sizes]	
	Single size Gravel	Graded gravels
< 200	10 or 14 single-size gravel	14 to 5 graded
200 to 500	10, 14 or 20 single-size gravel	14 to 5 graded or 20 to 5 graded
> 500	10, 14, 20 single-size crushed rock, or gravel	14 to 5 graded or 20 to 5 graded

The suitability of as-dug trench material as an embedment material and where imported, the source shall be approved by the Project Manager. Any delays as a result of not seeking this approval in good time shall be entirely to the Contractor's account

All layers of the embedment shall be thoroughly compacted, and shall not exceed 150 mm and be raised evenly on both sides of the pipe as it is placed. A minimum compaction of 90% MPD shall be achieved at all times, this being confirmed by sampling and testing at intervals on different levels of embedment at intervals of not more than 50 m with testing in accordance with BS 1377 or ISO 22476 using the "sand replacement" method.

Should any results fail to achieve this absolute minimum level, then the pipes, embedment material and layer shall be removed for an equal distance on either side of the failed test, the total distance being equal to the length between adjacent sampling locations, and re-laid appropriately but with compacted layer thickness halved. In addition the distance between sampling and testing shall also be halved until in the opinion of the Project Manager's Representative a sufficient number of consecutive passes allows both individual layer thickness and the distance between sampling and testing to be returned to the previous thickness and spacing.

All backfill soil above the embedment shall be free from clay lumps, boulders and rock fragments greater than 50 mm and as far as practicable, given the nature of the soil, 90 % MPD shall be attained. However, this requirement may be relaxed to 85% MPD by the Project Manager's Representative if he considers the circumstance warrant it.

430.2 Pipes Laid in Trench

Pipes and fittings laid in trench shall have at least the minimum cover stated in the Drawings.

Long radius curves in buried pipelines shall be negotiated by deflections taken up in the joints of one or more pipes. The deflection at joints shall not exceed 75% of the manufacturer's maximum specified limits. Designs have been based upon the use of 6m long pipes. If the Contractor provides longer pipes sufficient short lengths shall be provided to enable the proposed pipe curvature without additional bends or deep excavation.

Pipes shall not be dragged along the trench bottom. Pipes laid in trenches shall be laid and firmly bedded on an even and uniform bed. Where pipes are not laid on a granular bed, the bottom of the trench shall be smooth and free from stones or other projections.

Joint holes shall be excavated below the trench bottom and shall be as small as possible and shall be filled in and compacted after the pipes are laid and before the refilling of the trench is commenced.

430.3 Pipe Bedding and Surround

For polyethylene, uPVC and GRP pipelines, Class S bedding shall be used where the cover is equal to or greater than 1.0m. Where there is less than 0.6m cover, Class A concrete surround shall be used. In between the Project Manager shall decide upon the bedding type dependent upon the assessed risk of damage to the pipe.

430.4 Pipes Laid Above Ground

Pipelines to be laid above ground shall be constructed of flanged ductile iron pipes with mechanical type expansion joints. Supports shall be provided at a maximum spacing of one pipe length and adjacent to the flanged joints.

The expansion joints shall compensate for a variation of ambient temperature between zero and 40° C on the adjoining pipeline. Anchorages shall be provided immediately uphill of each expansion joint and at each change in vertical and horizontal alignment. The ground/rock surface under the pipeline shall be re-graded as necessary to allow a satisfactory vertical alignment of the pipeline.

The Contractor may propose, as an alternative to the use of mechanical expansion joints, either of the following methods for accommodating thermal expansion:

- (1) A zigzag pipeline alignment whereby the thermal movement is accommodated by deflection of the bends.
- (2) A rigid form of construction with the thermal movement being constrained within the pipe walls by the use of substantial anchor blocks.

Joints shall be made in compliance with the manufacturer's instructions as approved by the Project Manager. Care shall be taken to ensure the absolute cleanliness of the pipe ends and joint components. Only the recommended approved lubricants shall be used.

Jointing shall only be carried out by experienced personnel under close supervision by the Contractor.

The Contractor shall ensure that no dirty water or other extraneous matter is allowed to enter the pipes during or after laying. In the event of dirty water or extraneous matter entering the pipes the Contractor shall immediately carry out cleaning and disinfection as directed by the Project Manager.

Except when necessary for jointing, the end of the last pipe laid shall be kept plugged to the satisfaction of the Project Manager to prevent the ingress of dust, dirt, rocks and other debris.

The Contractor shall be liable for any damage caused to the Employer's Plant and apparatus or other equipment as a result of foreign matter of any kind not having been cleared out of pipelines before Taking-Over.

Pipe trenches shall not be backfilled until approved by the Project Manager. Once approved trenches shall be backfilled without delay to at least the minimum extent required for pressure testing.

431 Cutting Pipes

The edges of the cut pipes shall be clean, true and square. Ductile iron pipes shall only be cut with an approved mechanical pipe cutter in conformity with the pipe manufacturer's recommendations. The use of oxyacetylene flame cutter will not be permitted. The edges of the cut together with those parts of the pipes from which the coating has been removed shall be given two coats of bituminous paint and the internal lining repaired. When the cut pipe is to be inserted in a "Tyton" type joint it shall be bevelled for 10mm at 30° to pipe the axis.

Asbestos Cement, HDPE, uPVC and GRP pipes shall be cut with an approved mechanical pipe cutter and in conformity with the pipe manufacturer's recommendations. Where the cut end of the pipe is to be incorporated in a joint the pipe shall be turned down to the correct diameter required for forming the joint by an approved mechanical turning machine. The length of turning shall be accurately bevelled by mechanical means to the dimensions specified in the manufacturer's recommendations.

Steel pipes shall be cut by using a mechanical pipe cutter approved by the Project Manager. The use of an oxyacetylene flame cutter will not be permitted. The edges of the cut shall be given two coatings of liquid epoxy compatible with the original coating. The external coating and the internal lining shall be repaired to the approval of the Project Manager. The cut end shall be bevelled as required to suit the form of joint used.

432 Proprietary Joints and Couplings

Proprietary joints and couplings shall be assembled in accordance with the manufacturer's instruction as approved by the Project Manager. Where pipes are laid above ground and jointed with bolted couplings the joint shall be protected against vandalism by sheathing with an approved heat-shrink moulding as manufactured by Raychem of Swindon UK or similar approved.

433 Flanged Joints

Flanged joints shall be made with two washers per bolt, one under the bolt head and the other under the nut. The tightening of the bolts shall be carried out in the sequence and to the torque recommended by the manufacturer. A torque wrench shall be used.

Buried flange joints shall be protected by painting with approved bitumen paint and by wrapping using 'Denso' paste, mastic tape and outer wrap, or similar approved materials all in accordance with the manufacturer's instructions as approved by the Project Manager, unless supplied with epoxy coating and galvanized bolts.

Flanged adaptors and mechanical couplings shall have a RILSAN nylon coating applied by the manufacturer.

434 Steel Pipelines Welded Joints

If specifically required under the contract pipes shall not be welded. If permitted by the Project Manager for particular conditions the Contractor shall submit to the Project Manager a detailed method statement for constructing the pipeline using welded joints which shall include, but not be limited, to:

- (i) details of the Contractor's skilled labour and supervision staff who have direct experience in the construction of welded steel pipe;
- (ii) details of the Contractor's plant to be deployed;
- (iii) details of temporary staging, access and craneage;
- (iv) procedure for construction of supports and anchorages, and welding joints;
- (v) quality assurance proposals for testing the integrity of the welds.

These details shall be submitted to the Project Manager for his approval not later than 21 days before the Contractor wishes to commence pipe laying.

All field welds shall be inspected visually with special attention given to the line up and down the root run

or stringer beads. Non destructive testing of the completed weld shall be carried out using radiographic methods with procedures in accordance with BS 2910.

On completion and inspection of joint welding, remedial works shall be carried out on the internal lining and external coating. No more than five pipe joints shall be welded without completion of remedial works to joints.

435 Fixing Valves and Penstocks

Valves, penstocks and other fittings shall be securely fixed. Extension spindles and headstocks shall be properly aligned and fixed in a vertical position and valve caps shall be fixed securely using the locking nut.

436 Thrust and Anchor Blocks

Concrete thrust and anchor blocks shall be formed at bends, tees and valves in accordance with the details shown on the Drawings or as directed by the Project Manager. Excavation shall be made after pipelaying and the blocks concreted immediately after excavation. The back supports and blocks shall abut in to solid undisturbed ground with all loose material being removed before concreting.

No pressure shall be applied in any section of main until the concrete has achieved adequate strength and at least three day's curing.

Flexible joints shall not normally be cast in. Where the size of the block does not make this possible, additional flexible joints shall be provided no greater than half a pipe diameter beyond each face of the block.

437 Concrete Surround to Pipes

Where pipelines pass under streams and rivers or where directed by the Project Manager, the pipeline shall be surrounded with concrete as shown on the Drawings.

Concrete surround shall be "broken" at all pipe joints to retain flexibility in the pipeline. No joints shall be concreted in without the prior approval of the Project Manager.

438 Flotation of Pipelines

The Contractor shall ensure that flotation of the pipeline does not occur during construction. Sufficient backfill shall be placed over each pipe after laying and before testing to prevent flotation.

439 Pressure Rating

The pressure rating of pipes shall be as indicated on the drawing or Bill of Quantities or if not indicated then selected such that the maximum pressure in the pipeline inclusive of surge pressures shall not exceed the maximum allowable sustained working pressure rating of the pipe;

The surge pressure amplitude (the difference between maximum and minimum surge pressures) shall not exceed one half of the maximum allowable sustained working pressure rating of the pipe.

440 Testing of Water Supply Pipelines

All pressure pipelines shall be hydrostatically tested. Site test pressures shall be 1.5 times the maximum working pressure or allowance pressure plus 5 bar whichever is the smaller measured at the lowest part of the pipeline, unless otherwise specified on the drawings.

The Contractor shall give the Project Manager not less than 48 hours notice of his intention to carry out a pressure test. Testing shall not commence without the Project Manager's approval. Before a length of pipe is tested, each pipe shall be securely anchored. All thrust and anchor blocks shall have been constructed and, the barrel of each pipe shall be backfilled to the extent necessary to prevent flotation or movement of the pipeline and shall be not less than 600mm.

Normally joints shall be left exposed until pressure testing has been satisfactorily completed. Any need to backfill a pipeline before pressure testing shall not relieve the Contractor of his responsibility to excavate to locate and repair any leaks.

Pressure testing shall be carried out as the work proceeds in such lengths as are convenient but not exceeding 500m. The ends of the length of pipeline under test shall be closed by means of securely anchored caps or blank flanges. Pipeline valves shall not be used for this purpose. All washout valves shall be fitted with blank flanges and the valves opened before the commencement of any pressure test. At each air valve location, a special air release arrangement shall be provided to allow manual release of air during filling operations. Pressure testing shall not be carried out with permanent air valves in place.

The pipeline to be tested shall be filled slowly with water in such a manner that all air is expelled. Air vents shall be checked to ensure that no air is trapped at high points.

The pressure in the pipeline shall slowly be raised to the working pressure, the test pump disconnected and the pipeline left charged under pressure with air valves opened for a period of not less than 24 hours to allow air in the pipeline to be expelled and pipe linings and pipe walls of absorbent materials to become saturated. At the end of this period of time air valves shall be closed and the test pump shall be reconnected and the pressure in the pipeline raised to the test pressure and this pressure maintained for a period of 24 hours or such other period as directed by the Project Manager.

Throughout this period the pressure in the pipeline shall not be allowed to fall or rise more than 6m head of water above the test pressure and this shall be accomplished by pumping water into or releasing water from the pipeline as required. The volume of water pumped into or released from the pipelines shall be carefully measured. At the end of the test period the pressure in the pipeline shall be adjusted to the test pressure by pumping water into or releasing water from the pipeline as required.

The apparent leakage from the pipeline shall be ascertained from the net volume of water that has been pumped into the pipeline during the test period. The permissible loss shall not exceed 2 litres per metre nominal bore per kilometre length per m head per 24 hours.

During the pressure test exposed joints shall be inspected and any leakage or seeping joints shall be remedied. All signs of leakage shall be remedied whether total apparent leakage from the pipeline under test is less than the apparent allowable leakage or not. Should any length of pipeline fail to pass the pressure test the Contractor shall at his own expense carry out all work necessary to locate and remedy the faults and to retest the pipeline until it satisfactorily passes the test.

A low pressure air test (not exceeding 0.3 bar) may be used as a preliminary joint tightness test prior to backfilling and hydrostatic testing. The water used for pressure testing shall be provided by the contractor and shall be free from impurities and of such a quality which will not pollute or injure the pipeline. The Contractor shall be responsible for obtaining the water, transporting it and for its safe disposal on completion.

441 Cleansing and Sterilizing of Pipelines

After the pipelines have been completed and pressure tested satisfactorily as herein specified the Contractor shall flush out and cleanse the pipelines. Where water is provided by the Employer, the cost of this will be reimbursable under a provisional sum.

Diameters 300 mm and greater:

Pipelines shall be cleansed in sections and this shall be carried out by means of passing through polyurethane foam swabs. The swabs shall be to the approval of the Project Manager.

Diameters less than 300 mm:

Pipelines shall be cleansed in sections by flushing with potable water, for a period of time to be decided by the Project Manager's Representative.

Cleansing of any section shall be repeated as required by the Project Manager's Representative in the event of the initial or subsequent operation not being to his satisfaction. The cost of such water shall be charged to the Contractor.

The Contractor shall supply all necessary equipment for the cleansing and sterilizing operations, including all swabs and swab detectors which shall be handed over to the Employer on completion of the Works.

Swabs shall be passed through pipelines at speeds of between 0.2 and 0.4 metres per second to obtain the best cleaning results with the minimum number of passes. Should it be apparent from the debris collected by the swab that damage to the lining has occurred, the Contractor shall be wholly responsible for repairing the lining to the satisfaction of the Project Manager's Representative.

The swabbing operation shall be controlled by an experienced Project Manager to ensure that no undue surges in the pipeline, heavy docking of the pig or pressurising of the pipeline occur causing damage to any of the permanent works. Any damage caused shall be made good by the Contractor to the satisfaction of the Project Manager's Representative.

The Contractor shall make all necessary arrangements for the transportation of water from the point of supply from the Employer to the required location, and make all arrangements for the disposal of the water. All disposal methods and locations shall be to the approval of the Project Manager's Representative.

When the pipelines have been cleansed to the satisfaction of the Project Manager's Representative the Contractor shall introduce at a slow rate of water flow by a portable chlorinator or other approved means of a solution of sterilizing agent in such quantity and of such strengths as will result in the concentration of chlorine throughout the length of the pipelines of not less than 30 parts per million. This sterilizing charge shall be allowed to remain in the pipelines for 24 hours after which time the pipelines shall be thoroughly flushed using the supply water to remove chlorine in excess of that in the supply water.

When this flushing has been satisfactorily completed samples of water will be taken by the Project Manager's Representative for bacteriological analysis by the Employer. If any of the results of the analyses are unsatisfactory when compared with those of the control sample of the supply water the sterilizing process shall be repeated until satisfactory results are obtained. On completion of sterilizing and flushing the pipelines shall be left full of supply water.

The Contractor shall be solely responsible for the provision of all labour, materials and chemicals necessary for carrying out the foregoing operations.

The cost of water used for repeated cleansing, sterilizing and flushing pipelines in accordance with this clause of the Specification will be charged to the Contractor and the Contractor shall be responsible for all temporary works and other arrangements in connection with cleansing, sterilizing and flushing the pipelines.

The costs of the initial sampling analyses and preparing reports on the bacteriological quality of the water shall be borne by the Employer but the costs of any subsequent sampling analyses and preparing reports should the initial reports be unsatisfactory shall be borne by the Contractor.

442 Painting

All steel or ductile iron pipes and fittings exposed to view including above ground pipelines shall be painted after making good the external protection with two coats of “Bitumastic Aluminium solution D. 5909” manufactured by Wailes Dove Bitumastic Ltd, Hebburn, Durham, England, or similar approved.

Pipes and fittings in chambers shall be painted with two coats of “Bituros Solution” manufactured by Wailes Dove Bitumastic Ltd, or similar approved. Valves and Surface Boxes shall be similarly painted.

443 Connections to and Diversions to Existing Pipework

443.1 General

The Contractor shall be responsible for connecting new pipework and service connections laid under the Contract to existing pipework, and for blanking-off existing pipework and service connections. The connection shall be made in a manner to minimize any disruption to supply.

Before blanking-off or making a connection to existing pipework the Contractor shall notify the Project Manager in writing no less than 14 days in advance of the date on which he proposes to carry out the work. After giving such notice the Contractor shall obtain from the responsible Authority agreement on the precise date, times and method that the connection will be made. The connection or blanking-off shall be made at such times of the day or night as stipulated by the Project Manager.

The Contractor shall prepare a detailed method statement, programme of the work and a schedule of all plant and materials to be used and shall obtain the approval of the Project Manager not less than 72 hours before commencement of the work. The programme shall allow for the immediate re-commissioning on completion of the work.

The Contractor shall be responsible for locating the exact line and level of the existing pipework and service connections and shall agree with the Project Manager and the responsible Authority the precise location of the connection or blanking-off.

443.2 Materials

Before commencing the connection the Contractor shall excavate trial pits as necessary and shall check the outside diameter of the existing pipework and ensure that the couplings to be used for making connections to the existing pipework and the materials used for blanking-off existing pipework are dimensionally suitable.

The Contractor shall ensure that all the materials are on site not less than 24 hours before the commencement of the work.

443.3 Personnel

The Contractor shall ensure that at least one senior member of his field supervisory staff, who is experienced in such operations and fluent in both English and the language of his labourers is on site throughout the duration of the work.

The Contractor shall also ensure that all necessary skilled artisans and an adequate number of labourers for the operation are on site throughout the work.

443.4 Preliminary Work

The Contractor shall execute all works possible before disconnection of the supply including:-

- a. Excavation and supports to the excavation.
- b. Blinding with concrete the immediate working areas, but not less than the whole of the bottom of the excavation.
- c. Putting in all drains, or where this is not possible a sump of adequate size from which a pump may operate.

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- d. Casting the floor of any chamber which is later to be constructed around any of the works.
 - e. Casting the thrust blocks or any other works which may be required.
 - f. Exposing and cleaning pipes in readiness for the work.

443.5 Carrying out the Work

The Contractor shall be responsible for emptying the section of existing pipework on which the work is to be carried out, by a method agreed with the Authority and approved by the Project Manager.

The Contractor shall take all precautions necessary to prevent dirt and other foreign matter entering the pipelines.

The Contractor shall provide at the Site a sufficient quantity of clean water containing approximately 10 parts per million (10mg/l) of chlorine before proceeding with the cutting of the existing pipeline. Each item of pipework including the joints shall be submerged in the solution for a minimum period of 15 minutes immediately prior to installation.

443.6 Water Pipes and Chambers to be abandoned

Where existing water pipes are to be replaced with new pipework the existing pipework is to be abandoned. Where new works conflict with existing pipework to be abandoned, abandonment of pipework shall consist of removal and disposal to a site approved by the Project Manager. Water supply pipework shall not be abandoned until suitable alternative means of supply are in place and ready for connection.

Where chambers are to be abandoned these shall be broken down and disposed of and the void filled and compacted with suitable material approved by the Project Manager. Chambers deeper than 1 metre will be broken down to 1 metre below finished ground level and the remaining void filled and compacted with suitable material approved by the Project Manager.

Section 4C. Drains, Sewers and Manholes

444. Excavation for Drains, Sewers and Manholes

The ground shall be excavated to the lines and depths shown on the drawings or to such other lines and depths as the Project Manager may direct. Trenches shall be of sufficient width to enable the pipes to be properly laid and jointed. In case of pipes of greater diameter than 300mm, the width of trench shall be external diameter of pipe, plus 400mm.

When any excavation has been taken out and trimmed to the levels and dimensions shown on the drawings or as directed by the Project Manager, the Project Manager shall be informed accordingly so that he may inspect the completed trench and no excavation shall be filled in or covered with concrete until it has been so inspected and the Contractor has been authorised to proceed with the work. All surplus materials from such excavations not required for refilling shall be carted away to tips, or otherwise disposed of, as directed.

All excavations shall be kept dry, and all bailing and pumping, timbering, shoring and supporting of sides that may be required, and any refilling, ramming and disposal of surplus materials necessary in carrying out the excavations and backfilling of trenches shall be taken to provide a solid and even bed for barrels of the pipes and, where a concrete bed is not specified, the floor of the trench shall be properly shaped to receive the sockets and the backfill must be thoroughly rammed along the sides of the pipe.

445. Supports for Pits, Trenches and Other Excavations

The sides of pits, trenches and other excavations shall, where necessary, be adequately supported to the satisfaction of the Project Manager, and all such excavations shall be of sizes sufficient to enable the pipes and bedding to be laid accurately, and proper refilling and compacting to be carried out.

The Contractor shall take all precautions necessary for the safety of adjoining structures and building by shoring, opening in short lengths or otherwise, during the time the trenches are open.

446. Rock Cutting in Trenches for Pipes

Where solid rock is met within trenches, it shall be cut out to a depth of 100mm below the intended level of the bottom of the pipes, and replaced with 100mm of approved material as specified. In measuring such rock excavation the Contractor will be allowed a width of 400mm more than the external diameter of the pipes to a level of 100mm below the bottom of the pipes. The Contractor shall dispose of all surplus material arising from rock excavation in a manner to the approval of the Project Manager.

447. Water in Trenches for Pipelines

Trenches shall be kept free from water at all times during construction of works until, in the opinion of the Project Manager, any concrete or other works therein are sufficiently set, and the Contractor shall construct any sumps or temporary drains that the Project Manager may deem necessary.

The Contractor shall be responsible for the removal and disposal of all water entering the excavations from whatever source and shall deal with and dispose of such water in a manner approved by the Project Manager so as to ensure that excavations are kept dry while ensuring that the disposal of this water does not cause a nuisance to adjacent plot holders or works. The Contractor shall provide all plant, labour and materials required for such work.

448. Laying and Jointing Rigid Jointed Concrete Pipes

Concrete pipes shall be laid true to line and level, each pipe being separately boned between sight rails.

For spigot and socket joints, the spigot of each pipe shall be placed home in the socket of the one previously laid, and the pipe then adjusted and fixed in its correct position with the spigot of the pipe accurately centred in the socket. A ring of tarred rope yarn shall next be inserted in the socket of each

pipe previously laid and driven home with a wooden caulking tool and wooden mallet, such yarn when in position shall be 25mm in depth. The socket shall then be completely filled with cement mortar 1 to 2 and a fillet of the same worked all round the side. The fillet shall be levelled off and extend for a length of not less than 50mm from the face of the socket.

For 'Ogee' jointed pipes, the joints shall be thoroughly cleaned before laying, and cement mortar, shall be applied evenly to the ends for jointing so as to completely fill the joint. The pipes shall then be neatly pointed with a band of cement mortar approximately 125mm wide and 20mm thick. The inside of each joint shall also be pointed up as the work proceeds.

Special care shall be taken to see that any excess of cement mortar etc. is neatly cleaned off while each joint is being made and any earth, cement or other material cleaned out of the pipes by drawing a tight-fitting wad through them as the work proceeds, or by other approved means. A properly fitting plug shall be well secured at the end of the last laid pipe and shall be removed only when pipe laying is proceeding. The trenches, pipes and joint holes shall be kept free from water until the joints are thoroughly set.

Where shown on the drawings or directed by the Project Manager, concrete pipes shall be bedded and haunched or surrounded with concrete.

449. Pipes Laid with Open Joints

O.G. porous concrete pipes shall be laid unjointed with a space of 12mm between the spigot and the inner end of the socket.

All pipes shall be packed and surrounded as directed by the Project Manager with approved broken stone, sand or gravel aggregate, to the gradings as shown on the drawings or stated in the Bill of Quantities.

450. Drains to be Left Clean on Completion

On completion, all drains, manholes, etc. shall be flushed from end to end with water from an approved source and left clean and free from obstructions.

451. Refilling Trenches

Trenches shall be refilled with suitable excavated material of 100mm surround but not before the work has been measured and approved by the Project Manager. For pipes which are not surrounded with concrete, the first layer of filling material shall be free from stones and shall not be thrown directly on to the pipes, but shall be placed and packed with care all round them. All filling shall be deposited and compacted in layers, not exceeding 225mm loose depth, to a dry density not less than that of the adjoining soil. The last 450mm of filling must be returned in the order in which it has been removed. Timber and framing shall be withdrawn ahead of the layer to be compacted, care being taken to keep the sides of the trenches solid and to fill all the spaces left by the withdrawn timber.

452. Connections of Existing Sewers and Drains

Where shown on the drawings, existing sewers and drains shall be properly extended, connected and jointed to new sewers, culverts, drains or channels. All such connections shall be made during the construction of the main sewer, drain or other work and a record of their positions kept for future use or reference. Where pipe connections are made to a sewer, stone pitched or lined channel, the pipes shall be well and tightly built into the concrete, or masonry work and be so placed as to discharge in the direction of the main sewer, drain or channel and with the end of the pipe carefully cut to the necessary angle. Where the connections are between pipe sewers or drains, special connecting pipes as shown on the drawings shall be supplied and be truly laid and properly jointed.

453. Manholes and Inspection Chambers

Manholes and inspection chambers shall be constructed in accordance with the drawings and in the position shown on the drawings or directed by the Project Manager. The side walls shall be fair faced or rendered internally as specified on drawings. They shall be brought up vertically to receive a precast slab formed of concrete of the appropriate classes specified and reinforced all as shown on the drawings. Cast iron manhole covers and frames shall be provided and frames shall be bedded in cement mortar 1 to 3 and so set that the tops of the covers shall be flush at all points with surrounding surface of the footway, verge or carriageway, as the case may be. Any slight adjustment of the slab level which may be necessary to accomplish this shall be effected by topping the side walls with concrete integral with the slab.

If required, half channel pipes, bends and junctions as specified shall be laid and bedded in cement mortar 1 to 3 to the required lines and levels, and both sides of the channel pipes shall be benched up with concrete of the appropriate class and finished smooth to the slopes and levels as shown on the drawings or directed by the Project Manager. The ends of all pipes shall be neatly built in and finished flush with cement mortar 1 to 3. Where the depth of the invert exceeds 1 metre below the finished surface of the carriageway or the adjacent ground, iron steps shall be built in with alternate steps in line vertically and with such additional hand irons as the Project Manager may direct.

All manholes when completed shall be watertight and to the satisfaction of the Project Manager. The prices inserted in the Bill of Quantities shall include for excavation, provision of all materials, construction, refilling and disposal of surplus.

454. Precast Concrete Manholes

Precast concrete manholes shall be supplied and laid generally in accordance with the drawings.

455. Gully Connections

Connections from gullies to sewers and surface water drains or ditches shall consist of concrete pipes and fittings jointed with cement mortar 1 to 3. All pipes, bends and junctions shall be laid to the lines and levels shown on the drawings or as directed by the Project Manager.

456. Surface Boxes, Covers Etc.

Surface boxes, manholes and other covers lying within the site of the works, shall be raised, lowered, altered or removed as directed by the Project Manager.

457. Gullies

Gullies complete with gratings and with rodding eyes where necessary shall be supplied and laid in accordance with the drawings. Where directed by the Project Manager, precast concrete gullies shall be laid on and surrounded with 100mm of concrete of the appropriate grade. The concrete surround is to be brought up to the underside of the frame or flush with the top surface as the case may be. Masonry gullies shall be constructed from 225mm building stone and rendered internally. Gullies shall be trapped where leading into foul sewers or into combined foul and surface water sewers.

458. Completion of Drainage Works

All sub-soil and surface water drains shall be completed in advance of the construction.

459. Temporary Stoppers

Junction pipes which are laid but not immediately connected to gullies shall be fitted with temporary stoppers or seals, and the position of all such junctions shall be clearly defined by means of stakes or training wires properly marked and labelled.

460. Provision for Future Connection to Manholes

Inlet pipes of the required diameters shall be built into the walls of manholes and elsewhere for future use and shall be of the diameters shown on the drawings. The external ends of all such connections shall be sealed off with temporary stoppers, approved by the Project Manager. The pipes shall be laid and jointed and during the placing of the concrete they shall be adequately supported.

461. Surrounding or Haunching of Pipes with Concrete

Surrounding or haunching of pipes shall be carried out using fine concrete. In carrying out this work the Contractor shall take care to pack the concrete under and around the pipes to ensure even bedding and solidity in the concrete and the concrete shall not be thrown directly on to the pipes. The upper surface of the concrete shall be struck off with a wooden screed or template and neatly finished off.

462. Invert Block and Stone-Pitched Drains

Precast concrete invert blocks and side slabs shall be formed of concrete of the appropriate grade and dimensions shown on the drawings. Each course of side slabs required in the Bill of Quantities shall be interpreted as one complete row of side slabs to one side of the channel concerned. Stone used for channels shall be 225mm x 100mm building stone. Drains should not normally be laid to a radius of curvature less than 10 times the actual width of the drain.

Invert block and stone-pitched drains shall be constructed in the positions and to the levels and dimensions shown on the drawings and laid to true line and even fall. Where under-filling is required it shall be in 100mm maximum thickness layers of compacted murrum. The earth sides to such channels shall be neatly finished to a slope of 1 to 1 or such other slope as the Project Manager may direct.

Invert blocks and side slabs shall be laid on a 100mm minimum thickness of compacted murrum and be neatly jointed with cement mortar 1 to 3 as the work proceeds. The excavation, murrum bedding, providing, laying and jointing invert blocks or stone, backfilling and disposal of surplus shall all be as specified and all in-situ connections shall be in concrete of the appropriate grade.

463. Testing of Jointed Pipes and Manholes

Sealed jointed drains, up to and including 600mm diameter shall be tested in sections (e.g. between manholes) by filling with water under a head of not less than 1 metre. Drains found to be water-tight after a period of 30 minutes will be passed as satisfactory but the water must be retained in the pipes until a depth of at least 450mm of filling has been deposited and compacted on top thereof. Drains failing to stand the test shall be taken out and the pipes re-laid and re-jointed until completely water-tight.

Drains exceeding 600mm in diameter shall be tested by means of a smoke test before they are covered up. Both ends of the lengths of drain to be tested shall be sealed to the satisfaction of the Project Manager, and smoke shall then be pumped into the section from an approved machine. Should any joint in the section show an escape of smoke, the section shall be taken out and the pipes re-laid and re-jointed until there is no further escape of smoke.

Should the Project Manager so direct, manholes shall be tested by completely filling with water, and there shall be no appreciable loss over a period of 2 hours.

On completion of the works, or at suitable intervals during construction, infiltration tests will be carried out. The permissible amount of infiltration shall be 1 litre per hour per linear metre of nominal internal diameter.

The Contractor shall provide all labour and apparatus for the above tests.

All testing will be done in accordance with the procedure of the British Standard Code.

464. Pipes with Rubber Ring Joints

Rubber rings shall be entirely suitable for the pipe being used and will be provided by the Contractor. They will be laid in the socket and the pipes then jointed as specified. The jointing of pipes shall be carried out in accordance with manufacturer's instructions and in conformity with any modifications proposed by the Project Manager.

465 Laying, Jointing and Backfilling for Flexible Jointed Pipes

The Contractor shall ensure that any hard spots and loose stones are removed from the formation prior to laying of bedding materials. The Contractor shall lay a bed of thickness 100mm consisting of granular material i.e. sand, gravel, or approved soil of friable nature.

After laying of pipes the Contractor shall lay bedding material on the sides of the pipe compacted by tamping into soffit of sewer.

After completion of this operation the Contractor shall lay the bedding material on top of the pipe in 150mm layers to a thickness of 300mm. The material is to be compacted by tamping. However, precautions are to be taken to avoid excessive tamping on top of the pipe. The remaining trench excavation is to be backfilled.

The pipes shall be laid with flexible ring seal joints provided that solvent cement joints could be used for fittings where necessary subject to the approval of the Project Manager. Pipes and fittings shall be checked for deformities prior to laying. Deformed pipes and fittings shall not be accepted.

Flexible Rubber Ring Joints

The Contractor shall ensure that the spigot end is free from grit, dust or dirt and sealing rings should be seated evenly in the socket groove. Pipe lengths and fittings are supplied with a chamfer on the spigot. Where pipes are to be cut or are supplied without a chamfer on the spigot end the Contractor shall ensure that the pipe is cut square and then form a chamfer on the spigot end with a medium file to an angle of 15 degrees. Remove saw flashing by scraping with a pen-knife.

Expansion Gap

It is necessary to leave a gap between the edge of the spigot end and the base of the socket to allow for expansion. Moulded fittings are supplied with an embossed line indicating the correct depth of insertion. In other cases where the marking is not done, the Contractor shall ensure that an expansion gap of at least 3mm per metre length of pipe or at least 15mm per pipe length is provided. This can be done by marking spigot ends or by pushing spigot fully home, making a small mark on pipe and then withdrawing the pipe by 15mm.

After completing jointing the pipe shall be laid on the prepared bed making sure that a suitable depression is created in the bed for the socket.

Solvent Cement Joints

For solvent cement joints make sure that mating surfaces are clean and free of grease and dirt. Roughen mating surface with sandpaper, clean both surfaces with cleansing fluid using a clean cloth. Apply solvent cement on both mating surfaces. Without delay bring mating surfaces together and hold in position firmly for a few seconds. A layer of cement should be visible at the edges. Joints should not be disturbed for at least 10 minutes after assembly.

Section 5. Building and Structures

501 Concrete Building Blocks

Concrete building blocks shall be of approved manufacture and shall be formed in a press. The blocks manufactured in Class C30 concrete shall be cured for at least 10 days before use.

Blocks shall be well and evenly formed with true corners and unbroken arises, and shall be carefully handled and stacked.

502 Laying Building Blocks

Joints between blocks shall be filled solid with mortar and shall be of regular thickness of 5 to 10mm. The blocks shall be laid in level courses and bonded so that each vertical joint is midway above the face of the block below, except at junctions and piers where a bond of not less than 100mm shall be provided. The walls shall be raised in lifts not exceeding three metres in height in any one day, and truly vertical. All blocks shall be wetted before being laid.

Joints of exposed work shall be raked out and neatly flush-pointed in the same mortar. The whole of the visible faces of the walls shall be left perfectly cleans and all surface mortar and droppings shall be removed before they have set.

Joints in work to be rendered shall be raked out to a depth of 8mm to provide a key for the rendering.

Blockwork shall be tied into adjoining structural members at the same level as blockwork reinforcement using 150mm long butterfly tangs or equivalent fixed and mortared into proprietary vertical strips.

503 Precast Concrete Units Generally

All precast concrete units shall include all fixing plugs and strips to enable screw ties or other fixing devices to be firmly attached. For all precast units to be set in block of masonry walls the plugs and strips shall be so positioned as to provide fixing at course and in no case exceeding 450mm centres.

504 Masonry Using Natural Irregular Stones

Stones shall come from selected quarry layers to the approval of the Project Manager. They shall be homogeneous, frost resistant, flawless, free of any cracks or bousins, solid, and of equal grain and shall have all the required quantities to give a regular facing. They shall give out a clear sound when hit by a hammer.

Mortar shall be removed from the external surface of the wall. The Contractor shall prepare a wall sample approved by the Project Manager which shall be kept at the construction site until all the masonry is completed.

505 Screen Walling

Screen walling shall consist of perorated precast concrete blocks 100mm thick of approved shape, design and manufacture laid to an approved pattern in cement mortar wit perfectly even joints which shall be neatly flush or recess pointed as directed.

506 Damp-Proof Course

All external walls of buildings are to be provided with damp-proof course (DPC) of textured PVC strip of width equal to the total thickness of the wall and any external rendering. The DPC is to be lapped with the damp-proof membrane and bedded in mortar specified for the type of block used. The greatest lengths possible are to be used for the DPC's but any end laps required are to be at least 200mm long made dry without intervening mortar. Piers are to have complete DPC's lapped with the wall DPC.

507 Damp-Proof Membrane

Damp-proof membranes shall be laid, as directed by the Project Manager, beneath all floor slabs resting on the ground. They shall be composed of single sheets of minimum thickness 0.300mm black

polyethylene film of an approved manufacturer specially made for use as damp-proof membrane.

The film shall be laid on sand and turned up around all edges of the slab and with 150 mm margin above the top of the slab to be tucked into the perimeter walls of the building. Where the building is so large as to exceed the maximum sheet size available, several sheets shall be used and the joints shall be lapped 150mm and fused together using a welding tool designed for that purpose. Every care should be taken by the following trades to prevent perforation of the membrane but in the event of the puncture the perforation shall be covered by a patch of similar material of dimensions exceeding the area of the puncture by 300mm and the two sheets welded together as described above.

508 Composition of Mortars

- a. Cement mortar for bonding concrete shall be composed of cement and sand mixed in the proportion of the jointed concrete.
- b. Cement mortar for setting precast concrete or pitching shall be composed of cement and sand mixed in the proportion of 50kg of cement to 0.14m³ of sand, with the addition of an approved plasticizer.
- c. Cement mortar for blockwork in concrete blocks shall be composed of cement and sand mixed in the proportion of 50kg of cement to 0.14m³ of sand.
- d. Sand and Cement for mortars shall be as described in the specification for concrete.

509 Mixing of Mortars

The materials of mortars shall be measured out in their correct proportions and shall first be thoroughly mixed together in a dry state by turning them over upon a clean wooden stage until they are of a homogeneous appearance in consistency and colour. Clean water shall then be added while the mixture is being turned over until it attains a suitable consistency. Plasticizer shall be added in accordance with the manufacturer's recommendations as approved by the Project Manager.

The mortar shall be used immediately after it has been mixed. No mortar which has commenced its first set shall be used, or mixed up again. Mortar shall, where possible in hot weather, be protected from too rapid action by covering with impervious material such as polyethylene film.

Mixing by hand will be allowed only if the Project Manager gives specific approval. Mixing by machine using the same sequence of operations described above shall be carried out whenever possible.

510 Cement Rendering

Rendering shall be in a 50 kg to 125kg cement: sand mix but where approval had been given to the use of a plasticizer or other additives these proportions may be modified to the approval of the Project Manager.

All surfaces to receive a finishing coat of cement rendering or fine concrete shall be thoroughly prepared and cleaned and the rendering or screeding shall be placed immediately after such surfaces have been thoroughly wetted.

All rendering shall be put to a minimum of two coats, the first being left rough to a minimum of 10 mm thickness, but the second coat shall be trowelled up to a fair faces as soon as possible after it is applied.

All internal rendering shall be finished to an even and polished surface with a float, trowel or other suitable tool, special care being taken to obtain perfectly smooth and glazed faces. It shall not be less than 15mm thickness when finished unless instructed otherwise.

All external rendering shall be brought to an even surface with a wood float following which a tyrolean finish of approved colour shall be applied unless otherwise stated.

All rendering shall be protected from sun and rain by adequate and suitable coverings which shall be supplied and fixed in advance of these conditions arising. The renderings shall be kept damp while setting and protected from drying winds.

511 Tanking to Buried Concrete Surfaces

External concrete surfaces to be tanked shall be coated with a bituminous waterproofing membrane 3mm minimum thick. The tanking shall be dressed into structure as shown in the Drawings and be protected by non-rotting boarding prior to backfilling.

512 Waterproof Rendering

Waterproof rendering slurry shall comprise a 50kg to 125kg cement sand mix with an approved waterproofing admixture such as styrene acrylate copolymer.

The material shall block capillaries and minor shrinkage cracks to prevent water ingress while allowing the passage of water vapour through the structure.

The render shall be applied to a total thickness of not less than 20mm the first coat shall be applied levelled scratched and left to dry for not less than 3 days.

513 Grouting in Ironwork

All brackets, rag-bolts and other ironwork for which holes have been boxed out or left in the concrete of a structure shall be carefully grouted in to their correct positions in all particulars. The grouting in shall be carried out with cement and sand grout in such a manner that there shall be no apparent difference in the texture or colour throughout the face of the finished structure and that there shall be no seepage of water either between the ironwork and the set grout or between the set grout and the surrounding structure.

The above instructions shall apply also to the building-in of pipes except that Class C25/10 concrete shall be used in lieu of cement grout.

All holes left for building-in shall be free from any sign of infiltration of water before the building-in is carried out. No reliance shall be placed upon the building-in process for the sealing of such leakage.

514 Cable Duct Covers and Frames

514.1 Recessed Covers

Cable duct covers recessed for flooring finishes shall be provided with galvanized rolled steel angles of height equal to the thickness of the floor finishing and fixed to the surface of the structural floor slab along all edges of the trenches so that the top edge is level with the finished floor level. The angle shall be laid so as to form seating for duct covers and all additional galvanized rolled steel tee sections shall also be provided to support the duct covers.

The duct covers shall be galvanized to suit the ducts and the seating described above. A lightweight galvanized steel mesh shall be fixed to the upper surface of the trays to provide a key for floor finishes. The seating and trays shall be so laid that the finished floor is perfectly level and all trays fully supported at all edges without the use of loose packing. At least one tray in every series of trays covering a length of duct shall be provided with cast-in lifting eyes and a pair of suitable lifting keys shall be handed to the Project Manager on completion.

514.2 Checker Plate Covers

Checker plate covers shall be hot dipped galvanized mild steel fitted flush with the floor surface and fully

supported.

515 Fences and Gates

Fences generally shall be in accordance with the relevant parts of BS 1722 Part 1: 1986. Chain link fencing shall be Type PL.213 Grade A with 1.8 m high plastic covered chain link mesh. The mesh and line wires shall be galvanized prior to being plastic covered. The posts shall be reinforced concrete.

The straining posts, intermediate posts and struts shall be manufactured and erected complete as specified in BS 1722. The fencing shall be true to line and vertical, following profile of the ground, previously graded so as to prevent access beneath the bottom wire. Gates shall be hung on adequate post, and shall be truly vertical.

Ornamental fabricated metalwork fences and gates shall be constructed of mild steel bar, strip or tube in accordance with the Drawings. All welded joints and drillings for bolts shall be made before painting, and all bolts, nuts and washers shall be galvanized or plated in an approved manner. Any metalwork sunk into the ground shall be treated with two coats of bituminous paint.

516 Joint Sealing Compound and Sealants

Joint sealing compounds shall be impermeable ductile materials of a type suitable for the conditions of exposure in which they are to be placed, and capable of providing durable, flexible and watertight seal by adhesion to the concrete throughout the range of joint movement.

Hot poured joint sealants shall comply with BS 2499, Ordinary Type A1 sealant.

Cold poured polymer-based joint sealants shall comply with BS 5212: Part 1, Normal Type N sealant.

Two part polysulphide based sealants shall comply with the relevant provisions of BS 4254. Pouring Grade shall be applied to horizontal upward facing joints and Gun Grade to joints of any other aspect or inclination. Other two part polymer based sealants of Gun or Trowel Grade shall comply with the physical and test requirements of BS 4254.

Silicon bases building sealants shall comply with the relevant provisions of BS 5889. Primers for use with joint sealants shall be compatible with, and obtained from the same manufacturers as, the adjacent sealant. Primers shall have no harmful effects on the concrete.

Sealants and primers which will be in contact with water to be used for potable supply shall not impart to water taste, colour, or any effect known to be harmful to health, and shall be resistant to bacterial growth. Sealants and primers which will be in contact with sewage or sewage sludge shall be resistant to biodegradation.

517 Openings in Walls, Floors and Ceilings

The Contractor shall chase put and/or cut openings through walls, floors and ceilings for the passage of pipes and cables where described in the contract shall provide and fix in position approved tube sleeve cut off flush with the finished surface. All openings and ducts shall be sealed on completion to prevent the passage of toxic or explosive gases.

518 Structural Steelwork

Material for structural steel work shall comply with BS EN 10137 and workmanship with BS 5950. The steelwork shall be securely fixed to the foundations or building and designed to have such strength and stiffness that its deflection and movement under the loads to be applied shall be within tolerable limits.

All bolts and nuts shall comply with the requirements of BS 3693 except for High Strength Friction Grip Bolts which shall comply with BS 4395.

Mild steel electrode shall comply with the requirements of BS EN 499 and High Yield Steel with BS 2540.

All structural steel fabrication shall conform to the requirements of BS EN 5400. The use of High Strength Friction Grip Bolts shall be in accordance with BS withdrawn.

All structural steel work shall be fabricated using welded joints where possible for shop joints and bolted joints for field assemble.

519 Open Mesh Walkways and Covers

Open mesh type walkways, platforms and covers shall be of aluminium or galvanized steel, suitable for a superimposed load of not less than 6kN/m². The walkways, platforms and covers shall include all necessary supports not detailed on the Drawings.

Open mesh panels shall be trimmed with full depth nosing bar along all edges and bolted to each other when in place to help ensure a firm walkway. Panels shall be cut in such a way and fixing so as to provide a continuity of pattern.

Covers shall incorporate a hinged lockable open mesh access panel with a 750 x 750mm clear opening, strong durable hinges and heavy duty non-corrodible padlock. Openings for valve keys shall be just sufficient in size for the valve key and shall incorporate a cover hinged only.

All panels shall be securely bolted to the supporting structure. Where the supporting structure is concrete, galvanized mild steel angle curbs shall be provided and securely grouted into rebates left in the concrete such that the tops of the panels are flush with the top of the concrete.

520 Handrailing

Hand railing shall be approximately 1000mm in height with an intermediate horizontal rail with standards not more than 2000mm apart. Hand railing shall be designed for a horizontal loading of not less than 220N/mm. Hoops shall be welded on where required for fixing guard chains. Standards and rails shall be manufactured from black mild steel tube to BS 1387:1985, from steel tubing to BS 1775 or from extruded aluminium alloy approved by the Project Manager. The nominal bore of steel tubing shall be not less than 32mm. Adequate provision shall be made for thermal movement. Steel hand railing shall be hot dipped galvanized after fabrication.

521 Guardrail

Guardrails shall be 750mm in height with a single top rail. In all other respects it shall comply with the specification for hand railing.

522 Chains

Chains across openings in handrails at tops of ladders shall be galvanized mild steel having 3 SWG x 3 links per 100mm and shall be supplied complete with 'S' hooks and split rings.

523 Steel Access Covers

Steel access covers shall be to the duty required and sized to suit the opening shown on the Drawings. They shall be complete with frame and shall be weatherproof (prevent ingress of water) when closed and shall in all respects be strong and durable.

The covers shall be hinged and lockable and provided with stays to prevent the covers opening more than 105°. The Contractor shall provide with each cover a heavy duty non-corrodible padlock and four keys. The covers and frames shall be galvanized.

524 Isolation of Aluminium

All items of aluminium construction shall be isolated from concrete by the use of bituminous felt or DPC

material or two coats of bituminous paint. The aluminium shall be isolated from dissimilar metal by the use of fibre washers and spacers.

525 Galvanising

Where galvanizing has been specified the items shall after fabrication be hot dipped galvanized in accordance with BS 6530 Part 1 to a thickness of 0.15mm (005'). All items to be protected shall be prepared as specified in the above standards. Articles altered at the manufacturer's works in any way after galvanizing are to be re-galvanized as specified. Articles subject to minor alternations at site or requiring minor repair at site shall be wired brushed to remove all rust and coated with 3 coats of approved zinc rich cold galvanizing compound.

526 Fixings to Structure, etc.

Where fixings to structures previously constructed are to be made by setting a bolt system into performed holes, such fixings shall be made either by Rawlbolt Projecting Bolt Type or by using an approved proprietary resin anchor system. Where performed holes have not been provided a self-drilling expanding bolt system shall be used.

Where thin sections are involved or where stresses are likely to be set up which might cause damage to the structure the use of the resin anchor system only will be permitted. Only in special circumstances will the Project Manager or the Project Manager's Representative permit rawlbolts to be used. Performed holes shall be accurately set to template prior to placing the surrounding concrete and shall be kept rigidly in place until the concrete has properly set.

Where resin anchorage is used the Contactor shall ensure that the setting time of the resin is appropriate to the requirements for setting up, plumbing and aligning the work before it sets. Bolts shall be set to template and hole diameters shall conform to the recommendation of the suppliers. Whatever system is used, all bolts shall be plated to resist corrosion.

Section 6. Roads and Surfacing

601 Access Tracks

Permanent access tracks shall be constructed only where shown on the Drawings. Tracks shall be unsurfaced. Filling to bring formation to the required level shall be locally excavated material which shall be placed in layers and compacted by tracking with the excavation plant. The road formation shall be tracked and graded with a dozer blade or bucket to give a cross fall of not less than 1 in 40. Surface undulations shall not exceed 200mm over a length of 3.0m, unless otherwise approved by the Project Manager.

The maximum gradient shall not exceed one vertical to 6 horizontal and the minimum turning circle radius measured to track centre line shall not be less than 15.0m.

602 Access Roads

The road formation shall be the surface obtained after completion of any earthworks. Filling to bring the formation to the required level shall be selected material. It shall be laid and compacted in layers not exceeding 150mm in thickness, the compaction being carried out by a roller of not less than 8 tonne weight.

The Employer and the Contractor may at any time after the completion of the access road (after 14 days in the case of concrete surfaces) use them or allow their use by their employees or sub-contractors.

At such times during the Period of the contract or Period of Maintenance as the Project Manager may direct, the Contractor shall at his own expense make good any deterioration which may have occurred in the condition of the roads, whether as result of the use of roads by the Employer or otherwise. In particular, any parts of the foundations into which soil has penetrated shall be dug out and replaced with clean materials.

602.1 Macadam Roads and Macadam Hardstandings

(i) The sub-base shall consist of 150mm compacted thickness of free draining granular material conforming to the grading limits specified in the contract. The plasticity index shall be 0-6% maximum and the California Bearing Ratio at maximum density (Test 12, BS 1377:1990) shall be 25% minimum. The material shall be compacted to 95% of the maximum density as determined by Test No. 13, BS 1377:1990 (heavy compaction) by means of a roller of not less than 8 tonnes weight.

If the quality of foundation soil is considered inadequate, the Project Manager may direct that the sub-base be 300mm thick, in which case construction shall be carried out as described above but as two 150mm thick layers.

The road base shall consist of 150mm compacted thickness of free draining crushed limestone conforming to the grading limits stated in the Contract. The plasticity index shall be 0-6% maximum and the California Bearing Ratio at maximum density (Test 13, BS 1377:1990) shall be 80% minimum.

The base shall have a prime coat applied not more than seven days after the completion of the base and not later than twenty four hours after approval by the Project Manager. The asphalt used for the prime coat shall generally conform to the relevant AASHTO specification.

Before laying the tarmacadam base course onto the primed base, all loose blinding material shall be brushed off the road and removed. The tarmacadam base course shall consist of 60mm compacted thickness of 20mm nominal size dense base course macadam. The aggregate and asphalt shall be generally in accordance with the relevant AASHTO specification.

A tack coat shall be applied between successive layers of asphalt material and shall generally conform to the relevant AASHTO specification. Machine laying shall normally be used and compaction shall be carried out with a roller of not less than 12 tonnes weight so as to achieve a dense, smooth and even

surface. Where new road construction is to be joined to an existing road, the surface shall be cut back to a straight line and primed.

(ii) Should the Contractor wish to lay Macadam on the roads early in the Contract for use by the construction traffic, he may do so provided construction is stopped at completion of the Macadam base course and this single layer blinded with bituminous grit to seal the surface.

When all concreting, earth moving and heavy crainage and haulage has been completed, and in general towards the end of the Contract, the base course so provided shall be thoroughly cleaned off and repaired, and re-levelled where necessary, and a suitable cold bituminous emulsion tack coat generously applied by spray in accordance with the manufacturer's instructions, care being taken to avoid spattering kerbs or other adjacent concrete. The wearing course may then be laid and blinded as described in sub-section (i) above. Any additional costs involved in the adoption of the method of laying described in this sub-section shall be included by the Contractor in his rates for road making.

(iii) Notwithstanding the time of placing of the roadworks, the condition of the finished road at the completion of the Contract shall be of 'as new' quality, with clean, accurately profiled, rolled and sealed surface throughout, free from concrete spotting or staining, patch marks, trench outlines, paint, oil or fuel spillages or other visible or structural defects.

602.2 Unsurfaced Roads and Hardstandings

Unsurfaced roads and hardstandings shall be constructed from 300mm of crushed lime stone conforming to the grading limits specified in the Contract, laid in two layers of 150mm.

Each layer shall be compacted to 95% of the maximum density (Test 12, BS 1377:1990).

602.3 Pea Shingle Surfaced Areas

The sub-base to pea shingle areas shall be as defined in 801.1 above. Pea shingle consisting of 20mm thick 5mm nominal single sized stone laid and raked to a level finish.

603 Precast Concrete Kerbs and Channels

Kerbs shall be laid before the adjacent carriageway is constructed and sufficiently in advance to meet the Project Manager's requirements. Kerbs shall be bedded solidly and accurately in their concrete foundations before the initial set of the concrete has started. Each kerb shall be set solidly and accurately to the required line and level with joint no more than 6 mm wide, neatly pointed with cement mortar and filled for their full depth with cement grout as specified. At every tenth kerb joint, the pointing and grout shall be omitted. A piece of 4mm thick approved jointing material shall be placed in these joints, neatly trimmed to be flush with the face of the kerb. The bedding shall be well haunched up to the back of the kerb, to within 100mm of the top of the kerb. All cutting shall be neatly formed so as to show no damage to the exposed faces and to leave the ends square for the full width of the kerb.

The kerbs and channels shall be 130mm wide by 250mm deep. Kerbs shall be half battered. Kerbs damaged at the exposed faces will not be accepted.

604 Precast Concreting Edging

Edging shall be 50mm x 150mm in size. Edging shall be laid in the same manner as kerning and in short lengths, where required to be circular on the plan.

605 Footpaths and Paving

For surfaced footpaths and similar paved the base material shall be laid on hard fill or selected materials as directed by the Project Manager's Representative and compacted by a roller of 0.75 to 3 tonnes weight. The footpath base shall be formed of crushed rock graded from 50mm to 10mm suitable for the purpose and laid as wet-mix or dry macadam and rolled or compacted to the final form and grading of the

final surfacing to a thickness of 100mm.

The base course shall consist of 100 mm compacted thickness of bituminous macadam of 14mm nominal sized material. After laying and rolling the base course, a wearing course shall be laid to provide a final finish. This shall consist of 15mm compacted thickness of 100mm nominal size bituminous macadam. As soon as possible after laying the wearing course, it shall be blinded with bituminous grit (fine cold asphalt) to weather-seal. For concrete paving, the precast concrete flags shall be of approved colour and size not less than 30mm thick unless otherwise indicated. They shall be laid and bedded in cement mortar upon a 100mm thick bed of compacted crushed limestone.

The Contractor will be required to lift and relay at his expense flags which have sunk through consolidation of settlement of the ground beneath and the Project Manager's maintenance certificate will not be issued until such work has been completed to his satisfaction.

606 Laying to Grade

All new and reinstated roads, alleyways and hard standings shall be completed in a manner that ensures cross-falls are towards the storm water drainage intakes.

Section 7 Safety, Health and Environment

701 Introduction

The prevention of injury and/or illness to the site personnel and the public, damage to the Works and to public and private property, protection of the environment, and compliance with applicable laws, are primary objectives of the Employer. Because of the importance the Employer places on meeting these objectives, selected minimum requirements are outlined in these Safety, Health and Environmental Specifications with which Contractors shall comply while working on this contract. Given that these Specifications cannot cover every eventuality, the Contractor shall be expected to exercise good judgment in all such matters, even though not mentioned in these Specifications, and shall take any and all additional measures, as required or necessary, to meet his responsibility for safety, health and environmental matters during the period of the Contract.

The Employer nor its representatives shall not be held liable for any actions taken by the Contractor that are attributed to following the minimum requirements stated hereinafter.

The Contractor shall throughout the execution and completion of the Works and the remedying of any defects therein:

- (a) have full regard for the safety of all persons on the Site and keep the Site and the Works in an orderly state appropriate to the avoidance of danger to any person;
- (b) know and understand all laws governing his activities along with any site requirements and work site hazards. Such information shall be communicated by the Contractor to his personnel and subcontractors;
- (c) take all necessary measures to protect his personnel, the Employer's personnel, other persons, the general public and the environment;
- (d) avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequent of carrying out the Works.

702 Compliance with Specifications

The Contractor shall comply with the requirements of these Safety, Health and Environmental Specifications and all other applicable regulations or requirements under Kenyan laws, laid down by relevant authorities or issued by the Employer or the Project Manager concerning safety, health and the environment, in force or introduced or issued from time to time during the period of the Contract.

In so far as these Specifications are applicable, they shall apply to sites and personnel outside the Site associated with the performance of the Contract.

The Specifications equally apply to subcontractors and all other parties engaged by the Contractor and their personnel. The Contractor shall ensure all such parties are fully aware of and comply with the Specifications.

The Contractor shall comply with all notifications and written or verbal instruction regarding safety issued pursuant to these Specifications by the Employer, Project Manager or relevant authorities within the time specified in the notification or instruction.

The Contractor shall adopt a positive approach, awareness and responsibility towards safety, health and the environment, and take appropriate action, by:

- (a) ensuring the Specifications are enforced and followed by the Contractor's personnel. Any failure by the Contractor's personnel to follow the Specifications shall be regarded as

a failure by the Contractor.

- (b) paying attention to possible injury to unauthorized persons entering the site, particularly children.

Whenever in these Specifications the Contractor is required to provide test certificates for equipment and personnel and to comply with the relevant authorities' requirements and no independent test facilities are available or no relevant authorities exist in Kenya, the Contractor shall provide:

- (a) in lieu of independent test certificates:
- for equipment – details of the tests that have been carried out by the Contractor and a written statement that the Contractor has satisfied himself that the item of equipment is fit and safe for use;
 - for personnel – details of the training and experience of the personnel and a written statement that the Contractor has satisfied himself that they have the required level of competency;
- (b) in lieu of relevant authorities' requirements – details of the Contractor's own rules, regulations, requirements and procedures regarding safety, health and the environment.

If the Project Manager is dissatisfied with the details provided by the Contractor, the Contractor shall provide further details or carry out further tests or provide further written statements as may be reasonably required by the Project Manager.

When the Project Manager has satisfied himself regarding the Contractor's own rules, regulations, requirements and procedures provided in accordance with (b) above, such rules, etc. shall be deemed to form part of these Specifications and to which Clause 3 shall equally apply.

703 Failure to Comply with Specifications

703.1 General

Should the Contractor fail to comply with any of the Specifications or requirements of the Project Manager:

- (a) the Project Manager may suspend the Works of part of the Works until the Contractor has taken the necessary steps, to the satisfaction of the Project Manager, to comply with the Specifications or requirements.
- (b) the Employer may, following written notice to the Contractor, carry out themselves or arrange for another contractor to carry out such measures as they may consider appropriate on behalf of the Contractor. Any such actions by the Employer shall not affect or diminish the Contractor's obligations or responsibilities under the Contract.
- (c) the Project Manager may, by written notice of suspension to the Contractor, suspend all payment to the Contractor under the Contract if the Contractor fails to rectify any breach of the Specifications within the period specified by the Project Manager, provided that such notice of suspension:
- (i) shall specify the nature of the failure or failures; and
 - (ii) shall request the Contractor to remedy each such failure within a specified period after receipt by the Contractor of such notice of suspension.

Such suspension of payment shall remain in force until such time as the Contractor has rectified the breach or breaches to the satisfaction of the Project Manager. No interest shall be paid on the suspended payments.

Failure to comply with the Specifications or requirements shall be considered a breach of the Contract by the Contractor and may result in termination of the Contract by the Employer. In the event of the Employer taking action based on this Clause, the Contractor shall not be entitled to any additional costs or extension to the Contract Completion Date. All costs incurred by the Employer pursuant to Sub-Clause 703.1.1 (b) shall be deducted from the amounts otherwise due to the Contractor.

704 General Requirements

Preamble

All references to safety shall be deemed to include health and the environment.

Safety Officer

The Contractor shall appoint a competent Safety Officer who shall be responsible for safety, health and the environment. The Safety Officer shall be given sufficient time by the Contractor to carry out his duties; minimum requirements shall be as follows:

Workforce on site of over 250	- full time Safety Officer;
Workforce on Site of 100 – 250	- 50% of Safety Officer's time;
Workforce on site below 100	- as required for the Works but a minimum of 5 hours per week of Safety Officer's time where more than 20 workers.

The Contractor shall provide the Safety Officer with appropriate identification, including a white hard hat with red cross symbol and an identification badge. The appointment of the Safety Officer shall be in writing and copied to the Project Manager. The appointment shall include specific instructions to enforce these Specifications and delegated authority to take any action, measure or to issue instruction regarding their enforcement. All persons on Site shall be made aware of the name and authority of the Safety Officer and instructed to comply with any instruction or direction in safety matters, verbal or in writing issued by the Safety Officer.

The Safety Officer shall be provided with a mobile phone or other similar means of communication. The Safety Officer shall be accessible and available at all times including normal working hours.

Safety Training

The Contractor shall provide safety induction training for all site personnel upon starting on site. The

Contractor shall provide safety refresher/reinforcement training at regular intervals for his staff.

Safety Meetings

The Contractor shall hold regular safety meetings to provide safety instructions and receive feedback from site personnel on safety, health and environmental matters. A weekly safety Meeting shall be chaired by the Safety Officer and minutes shall be taken of the meeting. The meeting/minutes shall be given to the Project Manager. The Safety Officer should attend the Contractor's weekly site meetings and "Safety" shall be an item on the agenda.

Safety Inspections

The Safety Officer shall make regular safety inspection of the work site. The Safety Officer shall prepare a report of each inspection. This report shall include details of all breaches of these Specifications and any other matters or situations relating to safety found during the inspection, instructions issued by the

Safety Offices and actions taken by the Contractor. A copy of the Safety Officer's reports shall be given to the Project Manager.

Control of Substances Hazardous to Health

Hazardous materials shall be stored in approved safety containers and handled in a manner specified by the manufacturers and/or prescribed by relevant authorities.

Only properly trained and equipped personnel shall handle hazardous materials.

Potential Hazards

The Contractor shall inform employees of potential hazards, take the appropriate steps to reduce hazards and be prepared for emergency situations. The Contractor shall make an assessment of every operation involving hazardous substances. The assessment shall be recorded on a Hazardous and Flammable Substances Assessment Method Statement which shall be submitted to the Project Manager prior to the delivery and use of the substance on Site.

Accident Reporting

The Contractor shall report all accidents and dangerous occurrences to the Project Manager. The Contractor shall prepare a report on each accident or dangerous occurrence and a copy of the report, together with witness statements and any other relevant information, shall be submitted to the Project Manager. A reportable accident or dangerous occurrence shall include any accident to any person on site requiring medical attention or resulting in the loss of working hours or any incident that resulted, or could have resulted, in injury, damage or a danger to the Works, persons, property or the environment.

In the event of an accident or dangerous occurrence, the Contractor shall be responsible for completing all statutory notifications and reports. Copies of all statutory notifications and reports shall be passed to the Project Manager.

All accidents and dangerous occurrences shall be recorded in a Site Accident Book. The Site Accident Book shall be available at all times for inspection by the Project Manager.

The Contractor shall immediately rectify any situation or condition that could result in injury, damage or a danger to the Works, person, property or the environment. If the situation or condition cannot be corrected immediately, the Contractor shall provide temporary barriers and appropriate warning signs and devices and/or take other appropriate action necessary for the protection of persons, property and the environment.

Notices, Signs, Etc.

All safety, health, environmental and other notices and signs shall be clearly displayed and written in English. All requirements, instructions, procedures, etc. issued by the Contractor concerning these Specifications shall be printed in English and displayed and readily available to the Contractor's personnel.

First Aid and Medical Attention

The Contractor shall have comprehensive First Aid Kit(s) on Site at all times. First Aid Kits shall be conveniently located and clearly identifiable.

The Contractor shall have one employee on site trained in first aid for every 25 employees. Such persons shall be provided with appropriate identification, including a red hard hat with a white "red cross" symbol; and an identification badge.

The Contractor shall make contingency arrangements for calling a Doctor and transporting injured persons to hospital. The telephone numbers of the emergency services and the name, address and

telephone number of the Doctor and nearest hospital shall be prominently displayed in the Contractor's site office.

Employee Qualification and Conduct

The Contractor shall employ only persons who are fit, qualified and skilled in the work to be performed. All persons shall be above the minimum working age. Contractor's personnel shall use the toilet facilities provided by the Contractor.

The Contractor shall ensure:

- (a) that no firearms, weapons, controlled or illegal substances or alcoholic beverages are brought onto the Site and that no personnel under the influence of alcohol or drugs are permitted on Site.
- (b) That all personnel obey warning signs, product or process labels and posted instructions.
- (c) That drivers or operators of vehicles, machinery, plant and equipment follow the rules for safe operations. Drivers shall wear seat belts and obey all signs and posted speed limits.

705 Safety Requirements

Personal Protective Equipment

The Contractor shall provide personal protective equipment, including hard hats, safety glasses, respirators, gloves, safety shoes, and such other equipment as required, and shall take all measures or actions for the protection and safety of Contractor's personnel.

Non-metallic hard hats shall be worn at all times by all personnel at the worksite with the exception of those areas where the Project Manager has indicated it is not necessary to do so. Safety glasses shall meet international standards and be available for use and worn in specified worksite areas. As a minimum, safety glasses shall be worn for the following types of work: hammering, chipping, welding, grinding, use of electrically powered or pneumatic equipment, insulation handling, spray painting, working with solvents, and other jobs where the potential of an eye injury exists. Face shields and/or goggles shall be worn where possible exposure to hazardous chemicals, cryogenic fluids, acids, caustics or dust exists and where safety glasses may not provide adequate protection.

When handling acids, caustics and chemicals with corrosive or toxic properties, suitable protection, such as acid suits or chemical resistant aprons and gloves, shall be worn to prevent accidental contact with the substance.

Personnel shall not be permitted to work whilst wearing personal clothing or footwear likely to be hazardous to themselves or others.

The wearing of safety shoes with steel reinforced toes is recommended for all Contractor's personnel on site. In all cases, Contractor's personnel shall wear substantial work shoes that are commensurate with hazards of the work and the work site area.

Hearing protection, including muffs, plugs or a combination thereof, shall be provided for all personnel operating in areas where the noise level exceeds 90 decibels. Such protections shall also be provided for operators working with equipment exceeding such a level. This may include equipment such as excavators, shovels, jackhammers, saws, drills, grinders and the like are being used.

The Contractor shall encourage employees to wear substantial work gloves whenever practical and safe to do so.

Fire Protection and Prevention

The Contractor shall comply with fire protection instructions given by the Authorities having jurisdiction in regard to fire protection regulations. The Contractor shall, upon moving on site, provide to the Project Manager and the Authorities a fire prevention and evacuation plan. This shall include drawing(s) showing the fire assembly points. The fire prevention and evacuation plan and drawing(s) shall be updated from time to time as the Works progress. The Contractor shall ensure all personnel are fully informed on escape routes and assembly points and any changes thereto. Fuel storage will not be permitted in construction work areas. Contractors may establish fuel storage tanks in specified areas set aside for the purpose and approved by the Project Manager. Storage tanks shall be adequately banded to control spillage. Fire extinguishers shall be provided and installed in a suitable nearby location.

Highly combustible or volatile materials shall be stored separately from other materials and as prescribed by relevant authorities and under no circumstances within buildings or structures forming part of the permanent Works. All such materials shall be protected and not exposed to open flame or other situations which could result in a fire risk.

No combustible material shall be located inside or within 10 metres of a building or structure forming part of the permanent Works. Where units have to be used in these circumstances, they shall be constructed of non-combustible materials and have a half-hour fire rating inside to outside and outside to inside. Non-combustible furniture shall be used where practical.

All temporary accommodation and stores shall be provided with smoke detectors and fire alarms. Smoking shall be banned in high risk areas.

Expanded polystyrene with or without flame retarding additive, polythene, cardboard and hardwood shall not be used as protection materials. Plywood and chipboard shall only be used as protection on floors. Vertical protection shall be non-combustible. Debris netting and weather protection sheeting shall be fire retardant.

When using cutting or welding torches or other equipment with an open flame, the Contractor shall provide a fire extinguisher close by at all times. All flammable materials shall be cleared from areas of hot works or work locations prior to welding or oxy/gas burning operations. All hot works shall cease half an hour before the end of a work shift to allow for thorough checking for smouldering materials. Where appropriate, areas of hot works are to be soaked in water before the shift ends.

An adequate number of fire extinguishers of types suited to the fire risk and the material exposed shall be provided. These shall be placed in accessible, well-marked locations throughout the job site. Contractor's personnel shall be trained in their use. Extinguishers shall be checked monthly for service condition and replaced or recharged, as appropriate after use.

Only approved containers shall be used for storage, transport and dispensing of flammable substances. Portable containers used for transporting or transferring gasoline or other flammable liquids shall be approved safety cans. Fuel burning engines shall be shut off while being refuelled. Adequate ventilation to prevent an accumulation of flammable vapours shall be provided where solvents or volatile cleaning agents are used.

Flammables shall not be stored under overhead pipelines, cable trays, electrical wires or stairways used for emergency egress. Paints shall be stored and mixed in a room assigned for the purpose. This room shall be kept under lock and key.

Oily waste, rags and other such combustible materials shall be stored in proper metal containers with self-closing lids and removed every night to a safe area or off site. Every precaution shall be taken to prevent spontaneous combustion.

Electrical Safety

All temporary electrical installations, tools and equipment shall comply with current regulations dealing with on-site electrical installations. The Contractor shall establish a permit-to-work system for work in or in proximity to energized circuits of any voltage. Contractor's personnel shall not commence work on such circuits unless a permit to work has been issued and adequate safety measures have been taken and the work operation has been reviewed and approved by the Project Manager.

Only authorized personnel shall be allowed to work or repair electrical installations and equipment. Portable tools and equipment shall be 240 volt, unless otherwise agreed by the Project Manager.

When portable or semi-portable equipment operates at voltages in excess of 240 volts, the supply shall be protected by a Residual Current Device (RCD) regardless of any such device fitted to the equipment. The RCD must have a tripping characteristic of 30 milliamps at 30 milliseconds maximum.

All static, electrically powered equipment, including motors, transformers, generators, welders and other machinery, shall be properly earthed, insulated, and/or protected by a ground fault interruption device. In addition, the skin metal buildings and trailers with electric service shall be earthed. Metal steps, when used shall be securely fixed to the trailer.

Lampholders on festoon lighting shall be moulded to flexible cable and be of the screw in type. Clip on guards shall be fitted to each lamp unit.

All tungsten-halogen lamps shall be fitted with a glass guard to the element. These lamps must be permanently fixed at high level.

Electrical equipment shall be periodically inspected and repaired as necessary by competent persons.

Any work in electrical equipment and systems shall be made safe through locking, tagging, and/or isolation of the equipment before work commences. Prior to the start of the work, the equipment or systems shall be tested to ensure that they have been properly de-energised and isolated.

Electrical repair work on energized systems shall be avoided whenever possible.

Electrical trouble shooting shall be conducted only after getting written approval of the Project Manager.

Unauthorized personnel shall not enter enclosures or area containing high voltage equipment such as switchgear, transformers or substations.

Oxygen/Acetylene/Fuel Gases/Cartridge Tools

Compressed oxygen shall never be used in the place of compressed air. Flash-back (Spar) arrestors shall be fitted to all gas equipment. Liquid petroleum Gas (LPG) cylinders shall not be stored or left in areas below ground level overnight. Cylinders must be stored upright.

The quantity of oxygen, acetylene and LPG cylinders at the point of work shall be restricted to a maximum of one day's supply. Cylinders shall be kept in upright vertical rack containers or be safely secured to a vertical support.

Cartridge tools shall be of the low velocity type. Operators must have received adequate training in the safe use and operation of the tool to be used.

Scaffolding/Temporary Works

No aluminium tube shall be used, except for proprietary mobile towers, unless otherwise agreed with the Project Manager.

Drawings and calculations shall be submitted to the Project Manager, prior to commencement of work on the site, for all Temporary Works, including excavations, falsework, tower cranes, hoists, services and

scaffolding. Designs shall conform to international standards.

The Project Manager will not approve Temporary Work designs but the Contractor shall take account of any comments on such designs made by the Project Manager.

The Contractor shall inspect and approve all Temporary Works after erection and before access, loading or use is allowed. Completed and approved Temporary Works shall be tagged with a scaff-tag or similar safety system and the Safe Structure insert displayed. For scaffolding, one tag shall be displayed every 32 m² of face area. A central record system shall be kept on all Temporary Work. Temporary Works shall be inspected weekly and similarly recorded.

All mobile scaffold towers shall be erected in accordance with the manufacturer's instructions and a copy of these shall be submitted to the Project Manager prior to any use on site. Additionally, all towers shall be erected complete with access ladder, safety rails and kick boards whatever the height.

The Contractor shall repair or replace, immediately, any scaffold, including accessories, damaged or weakened from any cause.

The Contractor shall ensure that any slippery conditions on scaffolds are eliminated as soon as possible after they occur.

All scaffolds used for storing materials, for brick or block laying, for access to formwork or for any other purpose where materials may be accidentally fall, shall be provided with wire mesh guards of a substantial material, in addition to kick boards.

Use of Ladders

Manufactured ladders shall meet the applicable safety codes for wood or metal ladders. Metal ladders shall not be used where there is any likelihood of contact with electric cables and equipment. All metal ladders shall be clearly marked: "Caution – Do not use around electrical equipment". Job made ladders shall not be permitted.

Extension or straight ladders shall be equipped with non-skid safety feet, and shall be no more than 12 m in height. The maximum height of a step ladder shall be 2 m. Ladders shall not be used as platforms or scaffold planks.

Ladders rungs and steps shall be kept clean and free of grease and oil.

Extension and straight ladders shall be tied off at the top and/or bottom when in use. Only one person shall be allowed in a ladder at a time.

Defective ladder shall be taken out of service and not used. Ladders shall not be painted and shall be inspected for defects prior to use.

Elevated Work

The Contractor shall provide all personnel, while working at an elevated position, with adequate protection from falls. Details of such protections shall be submitted to the Project Manager.

The Contractor shall carry out daily inspections of all elevated work platforms. Defects shall be corrected prior to use.

• 705.7.1 Roofing and Sheet Metal Laying

- (a) A Method Statement detailing the procedures to be adopted shall be submitted to and agreed with the Project Manager prior to commencement of work on the site.
- (b) Mobile elevating work platforms or the equivalent shall be used to install roofing and sheet materials wherever practicable and a suitable base is available.

- **705.7.2 Erection of Structures**

- (a) A Method Statement detailing the procedures to be adopted shall be submitted to and agreed with the Project Manager prior to commencement of work on the site.
- (b) Safety harness and lines shall be provided by the Contractor for use by the erection personnel and worn at all times.
- (c) Mobile elevating work platforms or the equivalent shall be used to erect structures wherever practicable and a suitable base is available.

- **705.7.3 Mobile Elevating Work Platforms**

Operators shall be trained in the safe use of such platforms and hold a current Certificate of Competence.

- ☐☐☐ **705.7.4 Hoists**

- (a) A copy of the current Test Certificate shall be submitted to the Project Manager before any hoist (personnel or material) is brought into operation on the site. Where the range of travel is increased or reduced a copy of the revised Test Certificate shall be submitted.
- (b) Each landing gate shall be fitted with a mechanical or electrical interlock to prevent movement of the hoist when any such gates is in the open position.
- (c) Safety harness must be worn and used by personnel erecting, altering and dismantling hoists.

- **705.7.5 Suspended Cradles**

- (a) Suspended cradles shall be installed, moved and dismantled by a specialist contractor.
- (b) Suspended cradles shall comply with local regulations.
- (c) All powered suspended cradles shall incorporate independent safety lines to overspeed braking devices and independent suspension lines for personal safety harness attachment.

Use of Temporary Equipment

The safe design of any piece of equipment shall not be exceeded, nor shall the equipment be modified in any manner that alters the original factor of safety or capacity. Mobile equipment shall be fitted with suitable alarm and motion sensing devices, including back-up alarm, when required. The Contractor shall ensure that the installation and use of equipment are in accordance with the safety rules and recommendations laid down by the manufacturer, taking into account the other installations already in place or to be installed in the future.

The contractor shall inspect Equipment prior to its use on the Works and periodically thereafter to ensure it is in safe working order. Special attention shall be given to such items as cables, hoses, guards, booms, blocks, hooks and safety devices. Equipment found to be defective shall not be used and immediately removed from services, and a warning tag attached.

Natural and synthetic fibre rope made of material such as manila, nylon, polyester, or polypropylene shall not be used as slings. Only trained, qualified and authorized personnel shall operate equipment. All drivers and operators shall hold a current Certificate of Training Achievement for the equipment being used. A safety observer shall be assigned to watch movements of heavy mobile equipment where hazards may exist to other personnel from the movement of such equipment, or where equipment could hit overhead lines or structures. The observer shall also ensure that people are kept clear of mobile equipment and suspended tools.

When mobile or heavy equipment is travelling onto a public thoroughfare or roadway, a flagman shall ensure that traffic has been stopped prior to such equipment proceeding. While the mobile or heavy equipment is travelling on a public roadway, a trailing escort vehicle with a sign warning of a slow-moving vehicle that is dangerous to pass shall be provided.

Cranes:

- (a) The Contractor shall give a minimum of 48 hours' notice to the Project Manager prior to bringing a crane on site.
- (b) No cranes shall be erected in the site without the prior approval of the Project Manager. The Project Manager may direct the Contractor as to location where cranes may not be located. The Contractor shall take such directions into account when submitting his proposals for crane location points, base footings, pick up points and swing radius. Compliance with any such direction shall not entitle the Contractor to any extension of the Period of Completion or to any increase of the Contract Price.
- (c) Safety harness shall be worn and used at all times by personnel engaged on the erection, alterations and dismantling of tower cranes.
- (d) The Contractor shall provide a copy of the current Test Certificate (see Sub-Clause 702) to the Project Manager before any crane (tower or mobile) is brought into operation on the Site.
- (e) All lifting tackle must hold a current Test Certificate. All lifting tackle must be thoroughly examined every 6 months and an inspection report raised.
- (f) All fibrous/web slings shall be destroyed and replaced 6 months after first use.
- (g) All crane drivers/operators shall hold a Certificate of Training Achievement for the class of crane operated.
- (h) All banksman/slingers shall hold a Training Certificate from a recognized training agency.
- (i) The maximum weekly working hours of a crane driver or banksman shall be restricted to 60 hours.
- (j) Under no circumstances shall a crane or load come within 4 m of any energized overhead power line or other critical structure.

Locking-out, Isolating and Tagging Equipment.

Equipment that could present a hazard to personnel if accidentally activated during the performance of installation, repair, alteration, cleaning, or inspection work shall be made inoperable and free of stored energy and/or material prior to the start of work. Such equipment shall include circuit breakers, compressors, conveyors, elevators, machine tools, pipelines, pumps, valves, and similar equipment.

Where equipment is subject to unexpected external physical movement such as rotating, turning, dropping, falling, rolling, sliding, etc., mechanical and/or structural constraints shall be applied to prevent such movement.

Equipment which has been locked-out, immobilized, or taken out of services for repair or because of a potentially hazardous condition shall be appropriately tagged indicating the reason it has been isolated and/or taken out of service.

Where safety locks are used for locking out or isolating equipment, the lock shall be specially identified and easily recognized as a safety lock.

Installation of Temporary or Permanent Equipment

During installation and testing the Contractor's specialists Project Manager shall be in attendance. All control mechanism panel and wiring diagrams shall be available and printed in English.

Laser Survey Instruments

Details of the types and use of laser instruments shall be submitted and agreed with the Project Manager.

Working in Confined Spaces

Confined spaces, including tanks, vessels, containers, pits, bins, vaults, tunnels, shafts, trenches, ventilations ducts, or other enclosures where known or potential hazards may exist, shall not be entered without prior inspection by and authorization from the Site Safety Officer and the issuance of a Hazardous Work Permit.

Prior to entering the confined space, the area shall be completely isolated to prevent the entry of any hazardous substances or materials which could cause an oxygen deficient atmosphere. All equipment that could become energized or mobilized shall be physically restrained and tagged. All lines going into the confined space shall be isolated and/or blanked.

Personnel working in a confined space where emergency escape or rescue could be difficult, shall wear a safety harness attached to a lifeline. A qualified attendant(s), trained and knowledgeable in job-related emergency procedures, shall be present at all times while persons are working within the confined space. The attendant shall be capable of effecting a rescue, have necessary rescue equipment immediately available, and be equipped with at least the same protective equipments as the person making entry.

All equipment to be used in a confined space shall be inspected to determine its acceptability for use. Where a hazard from electricity may exist, equipment utilized shall be of low voltage type. The atmosphere within the confined space shall be tested to determine if it is safe to enter. Acceptable limits are:

- oxygen: 19.5% lower, 22% higher;
- flammable gas: not to exceed 10% of lower explosion limit;
- toxic contaminants: not to exceed the permissible exposure limit.

Subsequent testing shall be done after each interruption and before re-entering the confined space, as well as at intervals not exceeding 4 hours. Continuous monitoring is preferable and may be necessary in certain situations.

Adequate ventilation shall be provided to ensure the atmosphere is maintained within acceptable limits.

Demolition

A detailed Method Statement detailing the demolition procedures/techniques to be used shall be submitted to and approved by the Project Manager prior to commencement of work on site.

The Method Statement must include full details of measures to be taken to ensure that there are no persons remaining in the building/structure and to distance members of the public and Contractor's personnel from the building/structure prior to demolition.

Use of Explosives

The Contractor shall not use explosives without the written permission from the Project Manager and relevant authorities.

The Contractor shall observe all regulations regarding proper purchasing, transportation, storage, handling and use of explosives.

The Contractor shall ensure that explosives and detonators are stored in separate special building. These secured buildings shall be constructed, located and clearly marked in English:

“DANGER – EXPLOSIVES”

all as approved by the Project Manager and relevant authorities. The Contractor shall ensure that all possible precautions are taken against accidental fire or explosion, and ensure that explosives and detonators are kept in a proper and safe condition. The contractor shall ensure that explosives and detonators are always transported in separate vehicles and kept apart until the last possible moment and that metallic tools are not used to open boxes of explosives or detonators.

Blasting Procedure: the contractor shall carry out blasting operations in a manner that will not endanger the safety of persons or property. The Contractor shall, along with other necessary precautions:

- (a) clear all persons from building and the area affected by the blasting. All such persons shall be given adequate notice of the actual time and date of blasting;
- (b) ensure that police and other local authorities are kept fully informed, in advance, of the blasting programme so that they may be present when blasting takes place if they so require;
- (c) erect warning notices around the area affected that blasting operation are in progress;
- (d) carry out a thorough search of buildings and the area affected prior to blasting;
- (e) ensure that blasting is only carried out by experienced shot firers. Priming, charging, stemming and shot firing shall be carried out with greatest regard for safety and in strict accordance with the rules and regulations of the relevant authorities.
- (f) ensure that explosive charges are not excessive, charged boreholes are properly protected and proper precautions are taken for the safety of persons and property.

The Contractor shall maintain an up-to-date inventory of all explosives and explosive devices and shall submit a monthly report to the Project Manager, detailing the use of all explosives by date and location.

Excavation and Trenching

An excavation permit signed by the Project Manager must be issued before excavation proceeds in any work location. The contractor shall investigate and identify the location of existing services by study of the drawings, a visual/physical study of the site, sweeping by appropriate detection equipment and where necessary hand excavation of trial holes.

Following this investigation, the Contractor shall submit a written request for an excavation permit to the Project Manager.

The Project Manager will return the permit signed and dated to indicate:

- services which are to be maintained.
- services which are to be isolated.
- any special precautions to be taken.

A sample Excavation Permit is given in Annex 1 to this Specification. The issue of an Excavation Permit by the Project Manager shall not relieve the Contractor of his responsibilities under the Contract.

The side of all excavations and trenches which in the opinion of the Project Manager might expose personnel or facilities to danger resulting from shifting earths shall be protected by adequate temporary

supports or sloped to the appropriate angle of repose.

All excavations, slopes and temporary supports shall be inspected daily and after each rain, before allowing personnel to enter the excavation.

Excavations 1.3 metres or more in depth and occupied by personnel shall be provided with ladders as a means for entrance and egress. Ladders shall extend not less than 1 metre above the top of the excavation.

The Contractor shall provide adequate barrier protection to all excavations. Barriers shall be readily visible by day of night.

Excavated or other materials shall be stored at least 0.65 metres from the sides of excavations.

Concrete Reinforcement Starter Bars

The Contractor shall ensure concrete reinforcement starter bars are not a danger to personnel. Where permitted by the Project Manager, starter bars shall be bent down. Alternatively, the starter bars shall be protected using either hooked starters, plastic caps, plywood covers or other methods agreed with the Project Manager.

706 Environmental and Health Requirements

Contractor environmental and social management plan

The Contractor shall develop his own Environmental and Social Management Plan to ensure actions and mitigation necessary to protect the environment as contained in the Project ESIA Report and License, are incorporated into all site procedures. At a minimum, the contractor's ESMP must address the following:

- Policy
- Planning
- Implementation and Operation

706.1.1 Policy

The Contractor shall develop an environmental policy that includes, as a minimum, the following:

- A commitment to comply with applicable regulations and other requirements that the construction company subscribes to;
- A commitment to provide a safe work environment;
- A commitment to provide the training and equipment necessary for employees to conduct their work safely;
- A commitment to continuously improve performance and to pollution prevention; and
- A commitment to communicate the policy to all persons working for and on behalf of the company.

706.1.2 Planning

Environmental issues and the legal and other requirements in construction of the project have been identified in the project's ESIA Report. The Contractor must demonstrate within his plan that he has read and understood the ESIA Report and its provisions for environmental management and monitoring.

706.1.3 Implementation and Operation

Roles, responsibilities and authorities must be defined, documented and communicated to ensure effective environmental and social management. A specific management representative with requisite qualifications shall be assigned the responsibility for ensuring that the ESMP is established, implemented and maintained and shall be responsible for reporting performance, reviewing the Plan and making recommendations for improvement. Documented confirmation is required that the training needs of all persons working for or on the company's behalf whose work pose significant hazards to their health and

safety and/or may create a significant impact on the environment has been identified. Records of all training must be maintained.

Management, supervisory, and employee responsibilities must be communicated to all employees through training, formal job descriptions, work experience, hiring practices, etc. Awareness training shall be provided that include the importance of conforming to the policy and procedures, the significant environmental issues, and the roles and responsibilities of management and staff.

Records shall be legible, identifiable and traceable to the activity. Records shall be stored and maintained in such a way that they are retrievable and protected against damage, deterioration or loss.

The Contractor shall establish, implement and maintain procedures to identify potential emergency situations and potential accidents that can have an impact on the environment, surrounding communities, the employees, and/or the public.

The Contractor shall be prepared to respond to actual emergency situations and accidents and prevent or mitigate associated adverse environmental or social impacts. The ESMP must also address how the Contractor will receive, document and respond to external interested parties.

706.2 Protection of the Environment

The Contractor shall be knowledgeable of and comply with the Environmental Management Plan (EMP) and with all environmental laws, rules and regulations for materials, including hazardous substances or wastes under his control. The contractor shall not dump, release or otherwise discharge or dispose of any such materials without the authorization of the Project Manager.

Any release of a hazardous substance to the environment, whether air, water or ground, must be reported to the Project Manager immediately. When releases resulting from Contractor action occur, the Contractor shall take proper precautionary measures to counter any known environmental or health hazards associated with such release. These would include remedial procedures such as spill control and containment and notification of the proper authorities.

706.3 Air Pollution

The Contractor, depending on the type and quantity of materials being used, may be required to have an emergency episode plan for any releases to the atmosphere. The Contractor shall also be aware of local ordinances affecting air pollution.

The Contractor shall take all necessary measures to limit pollution from dust and any windblown materials during the Works, including damping down with water on a regular basis during dry climatic conditions.

The contractor shall ensure that all trucks leaving the Site are properly covered to prevent discharge of dust, rocks, sand, etc.

706.3 Water Pollution

The contractor shall not dispose of waste solvents, petroleum products, toxic chemicals or solutions on the city drainage system or watercourse, and shall not dump or bury garbage on the Site. These types of waste shall be taken to an approved disposal facility regularly, and in accordance with requirements of relevant Authorities. The Contractor shall also be responsible for the control of all run-offs, erosion, etc.

706.4 Solid Waste

706.4.1 General Housekeeping

- (a) The Contractor shall maintain the site and any ancillary areas used and occupied for performance of the Works in a clean, tidy and rubbish-free condition at all times.

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- (b) Upon the issue of any Taking-Over Certificate, the Contractor shall clear away and remove from the Works and the Site to which the Taking-Over Certificate relates, all Contractor's Equipment, surplus material, rubbish and Temporary Works of every kind, and leave the said Works and Site in a clean condition to the satisfaction of the Project Manager. Provided that the Contractor shall be entitled to retain on Site, until the end of the Defects Liability Period, such materials, Contractor's Equipment and Temporary Works as are required by him for the purpose of fulfilling his obligations during the Defects Notification Period.

706.4.2 Rubbish Removal and Disposal

- (a) The Contractor shall comply with statutory and municipal regulations and requirements for the disposal of rubbish and waste.
- (b) The Contractor shall provide suitable metal containers for the temporary storage of waste.
- (c) The Contractor shall provide suitable metal containers from site as soon as they are full. Rubbish containers shall not be allowed to overflow.
- (d) The Contractor shall provide hard standings for and clear vehicle access to rubbish containers.
- (e) The Contractor shall provide enclosed chutes of wood or metal where materials are dropped more than 7 meters. The area onto which the material is dropped shall be provided with suitable enclosed protection barriers and warning signs of the hazard of falling materials. Waste materials shall not be removed from the lower area until handling of materials above has ceased.
- (f) Domestic and biodegradable waste from offices, canteens and welfare facilities shall be removed daily from the site.
- (g) Toxic and hazardous waste shall be collected separately and be disposed of in accordance with current regulations.

706.4.3 Asbestos Handling and Removal

The Contractor shall comply with all local regulations regarding the handling of asbestos materials. In the absences of local regulations, relevant International Standards shall apply.

706.4.4 Pest Control

The Contractor shall be responsible for the rodent and pest control on the Site. If requested, the contractor shall submit to the Project Manager, for approval, a detailed programme of the measures to be taken for the control and eradication of rodents and pests.

706.5 Noise Control

The Contractor shall ensure that the works is conducted in a manner so as to comply with all restrictions of the Authorities having jurisdiction, as they relate to noise.

The Contractor shall, in all cases, adopt the best available plant/and or machinery shall be used. All equipment shall be maintained in good mechanical order and fitted with the appropriate silencers, mufflers or acoustic covers where applicable. Stationary noise sources shall be sited as far away as possible from noise-sensitive areas and, where necessary, acoustic barriers shall be used to shield them. Such barriers may be proprietary types, or may consist of site materials such as bricks or earth mounds

as appropriate.

Compressors, percussion tools and vehicles shall be fitted with effective silencers of a type recommended by the manufacturers of the equipment. Pneumatic drills and other noisy appliances shall not be used during days of rest or after normal working hours without the consent of the Project Manager.

Areas where noise levels exceed 90 decibels, even on a temporary basis, shall be posted as high noise level areas.

707 Additional Requirements for Work in Public Areas

General

Those additional requirements shall apply to all works carried out in Public Areas.

Public Areas are defined as areas still used by or accessible to the public. These include public roads and pavements, occupied buildings and areas outside the Contractor's boundary fencing.

All work in Public Areas shall be carried out to minimize disturbance and avoid dangers to the public.

Before commencing work, the Contractor shall ensure that all necessary resources, including labour, plant and materials will be available when required and that the works will proceed without delays and be completed in the shortest possible time. Period of inactivity and slow progress or delays in meeting the agreed programme for the Works, resulting from the Contractor's failure to provide necessary resources or other causes within the control of the Contractor, will not be accepted. In the event of such inactivity, slow progress or delays, the Contractor shall take immediate action to rectify the situation, including all possible acceleration measures to complete the works within the agreed programme. Details of the actions and acceleration measures shall be submitted to the Project Manager. If the Project Manager is dissatisfied with the Contractor's proposals, the Contractor shall take such further actions or measures as required by the Project Manager. All costs incurred shall be the responsibility of the Contractor.

Method Statement

The Contractor shall submit to the Project Manager a method statement for each separate area or work in Public Areas. The Method Statement shall include:

- (a) a general description of the Works and methodology of how it will be carried out.
- (b) Details of the measures and temporary works to minimise disturbance and safeguard the public. These shall include temporary diversions, safety barriers, screens, signs, lighting, watchmen and arrangements for control of traffic and pedestrians and advance warning to be given to the public.
- (c) Details of temporary reinstatement and maintenance of same prior to final reinstatement.
- (d) For works involving long lengths of trenches or works to be completed in sections, the lengths or sections of each activity (e.g. up to temporary reinstatement, final reinstatement) to be carried out at any one time.
- (e) Details of the availability of necessary resources (labour, plant, materials, etc.) to complete the work.
- (f) A programme showing start and completion dates and period for all activities of each length or section, including temporary works, and the works overall.

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- (g) Such further information as necessary or required by the Project Manager.

The Contractor shall not commence work, including temporary works, until after the approval of the Contractor's Method Statement by the Project Manager.

Method Statements shall be updated bases on actual progress or as and when required by the Project Manager.

Closure of Roads, Etc.

The closure or partial closure of roads, pavements and other public areas will only be permitted if approved by the Project Manager and Relevant Authorities. The Contractor shall detail for each closure the extent of area to be closed, the reasons and duration of the closure, and where appropriate, proposed diversions. A sample Street Closure Permit is given at Annex 2 to this Specification.

Trench and Other Excavations

The requirements covering trench and other excavations will depend on the location and type of the excavation and the potential risks to the public.

The following guidelines apply particularly to trenches but shall also apply to other types of excavations:

- (a) before commencing work the Contractor shall:
 - notify the Project Manager of the location and duration of the work. An excavation permit signed by the Project Manager must be issued in accordance with Sub-Clause 705.16 before excavation proceeds in any work location;
 - obtain permission from relevant authorities including the police when required;
 - erect all temporary works such as barriers, warning signs, lighting, etc.;
 - have available adequate materials for temporary supports to sides of excavations and necessary labour, plant and materials to complete the work within the shortest possible time.
- (b) in carrying out the works the Contractor shall, unless otherwise permitted or required by the Project Manager:
 - not open more than one excavation within a radius of 250 metres;
 - limit the length of trench excavation open at one time to 150 metres;
 - maintain and alter or adapt all temporary works including supports to sides of excavations;
 - remove all surplus excavated material the same day it is excavated;
 - complete the works, including final reinstatement within ten days;
 - where final reinstatement is not achieved within the required time, to carry out temporary reinstatement;
 - ensure that any temporary reinstatement is maintained at the correct level until final reinstatement is achieved.

The above guidelines shall not relieve the Contractor of his obligations and responsibilities.

Safety Barriers

Safety barriers shall be provided to the perimeter of work areas and to trench and other types of excavations and to existing openings such as manholes, draw pits and the like. When exposed to the public, safety barriers shall be provided to both sides and ends of trenches and around all sides of openings.

The Contractor shall provide details of the type or types of safety barriers for each excavation for the approval of the Project Manager prior to commencing work. No work shall commence until the safety

barriers are in place.

The type of safety barrier used shall be appropriate to the particular location and the potential risks to the public. Examples of different types of safety barriers are given below:

- Type 1 - excavated material;
- Type 2 - non-rigid barrier of rope or florescent tape strung between metal rods driven into the ground;
- Type 3 - rigid barrier of timber, steel or concrete. Such barriers could be in the form of horizontal rail(s) or sheet material secured to posts driven or concreted onto the ground.

The following are guidelines on the type of safety barriers that could be used in differing situations. They apply particularly to trenches but also apply to other types of excavation, existing openings onto the perimeter of work areas:

- areas not subject to vehicular traffic - Types 1 or 2;
- roadways (low traffic speed) - Types 1 or 2;
- roadways (high traffic speed or where excavation are greater than 2 m) - Type 3.

The above examples of the types of barriers and the guidelines on situations in which they could be used shall not relieve the Contractor of his obligations and responsibilities.

Section 8 Contractor's Site Check List

801 Contractor's Site Check List

A sample Contractor's Site Check List is included in Annex 1,2 & 3 to this Specification. This is included to assist contractors should they wish to introduce such a system as part of their site management procedures. The list is not exhaustive and further items will need to be added by the Contractor.

The list is issued for guidance only, and does not, in any way, revise or limit the requirements covered elsewhere in these Specifications.

Annex 1
Sample Excavation Permit

To: (Project Manager)

From: (Contractor)

Date:

Contract No:

Request for Excavation Permit No:

Please give approval for excavation to proceed in the following area: Work to
start on:

Existing services have been checked and identified by:

Drawings # Physical Survey #

Catscan # Trial Holes Excavation #

Signed (Contractor):

Approval by Project Manager

The above excavation may proceed, subject to the following: Service
to be maintained:

Services to be isolated before work proceeds:

Other matters:

Signed (Project Manager):

Date:

Annex 2
Sample Street Closure Permit

To: (Project Manager)

From: (Contractor)

Date:

Contract No:
Request for Street Closure Permit No:

Please give approval for the closure of the following street(s) from to (dates) Street(s):

Reasons:

Proposed diversions:

Signed (Contractor):

Approval of the Project Manager

The above street(s) may be closed for the periods stated subject to the following conditions: Approval has
been given by the relevant authorities and the police;

Other:

Signed (Project Manager):

Date:

Annex 3

Sample Contractor's Site Check List

Safe Access:

- arrangements for visitors and new workers to the site
- safe access to working locations
- walkways free from obstructions
- edge protection to walkways over 2m above ground
- holes fenced or protected with fixed covers
- tidy site and safe storage of materials
- waste collection and disposal
- chutes for waste disposal, where applicable
- removal or hammering down of nails in timber
- safe lighting for dark or poor light conditions
- props or shores in place to secure structures, where applicable

Ladders:

- to be used only if appropriate
- good condition and properly positioned
- located on firm, level ground
- secure near top. If not possible, to be secured near bottom, weighted or footed to prevent slipping
- top of ladder minimum 1 metre above landing place

Scaffolding:

- design calculation submitted
- proper access to scaffold platform
- properly founded uprights with base plates
- secured to the building with strong ties to prevent collapse
- braced for stability
- load bearing fittings, where required
- uprights, ledgers, braces and struts not to be removed during use
- fully boarded working platforms, free from defects and arranged to avoid tipping or tripping
- securely fixed boards against strong winds
- adequate guard rails and toe boards where scaffold is 2m above ground
- designed for loading with materials, where appropriate
- evenly distributed materials
- barriers or warning notices for incomplete scaffold (i.e. not fully boarded)
- weekly inspections and after bad weather by competent person
- record of inspections

Excavation:

- underground services to be located and marked, precautions taken to avoid them
- adequate and suitable timber, trench sheets, props and other supporting materials available on site before excavation starts
- safe method for erecting and removal of timber supports
- sloped or battered sides to prevent collapse
- daily inspections after use of explosives or after unexpected falls of materials
- safe access to excavations (e.g. sufficiently long ladder)
- barriers to restrict personnel/plant
- stability of neighbouring buildings
- risk of flooding
- materials stacked, spoil and vehicles away from top of excavations to avoid collapse
- secured stop blocks for vehicles tipping into excavations

Roof Work:

- crawling ladders or boards on roofs more than 10 degrees
- if applicable, roof battens to provide a safe handhold and foothold

-
- barriers or other edge protection
 - crawling boards for working on fragile roof materials such as asbestos cement sheets or glass. guard rails and notices to same
 - roof lights properly covered or provided with barriers
 - during sheeting operations, precautions to stop people falling from edge of sheet
 - precautions to stop debris falling onto others working under the roof work

Transport and Mobile Plant:

- in good repair (e.g. steering, handbrake, footbrake)
- trained drivers and operators and safe use of plant
- secured loads on vehicles
- passengers prohibited from riding in dangerous positions
- propping raised bodies for tipping lorries prior to inspections
- control of on-site movements to avoid danger to pedestrians, etc.
- control of reversing vehicles by properly trained banksmen, following safe system of work

Machinery and Equipment:

- adequate secured guards in good repair to dangerous parts, e.g. exposed gears, chain drives, projecting engine shafts

Cranes and Lifting Appliances:

- weekly recorded inspections
- regular inspections by a competent person
- test certificates
- competent and trained drivers over 18 years of age
- clearly marked controls
- checks by driver and banksman on weight of load before lifting
- efficient automatic safe load indicator, inspected weekly, for jib cranes with a capacity of more than one tonne
- firm level base for cranes
- sufficient space for safe operation
- trained banksman/slinger to give signals and to attach loads correctly, with knowledge of lifting limitation of crane
- for cranes with varying operating radius, clearly marked safe working loads and corresponding radii
- regular maintenance
- lifting gear in good condition and regularly examined

Electricity:

- measures to protect portable electric tools and equipment from mechanical damage and wet conditions
- checks for damage to or interference with equipment, wires and cables
- use of correct plugs to connect to power points
- proper connections to plugs; firm cable grips to prevent earth wire from pulling out “permit-to-work” procedures, to ensure safety
- disconnection of supplies to overhead lines or other precautions where cranes, tipper lorries, scaffolding, etc. might touch lines or cause arcing

Cartridge Operated Tools:

- maker’s instruction being followed
- properly trained operators, awareness of dangers and ability to deal with misfires
- safety goggles
- regular cleaning of gun
- secure place for gun and cartridges when not in use

Falsework/formwork:

- design calculations submitted method statement dealing with preventing falls of workers
- appointment of falsework coordinator

-
- checks on design and the supports for shuttering and formwork
 - safe erection from steps or proper platforms
 - adequate bases and ground conditions for loads
 - plumb props on level bases and properly set out
 - correct pins used in the props
 - timberwork in good condition
 - inspection by competent person, against agreed design, before pouring concrete

Risks to the Public:

- identify all risks to members of the public on and off site, e.g. materials falling from scaffold etc., site plant and transport (access/egress) and implement precautions, e.g. scaffold fans/nets, banksmen, warning notices, etc.
- barriers to protect/isolate persons and vehicles
- adequate site perimeter fencing to keep out the public and particularly children. secure the site during non-working periods
- make safe specific dangers in site during non-working periods, e.g. excavations and openings covered or fenced, materials safely stacked, plant immobilized, ladders removed or boarded

Fire – General:

- sufficient number and types of fire extinguishers
- adequate escape routes, kept clear
- worker awareness of what to do in an emergency

Fire – Flammable Liquids:

- proper storage area
- amount of flammable liquid on site kept to a minimum for the day's work
- smoking prohibited; other ignition sources kept away from flammable liquids
- proper safety containers

Fire – Compressed Gases, e.g. Oxygen, LPG, Acetylene:

- properly stored cylinders
- valves fully closed on cylinders when not in use
- adopt “hot work” procedures
- site cylinders in use outside huts

Fire – Other Combustible Materials:

- minimum amount kept on site
- proper waste bins
- regular removal of waste material

Noise:

- assessment of noise risks
- noisy plant and machinery fitted with silencers/muffs
- ear protection for workers if they work in very noisy surroundings

Health:

- identify hazardous substances, e.g. asbestos, lead, solvents, etc., and assess the risks
- use of other substances where possible
- control exposure by means other than by using protective equipment
- safety information sheets available from the supplier
- safety equipment and instructions for use
- keep other workers who are not protected out of danger areas
- testing of atmosphere in confined spaces; provision of fresh air supply if necessary. Emergency procedures for rescue from confined spaces

Manual Handling:

- avoid where risk of injury
- if unavoidable, assess and reduce risks

Protective Clothing:

- suitable equipment to protect head, eyes, hands and feet where appropriate

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- enforce wearing of protective equipment

Welfare:

- suitable toilets
- clean wash basin, hot/warm water, soap and towel
- room or area where clothes can be dried
- wet weather gear for those working in wet conditions
- heated site hut where workers can take shelter and have meals with the facility for boiling water
- suitable first aid facilities

Work in Public Areas:

- all risks to the public identified
- method statement approved
- road closures approved
- temporary diversions in place
- safety barriers erected/maintained
- labour, materials, plant and other resources sufficient to meet programme
- temporary reinstatement completed and properly maintained
- permanent reinstatement completed at earliest possible date.

902 Construction Environmental Management Plan

A Construction Environmental Management Plan (CEMP) is a practical and achievable plan of management to ensure that any environmental impact during the design, planning and construction phase are minimised. CEMP's have been proposed to deal with the following issues during Project construction:

Compensation and land take
Physical setting, flora and fauna;
Interruption of key infrastructure installations; Water
quality and energy management;
Dust and air quality; Occupational
health and safety; Noise and
vibration; and
Waste management.

Detailed CEMP's are presented below.

CEMP for Compensation and land take

Objective	To ensure that the land owners are properly compensated and avail land for the proposed Project.			
Management strategy	Since compensation is an integral part of Project design ensure it is dealt with from the earliest stages of Project preparation and comply with the laws of Kenya.			
	Activities	Responsibility	Timing	Costs (KES)
Actions	Land take should be minimized where feasible, exploring all viable alternative Project designs e.g. realignment of the pipeline may significantly reduce compensation; and Where displacement is unavoidable, compensation and resettlement plans should be developed with adequate compensation under guidance of various lead agencies including Ministry of Lands, TWSB, Local Councils and the District Development Committees.	Proponent	Prior to construction	TBD
Performance indicators	Lack of complaints / Complaints.	Proponent	Construction Phase	
Monitoring requirements	Documentation; and Land easement	Proponent	Construction Phase	
Reporting	Documentation	Proponent	Construction Phase	
Corrective actions	Implement recommendations.	Proponent	Construction Phase	
Interface	Ensure compliance with the Law of Kenya and the requirements of any donors involved in the Project.	Proponent	Construction Phase	

CEMP for Physical setting, flora and fauna

Objective	Maintain the existing balance within the physical, fauna and flora components in the Project area setting.			
Management strategy	Provide for appropriate measures that guarantee the protection of habitats, flora and fauna.			
	Activities	Responsibility	Timing	Costs (KES)
Actions	Provide structures that will not hinder free movement of animals and dispersal of propagation components; Maintain as much as possible the natural drainage systems and patterns; Grade sites to original levels to maintain topography; As much as practical limit the amount of vegetation cleared during works; Discourage bush meat hunting; In the event that considerable damage to vegetation is envisaged, set out a plan for replacement or grading to encourage natural rejuvenation; and Design and plan for use of wayleave by pedestrians and non-motorised systems.	Consulting Engineers Contractor AWSB	Planning. Design & construction	TBD
Performance indicators	Presence of a good balance of flora and fauna; and Minimal or no flooding in Project area.	AWSB	Construction Phase	
Monitoring requirements	Baseline data/Project completion Baseline; and Changes in local hydrology.	AWSB	Commissioning stage.	
Reporting	Site log book and EMCA requirements.	Contractor	Construction Phase	
Corrective actions	Rehabilitation	AWSB	Commissioning stage	
Interface	EMP complies with the EMCA and other applicable laws.	AWSB	Construction	

CEMP for management of infrastructure installations

Objective	Plan construction activities to minimise interruptions of infrastructure and ensure smooth Project implementation while complying with the laws of Kenya			
Management strategy	Liaise with stakeholders in the project area to ensure that access on protected or private areas is granted in good time in order to achieve Project milestones.			
	Activities	Responsibility	Timing	Costs (KES)
Actions	Establish the nature of all stakeholders; Identify key interests of each of the stakeholders; Formally liaise with the stakeholder and communicate the Project details to them with a view of developing a work plan; Implement work plan; and Acquire notes on Satisfactory Completion of Works by each affected party.	AWSB Consultant Contractors	Planning, Design and Construction phase	TBD
Performance indicators	Level of complains.	All	Construction phase	
Monitoring requirements	Timely achievement of milestones; and Lack of interruption of services.	All	Construction	
Reporting	Site log book	Contractor	Construction phase	
Corrective actions	Investigate cause of interruptions; Implement corrective measures.	AWSB Stakeholders	Construction phase	
Interface	Comply with the EMP contained in this report.	Contractor	Construction phase	

CEMP for water and energy management

Objective	Minimise impact on water and energy resources within the Project area due to the construction works.			
Management strategy	Conserve water and energy resources, abate pollution and comply with the laws of Kenya.			
	Activities	Responsibility	Timing	Costs (KES)
Actions	Provide appropriate and adequate drainage infrastructure where required; Ensure machinery is regularly serviced to avoid leakages and/or spillages; Oils, fuels and other materials to be stored in accordance with the manufacturers' safety data sheets (MSDS); Train staff on spill response; Implement erosion and sedimentation controls; Proper handling/disposal of liquid waste; Energy management through use of sound/appropriate equipment; Application of rated equipment in welding and related works; and Use of efficient mechanical plant and energy savers on sites.	Contractor	Construction phase	TBD
Performance indicators	Minimal interference of water and energy resource in the area.	Contractor	Construction phase	
Monitoring requirements	Physical inspection; and Level of complains.	Consultant	Construction phase	
Reporting	Site activities log book.	Contractor	Construction phase	
Corrective actions	Implementation of monitoring findings and recommendations.	Contractor	Construction phase	
Interface	Comply with laws and guidelines.	Contractor	Construction phase	

CEMP for dust and air quality

Objective	Maintain the quality of the air and minimise any harmful emissions into the atmosphere and comply with the laws of Kenya			
Management strategy	Abate pollution of the atmosphere by airborne particulate matter.			
	Activities	Responsibility	Timing	Costs (KES)
Actions	Dampen work areas materials heaps and mulch bare ground to minimise dust emissions; Maintain equipment and machinery to manufacturers' specifications; Use environmentally friendly fuels; Minimise the period for machinery idling; Pursue good practices in energy use and sensitise staff; and Provide appropriate personnel protective equipment to site workers.	Contractor	Construction phase	TBD
Performance indicators	Lack of complaints / Complaints; and Reports / Log book entries.	AWSB	Construction phase	
Monitoring requirements	Physical inspection Site Log books	Consultant	Construction phase	
Reporting	Site logs of inspections and corrective actions.	Contractor	Construction phase	
Corrective actions	Implement recommendations	Contractor	Construction phase	
Interface	Review and comply with laws and regulations.	Contractor	Construction phase	

CEMP for occupational health and safety

Objective	Ensure the safety and health of all the Parties involved in the Project implementation and comply with the laws of Kenya			
Management strategy	Provide proper safety equipments, facilities and conditions that will eliminate or reduce the risk to the Project workers and all those present therein.			
	Activities	Responsibility	Timing	Costs (KES)
Actions	Comply to the OSHA; Provide for appropriate signage and warnings at work sites; Provide appropriate personnel protective equipment (PPE) to workers and any visitors; Provide for First Aid facilities as per the Occupational Safety and Health Act; Provide and clearly display emergency contacts; and Develop and implement a detailed and site specific Emergency Response Plans.	AWSB Consulting Engineers Contractor	Construction phase	TBD
Performance indicators	Health and safety awareness among staff; and Frequency of incidents/accidents and fatalities.	Consultant AWSB	Construction phase	
Monitoring requirements	Daily inspection of work sites; and Tool box meetings.	Consultant	Construction phase	
Reporting	Log incidents/accidents and fatalities; and Tool box minutes.	Consultant	Construction phase	
Corrective actions	Investigate incident/accidents and fatalities; and Follow up on complains and other issues from tool box meetings.	Consultant	Construction phase	
Interface	Updates on the OSHA and orders from Directorate	AWSB	Construction phase	

CEMP for noise and vibration management

Objective	Manage activities at construction sites to reduce impacts of noise on surrounding properties and comply with the laws of Kenya.			
Management strategy	Noise to be managed through administrative and maintenance controls during construction.			
	Activities	Responsibility	Timing	Costs (KES)
Actions	All construction activities to be limited to between 7am to 6pm; All equipment used during the construction phase to be regularly maintained to ensure efficient operation; Noise dampening materials to be used where excessive noise generating-equipment are in use; Use of appropriate cushioning for heavy equipment; and Use of personal protective equipment by operations staff.	Contractor	Construction phase	TBD
Performance indicators	Lack of complaints / Complaints.	Contractor	Construction phase	
Monitoring requirements	Periodic inspection of work sites; and Service log for equipment / machinery.	Contractor	Construction phase	
Reporting	Complaints / incidents should be recorded in a log book on location.	Consultant	Construction phase	
Corrective actions	Investigate cause of noise and vibrations; Implement corrective measures prior to commencement of works; and Consider possibility of rescheduling noise and vibration generating activities.	Contractor AWSB	Construction phase	
Interface	Ensure that if the Contractors or subcontractors have an EMP and that it complies with the EMP contained in this report.	AWSB	Construction phase	

CEMP for waste management

Objective	Minimise the potential for environmental impact of wastes generated due to the construction activities and comply with the laws of Kenya.			
Management strategy	Effectively manage the sites and activities that may lead to generation of wastes.			
	Activities	Responsibility	Timing	Costs (KES)
Actions	All wastes shall be contained on site prior to disposal using appropriate storage containers; All wastes shall be regularly cleared from the site and disposed of in approved manner; High level of housekeeping shall be maintained; and Staff shall be trained / sensitised about waste management at the start of the Project and regularly as may be found appropriate.	Contractor	Construction phase	TBD
Performance indicators	No waste at work sites except in approved and marked locations.	Contractor	Construction phase	
Monitoring requirements	Regular site inspections; and Waste disposal documentation and tracking.	Contractor	Construction phase	
Reporting	Review of waste handling slips and other related documentation.	Contractor	Construction phase	
Corrective actions	Provide reports, corrective actions and recommendations where non-conformities occur.	Contractor	Construction phase	
Interface	Ensure that Contractors or subcontractors EMP complies with the EMP contained in this report.	Contractor	Construction phase	

Section 10 – Mechanical and Electrical Plant

1001 Scope of Mechanical and Electrical Work

The electromechanical equipment to be provided and installed by the Contractor should have capacity to handle 1,500m³/d of sewer flow. Contractor to provide shop drawings and power loading capacities for Engineer approval. This specification below are for general guide purpose

- Site Lighting
- Flowmeters
- Laboratory Equipment

Instrumentation

Electromagnetic Flow Meter

The electromagnetic flow meter uses the principle, that an electrical conductor (in this case the floating medium) induces a voltage if moved in a magnetic field that is proportional to the average flow velocity. This voltage is measured with two electrodes inside the pipe, while two coils mounted on the pipe generate the alternating magnetic field. From this the measuring transmitter determines the flow value of the medium.

The measuring sensor should provide:

- Flow rate: suitable for the required purpose
- Diameter of the sensor: adequate to the media pipe
- Magnetic field: alternating by pulsed direct current
- Protected against flooding: min. 24 h, 3m, according to location
- Permissible pressure: min. PN10, according to location
- Materials, pipe: Steel, coated with PTFE
- electrodes: High grade steel 1.4571
- casing: Aluminium, powder coated
- Medium temperature: 0°C....90°C
- Min. conductivity of medium: 5 µS/cm
- Degree of protection: IP 67

The measuring transmitter should provide:

- Digital display for momentary flow rate and total quantity, separately mounted (8 digits) at a location, where it can be easily calibrated, operated and read
- Monitoring of pulsed magnetic field
- Automatic zero calibration
- Field-mounted housing, powder coated die-cast aluminium, IP 67
- Output signals, 0/4...20 mA, counting pulse, status output
- Power supply, 230 VAC, 50 Hz

All surfaces being in contact with the medium have to be coated with suitable material, so that cleaning is not necessary and accuracy is not impaired during operation. The selected material must be suitable for use in wastewater, sewage sludge, and chemicals or as required by the respective purpose.

The flow meter must be mounted to the pipes, regarding the right location where no turbulent disturbances may cause false results. Mounting material, construction pipes, replacement pipes to install while the sensor is removed, telescopic pipes to ease the removal of the sensor, earthing system, reference electrode system and all electrical connections have to be provided. The measuring transmitter shall be mounted separately so that it can easily be checked and calibrated.

Electromagnetic flow meters shall be preferably used. Other kinds of flow measurement shall only be installed, if electromagnetic flow meters are not applicable (e.g. in open channels, concrete pipes, etc.).

Ultrasonic Flow Meter

At these flow meters the water flow is measured with a Venturi channel, where the channel profile is constricted in a way, that the flow changes from laminar to turbulent. In this case the flow can be determined by a single level measurement upstream of the throat. For this an echo measurement is used: An echo system transmits ultrasonic pulses towards the surface from above and receives the returning echo. It determines the level from the speed of sound, the propagation time, the devices' height and the channel construction. Variations of the ambient temperature must not influence the measurements' accuracy and therefore have to be compensated automatically by use of a temperature sensor. The complete measuring system consists of the Venturi channel, the ultrasonic level meter, the measuring transmitter and the signal processor to calculate the flow rate and to generate count pulses according to the quantity of water passing the sensor.

The Venturi channel shall provide:

- Type: Khafagi-venturi, rectangular cross section
- Size: Fitting to the channel
- Materials: Sealed polypropylene, zinc plated steel reinforcements
- Flow rate: suitable for the required purpose

The ultrasonic sensor shall provide:

- Integrated temperature sensor for compensation
- Temperature: -20°C...+80°C
- Measuring range: suitable for the required purpose
- Degree of protection: IP 68
- Connection to processor: Via 5 m cable

The signal processor shall provide:

- Digital display for momentary flow rate and total quantity (4 digits)
- Continuous flow measurement
- Field-mounted housing, IP 65
- Output signals, 0/4...20 mA, 1 status contact, counting pulse, all potential-free
- Power supply, 230 VAC, 50 Hz

The sensor shall be mounted above the channels' middle to a cantilever that is fixed to poles on both sides of the channel. The distance to the water surface must be more than the sensors block distance. The measuring ultrasonic signal must not be disturbed by any fittings inside the channel to get reliable results. The original manufacturer shall calibrate the flow meter on site. A certificate stating the accuracy at least at 10 different flow rates within the total range after installation at the wastewater plant must be submitted.

All fittings must be easy to access and to remove for maintenance or repair. All mounting material also shall be provided.

Ultrasonic Water and Sludge Level Meter

At this measuring instrument an echo system transmits ultrasonic pulses towards the medium surface from above and receives the returning echo. It determines the level from the speed of sound, the propagation time, and the sensors' height. The complete measuring system consists of the ultrasonic level meter and the fitting-measuring transmitter.

The ultrasonic sensor should provide:

- Integrated temperature sensor for compensation
- Temperature: -20°C...+80°C
- Measuring range: suitable for the required purpose
- Degree of protection: IP 68
- Connection to transmitter: Via 5 m cable

The measuring transmitter should provide:

- Digital display for momentary level respectively level difference (m, %) and volume (cum, %), 4 digits
- Permanent measurement of the medium level
- Field-mounted housing, IP 65
- Output signals, 0/4...20 mA, 1 status contact, 2 limit contacts, potential-free
- Power supply, 230 VAC, 50 Hz

The installed meter shall be resistant against gases, humidity and weathering. The function and accuracy of the meter must not be affected by these phenomena.

The sensor shall be mounted according to the purpose. At open channels or tanks it is fitted to a cantilever that is fixed to a pole on the edge of the channel or tank. Closed pipes or tanks must be supplied with a suitable flange fitting with gaskets. The material of the mounting devices shall be suitable for the material of the respective tank or pipe and shall be thermo-insulating. The distance to the medium surface must be more than the sensors block distance. The measuring ultrasonic signal must not be disturbed by any fittings inside the channel, tank or pipe to get reliable results. All fittings must be easy to access and to remove for maintenance or repair. All mounting material shall be included. In order to avoid excessive condensation at the sensors membrane, the sensor shall be mounted in a thermal-insulated manner so that the temperature of the sensor

follows the air temperature. The membrane of the sensor must be water-repellent and shall be shaped in a way that there is no built-up of water films.

Hydrostatic Level Meter

The hydrostatic level meter is mounted at the bottom of the respective tank to measure the pressure caused by the medium. From this the level can be determined, if the medium density is known. Thus effects like foam on the medium surface do not influence the measuring unit.

The sensor should provide:

- Suitable for installation in potentially explosive atmosphere (if required)
- Measuring range: suitable for the required purpose
- Output signal: 0/4...20 mA
- Degree of protection: IP 65
- Medium temperature: -30 ... +100 °C
- Housing and mounting material made of high grade steel (material 1.4301)

The measuring transmitter should provide:

- Self monitoring
- Noise-free, two wire signal transmission
- integrated linearisation
- two limit contacts with adjustable hysteresis
- power supply for measuring sensor
- Suitable for installation in potentially explosive atmosphere (if required)
- Field-mounted housing, IP 65
- Input signal: 0/4...20 mA
- Output signals: 0/4...20 mA, 4 limit contacts, potential-free
- Power supply, 230 VAC, 50 Hz
- LCD display, 4 digits

The sensor shall be mounted to a suitable flange fitting with shutoff valve and vent valve. The material of the mounting device shall be suitable to the material of the respective tank or pipe. All fittings must be easy to access and to remove for maintenance or repair. All mounting material is also included.

PH-Meter

The pH-probe consists of a measuring electrode with membrane glass, a reference electrode and a temperature sensor Pt100 for temperature compensation and temperature measurement, all combined in one sensor. The sensor is mounted inside and protected by a PVC armature. An adequate measuring transmitter is required with automatic temperature compensation and self-monitoring. The sensor is mounted to the channel or the pipe with a suitable flanged fitting, whereby the sensor shall be installed within a protective pipe that allows the sensor to be taken out without interruption of the process.

The pH-probe should provide:

- Measuring range: pH 1...13

- Temperature range: -5°C...+80°C
- Permissible pressure: 6 bar
- Shaft length: suitable for the required purpose
- Temperature compensation: -10°C...+55°C

The armature should provide:

- Shaft length according to on site conditions
- Preamplifier and 5 m shielded coaxial connecting cable with watertight and reliable connectors for probe, amplifier and measuring transmitter
- Submersible armature, self-cleaning to be lowered into the medium from suitable high grade steel fitting

The measuring transmitter should provide:

- Display: LCD, range pH 0...14, -5°C...+80°C, status-indication, 4 digits
- Output: 2 x 0/4...20 mA for pH value and temperature
- Power supply: 230 VAC, 50 Hz
- Field-mounted housing
- Degree of protection: IP 65
- Output signal: 1 status contact, potential-free

Furthermore the service includes one complete spare sensor, materials and calibration solutions for two years of operation. All fittings must be easy to access and to remove for calibration, maintenance or repair. All mounting material is also included.

Oxygen Measuring Device (DO-Meter)

A membrane-covered, amperometric sensor following the potentiostatic principle measures the oxygen content. This kind of sensor provides two measuring electrodes in an electrolyte, which is separated from the liquid being measured by a membrane, which allows oxygen to diffuse into the electrolyte.

A third electrode used as a reference electrode is used for several functions: Reduction of measuring errors, monitoring of calibration, membrane faults, and electrolyte quality, self-monitoring. The life-span of the probe is at least 1.5 years without refilling of electrolyte.

To complete the measuring system an additional measuring transmitter is required. This should be a continuously working microprocessor-based O₂-transmitter. An alternative value can be provided to the control system by an extra switch to avoid control errors, if the oxygen measurement is not working due to maintenance or repair.

The selected probe should provide:

- Automatic zero calibration
- Self monitoring
- Construction: Compact probe with cable (6.5 m) and plug-in
- Mechanical fitting: Screw-in thread R1"
- Material:

Casing: High grade steel / PVC

Counter-electrode: Silver

Reference-electrode: Silver

Working-electrode: Gold

- Membrane-thickness: 45 µm
- Flow rate: > 0.005 m/s
- Max. permissible temperature: 50°C
- Temperature compensation: 0 - 50°C by two thermistors
- Degree of protection: IP 68
- Accessories for 2 years of operation, at least:
 - ☐ 2 spare membranes as exchangeable cartridges
 - ☐ 50 ml cleaning solution
 - ☐ 50 ml electrolyte

□ 50 ml cathode-cleaner

The selected measuring transmitter should provide:

- Amperometric three-electrode measuring principle
- No zero calibration
- Automatic calibration
- Automatic air-pressure compensation
- Self monitoring
- Display: LCD, range 0...60 mg O₂/l, selectable scale, 4 digits
- Input: Socket for plug-in from the probe
- Output signals: 0/4...20 mA, 1 status contact, potential-free
- Power supply: 230 V, 50 Hz
- Field-mounted housing
- Degree of protection: IP 65
- High grade steel protective roof

The sensor shall be fixed to a submerged fitting made of PVC that can be lowered into the water from a high grade steel cantilever mounted to the edge of the tank. Before installation the best location shall be determined together with the other engineers to get a reliable result from the measurement. All fittings must be easy to access and to remove for calibration, maintenance or repair. All mounting material is also included.

Temperature Measuring Device

The temperature-measuring unit consists of a sensor Pt100 and the transmitter. The sensor is mounted to the channel or the pipe with a suitable flanged fitting, whereby the sensor shall be installed within a protective pipe that allows the sensor to be taken out without interruption of the process.

The sensor should provide:

- Measuring range: suitable for the required purpose
- Temperature range: -20°C...+75°C
- Shaft length: suitable for the required purpose

The measuring transmitter should provide:

- Display: LCD, 4 digits
- Output: 0/4...20 mA, 1 status contact, potential-free, 2 limit contacts
- Power supply: 230 VAC, 50 Hz
- Field-mounted housing
- Degree of protection: IP 65

The service includes installation, all fittings and mounting material. All fittings must be easy to access and to remove for maintenance or repair.

Laboratory Equipment

The Contractor shall deliver and furnish the laboratory room with sufficient laboratory equipment to facilitate the execution of all necessary wastewater, sludge, and digester gas analyses as required by the current National Legislative, in accordance to the requirements.

1. All laboratory furniture shall be manufactured according to the relevant DIN or acceptable standards, the electrical devices shall be suitable for 230/380 V, 50 Hz. Power supplies shall be in accordance with the relevant VDE (or comparable) directions.

2. The Contractor shall install, calibrate and connect to water or drainage services as necessary all such equipment to the approval by the Project Manager. The intake points of the electric supply shall be provided in the same line as the service supply points.
3. The Contractor shall supply and assemble parts and materials for adapting the furniture to wall, floor and ceilings and shall deliver detailed layout schemes of service connecting and drainage points as well as schematic wiring diagrams.
4. The Contractor shall submit layout plans for the arrangement of the laboratory furniture in the building to the Project Manager for approval, in accordance to the Contractors Design Proposal.
5. All stainless steel items mentioned below that are used in connection with laboratory tests and operations shall be of special stainless steel type, suitable for laboratory use and highly resistant to corrosion.
6. For comprehensive interchange-ability purposes, e.g. spare part stocking, the furniture has to be assembled from standardised components. The widths shall be multiples of 150 mm. The permissible module widths shall be 600, 900, 1200 and 1500 mm for plumbing units, and 450, 600, 900 and 1200 mm for storage cabinets. The laboratory furniture shall consist of self-contained components, which can be assembled together. Working heights shall be 900 mm for standing work and 750 mm for sitting work.
7. The Contractor shall provide and assemble all necessary equipment for cleaning, disinfection, refuse, first aid, fire-fighting, etc., including life vests, life belts and an automatic oxygen life-saving device with casing. The Contractor shall submit a detailed inventory listing the complete laboratory equipment to the Project Manager. The Contractor shall provide the manuals for all laboratory equipment in English and Kenyan language, including the relevant standards, three-fold/language.

Chemicals

The Contractor shall provide a sufficient amount of chemicals for carrying out all the required tests for a period of 2 years after the end of the defects liability period, restocking after the end of the Contractors O&M period, respectively. Chemicals and reagents with storage periods shorter than 1 year shall be supplied in quantities that will be completely used up in the laboratories with the maximum storage life. The Contractor shall submit a complete and detailed list of all chemicals and reagents and the quantities thereof to the Project Manager for approval prior to placing any order.

Laboratory Equipment

The following items shall be included in the Contractors scope of supplies as a minimum requirement.

Item	Volume	No. Req.
General Laboratory Basic Equipment		
Measuring pipettes glass	5 ml	10
Measuring pipettes glass	10 ml	20
Measuring pipettes glass	20 ml	3
Suction flask pipettes	5 ml	3
Suction flask pipettes	10 ml	3
Suction flask pipettes	20 ml	3
Suction flask pipettes	25 ml	3
Full pipettes glass	5 ml	5
Full pipettes glass	10 ml	5

Item	Volume	No. Req.
Full pipettes glass	20 ml	3
Full pipettes glass	25 ml	3
Full pipettes glass	50 ml	2
Full pipettes glass	100 ml	3
Pipettes bulb (ball)		4
Test glasses (Tubes) 16 x 160 mm - pkg. 100 piece		5
Test glasses stand for 12 tubes		5
Feeder machine, complete	0 - 30 ml	4
Feeder machine, complete	0 - 50 ml	4
Bottles NS narrow neck - clear glass	50 ml	15
Bottles NS narrow neck - clear glass	100 ml	15
Bottles NS narrow neck - clear glass	250 ml	15
Double Spatula 18 / 8 , 210 mm long		5
Tweezers 18 / 8 , blunt , 115 mm long		2
Test tube mixer		2
Drip stand - metal (wire)		3
Glass dishes, low form	100 ml	10
Glass dishes, low form	400 ml	10
Glass dishes, low form	1000 ml	10
Erlenmeyer flask, narrow neck	500 ml	20
Erlenmeyer flask, large neck	500 ml	20
Brush for funnels		4
Brush for test glasses		4
Brush for Erlenmeyer flasks		4
Brush for glass dishes		4
Brush for glass dishes		4

Brush for sedimentation vessels		4
Balloon with plastic tap	10 l	2
Narrow neck bottles PE	250 ml	30
Narrow neck bottles PE	500 ml	30
Narrow neck bottles PE	1000 ml	40
Large neck bottles PE	250 ml	20
Large neck bottles PE	500 ml	20
Measuring (graduated) cylinder, high form	50 ml	10
Measuring (graduated) cylinder	100 ml	10
Measuring (graduated) cylinder, high form	250 ml	10
Measuring (graduated) cylinder, high form	1000 ml	10
Felt pen - Black		6
Felt pen - Red		6
Felt pen - Blue		6
Manual Sampling		
Sampling stick 3.5 m long		3
Sampling ladle, one piece	1000 ml	3
Sampling ladle, two pieces	1000 ml	3
Basket, metal wire		3
Transport vessels, plastic	2000 ml	12
Bucket with handle and drain	10 l	10
Measuring dish, plastic	1000 ml	5

Item	Volume	No. Req.
Measuring dish, plastic	2000 ml	5
Temperature Measurement		
Water - Ladle Thermometer		1
Substitute Thermometer		2
Plastic rope 8 m long		2
Outside Thermometer		2
Max. Min. Outside Thermometer		2
Digital Thermometer		2
Visibility Depth Measurement		
Disc for measuring Transparency with handle		2
Disc for measuring Transparency with rope DIN conform		2
Visibility cylinder - small model		2
Visibility cylinder, large model		2
Settle-able Solids		
Sedimentation vessels, PVC	1000 ml	12
Sedimentation vessels, glass	1000 ml	6
Intake stand, PVC		3
Stop watch 120 min.		2
Viscose cleaning swam		3
Oil – Detection		
Oil test paper 320		2

pH Measurement		
Portable (Pocket) pH -meter, (pH 96A / Set)		2
pH – meter, (pH 196 with temperature control digital)		3
pH – Measuring Chain (E 50 - 1.5)		2
Measuring pen (TFK 150 - 1.5)		2
pH – Electrodes, pieces		4
Oxygen Measuring Instruments (DO-Measurement)		
Oxygen/Temperature Measuring Instrument (e.g. OXI* 92/Set)		3
Microprocessor-O ₂ -Measuring Instrument (e.g. OXI* 196)		3
Oxygen – Electrode (e.g. EO 196-1.5)		6
Microscopes		
Microscope Primus monocular, Stage 10 x, 40, 100 objectives		1
Cross - Table		1
Microscope binocular with phase contrast - equipment		1
Cupboard closeable		2
Covering glasses package /100 piece (Slides)		2
Covering glass tweezers (Slides)		3
Drip pipettes with rubber cap		4
Photometric Determinations		
Refrigerator 120 l lockable		3
Dispersing machine		3
NANOCOLOR* photometer 300 D		3
NANOCOLOR* thermoreactor R-2T		3
NANOCOLOR* security box		3
NANOCOLOR* test tubes Ammonia 50		4
NANOCOLOR* test tubes COD 160		4
NANOCOLOR* test tubes COD 40		4

Item	Volume	No. Req.
NANOCOLOR* test tubes COD 1500		4
Digital flask pipette 1.0-5.0 ml.		3
Digital flask pipette 0.2-1.0 ml.		3
Plastic cap for 1.0-5.0 ml. Pipette		3
Plastic cap for 0.2-1.0 ml. Pipette		3
Plastic stand for 3 flask pipettes		3
Reagent Vials for COD Tests to fit a.m. reactor		20
– Disposable (box with 25 vials)		
Forceps for crucibles (Length 50 cm)		2
Forceps for crucibles (Length 20 cm)		2
Markers for crucibles, Heat resistant		5
BOD Bottles with caps, with sealing water tip.	300 ml	60
Dessicators		4
– non - vacuum, D = 300 mm, H = 300 mm		
– with porcelain plates		
Burettes + Container (500 ml)		5

- Volume 5 ml, Subdivision 0.05		
- Automatic, Pyrex glass type zero, mark sets in		
- automatically, complete with rubber bulb.		
Beakers (glass)	1000 ml	24
Beakers (glass)	500 ml	24
Beakers (glass)	250 ml	24
Beakers (glass)	100 ml	24
Beakers (transparent plastic)	1000 ml	12
Beakers (transparent plastic)	500 ml	12
Beakers (transparent plastic)	250 ml	12
Beakers (transparent plastic)	100 ml	12
Reagent bottles (Amber glass)	1000 ml	12
Reagent bottles (Amber glass)	500 ml	12
Reagent bottles (Amber glass)	100 ml	12
Plastic bottles for washing	500 ml	6
Glass bottles for dropper	100 ml	12
Funnels (glass), D = 10 cm, stem = 10 cm.		12
Filter paper Watman 40/42, (100 filter/packet), Packets		30

Electrical Power Supply

Purpose: Feeding of electrical power from the public electricity network to the WWTP

Location: Electricity supply company

Drawings: WWTP

All works have to be supplied with electricity on a very high level of reliability. The actual design and the dimensions have to be determined by the Tenderer according to the requirements of his offered plant.

The offered price must include all costs, taxes and charges to be paid to the electricity supply company, for the construction of the supply line, the extension of existing transformer and switchgear stations and all required equipment outside the plants. The Contractor shall carry out all coordination's with the local electricity supply

company according to the best possibility to realise such supply of electricity at all points of the works. All costs necessary for the supply of electricity from the public network have to be included in the offer.

Electrical Power Supply for WWTP

There is an existing 100 kVA 11 kV / 415 V 50 Hz electrical supply and transformer at the existing WWTP. The Contractor should check if this is sufficient for their needs. If insufficient they shall renew the transformer in close liaison with the Employer and KENGEN.

Emergency Power Generation

In order to overcome possible power outages of long durations of the public network, which would interfere extremely with the operation of the wastewater treatment and pump stations an emergency power generator, shall be provided at those locations. Already in the first implementation stage of the works a very reliable diesel generating station for the emergency power supply with a sufficient capacity to supply each plant, and with the total emergency power that is required to supply all important consumers at the final implementation stage, shall be installed

Each diesel generating station includes, but is not limited to, at least one Gensets with all equipment as specified hereinafter and as required.

General Specifications for Diesel Generating Sets

Each Diesel Generator Station must be able to start up and supply the respective plant automatically in the situation of power outage (black out) or power irregularities (brown out, phase loss, etc.) after maximum 1 (one) minute. Each Diesel Generating Set (Genset) must be suitable for parallel operation with other Gensets.

The size and electrical power of the emergency power system must be sufficient to operate all important consumers (like pumps, blowers, etc.) if mains power is failing. Taking the emergency power concept of the future extensions into consideration, the minimum power of each Genset must be approx. 150 kVA.

Current peaks e.g. by start-up of big drives or demagnetizing of transformers must be taken into account at the design of the generators.

The degree of noise reduction shall be provided so that noise emission is limited to 45 dB(A) at the nearest building next to the WWTP and PS or at 150 m distance, whatever is more stringent..

The values of the exhaust gas emission have to be less than stipulated by the relevant Standards (clean air legislation).

Only such Generating Sets will be accepted for which a local dealer/agent with well-known reputation is available.

The Contractor shall deliver and install the Diesel Generating Sets, including all additional equipment and accessories that are necessary to get a very reliable emergency power system, which meets the present state of the art.

The engineering for the Gensets shall take the requirements for overvoltage protection into consideration as well.

All equipment that may not be separately described in the tender documents, but is actually required shall be included in the offered service.

All equipment must be completely supplied, installed, aligned, adjusted, tested, commissioned, documented, etc., incl. all necessary materials. The work to be carried out shall be carefully coordinated with all parties involved.

Low Voltage Main Distributions

Purpose: In order to receive electrical power from the transformers and to distribute this power to the LV Process Distributions

Location: WWTP

Drawings:

LV Main Distribution to receive electrical power from the transformer and to distribute this power to the LV Process Distributions. Each LV Main Distribution is to be segmented into sections according to the number of connected transformers (minimum = 2). Each incoming feeder shall be equipped with a suitable motor driven circuit-breaker as specified and with an Electronic Line Monitor. All sections have to be connected via motor driven circuit-breakers. During normal operation all sections of a LV Main Distribution are switched together. During faults or maintenance each section can be isolated.

The front of each LV Main Distribution shall be equipped with all control switches, indicators, meters, instruments, etc. required to control the unit.

Each LV Main Distribution shall also be equipped with one automatic reactive current compensation unit for each busbar section and with raised floor, labelling, etc. The drives of important circuit-breakers must be supplied by the battery of the respectively HV station.

The Contractor shall produce the final design of his equipment after his own technical clarification and obtain written approval of the design from the Project Manager.

Automatic Power Factor Compensation

The power factor shall be limited according to the requirements of the local electricity supply company but at least to cost approx. 0.95 by automatic three-phase reactive current compensation units.

The necessary compensation units are to be located one for each power transformer. Each compensation unit shall be divided into approx. 10 steps. Several capacitors each have to be provided. Due to the harmonic distortions created by large frequency converters and soft starters, each capacitor shall be connected in series with a suitable reactive coil such forming individual

resonant circuits. The resonance frequencies of these draining circuits have to be adjusted to the 5th, 7th, 11th, and 13th harmonic (250 Hz, 350 Hz, 550 Hz, 650 Hz) in order to achieve a sinusoidal mains voltage.

Each unit agrees with VDE 0560-41 and VDE 0660-500, IEC 439 and provides the following characteristics:

- Rated voltage: 400 V
- Rated frequency: 50 Hz
- Control voltage: 230 V, 50 Hz
- Degree of protection: IP 20

It is to be mounted in cabinets according to the design criteria for low voltage distributions.

The service includes suitable power capacitors according to VDE 0560 part 4, IEC 70 and VDE 560 part 41, IEC 439 with the following characteristics:

- Low losses, dielectric loss $< 0.2 \text{ W/kvar}$
- Self-sealing capacitor elements
- Constructed in a way, that guarantees automatic disconnecting of capacitor elements in case of over temperature or faults
- Compressible granulated filling in a steel casing
- Dry insulation, free of PCB (Poly-Chlorinated-Biphenyls)
- Compact and stable design
- Mounting possible in any position

The compensation units have to be tested according to VDE 660 part 500, IEC 439, i.e. for the temperatures according to the local requirements.

Each var-controller is mounted to the respective cabinet door including $\cos\phi$ -indicator. Miniature circuit breakers, switches, discharge device, under-voltage tripping and remote control input have to be included in the service. All wiring, mounting materials and complete installation ready for operation are also included.

Low Voltage Process Distributions and Electrical Process Installations

Purpose: Distribute this power via motor control units to all electrical consumers

Location: Each section of the plant's process

The Contractor shall deliver a complete and functioning Low Voltage (LV) System for the WWTP, including all engineering and all accessories that are necessary to get a very reliable energy supply system which meets the present state of the art.

One common LV Process Distribution (also called MCC) shall be realized.

Each LV Process Distribution is to be segmented into sections according to the number of connected incoming feeders (minimum = 2). Each incoming feeder shall be equipped with a suitable motor driven circuit-breaker and with an Electronic Line Monitor. All sections have to be connected via motor driven circuit-breakers. During normal operation all sections of a LV Process Distribution are switched together. During faults or maintenance each section can be isolated.

The LV Process Distributions receive power from the respective LV Main Distribution and distribute this power via motor control units (switchgear assemblies, soft starters, frequency converters, etc...) to all electrical consumers. The front of the LV Process Distribution respectively MCC shall be equipped with all control switches, indicators, meters, instruments, operator panels, etc. required to control all consumers additionally to the central control. All electrical consumers are to be supplied with electrical power on a very reliable level. For each electrical consumer an appropriate switchgear assembly with current transformer, ammeter, measuring transmitter, operation hour meter, etc. shall be provided as specified hereinafter.

The operating levels (control levels) for each drive are to be realized according to the specifications.

The service shall include a field control unit for each drive, raised floor for each LV-Room, complete labelling, internal wiring, etc.

Design Criteria for Low Voltage Distributions

Regulations: VDE 0660 part 500 air- and creeping paths, VDE 0110, VDE 0106.

For electrical plants within hazardous locations, the regulations of VDE 0165 are to be regarded.

LV panel rooms must be kept dry under any operating conditions. They may not be located below the surrounding ground level.

Switchgear-Assemblies and Components

Switchgear assemblies are complete combinations of electrical components to supply and control electrical motors and electrical consumers (i.e. Motor Control Centres / MCC).

LV switching devices must always fulfil VDE 0660. Power contactors shall be suitable for utilization category AC 3. All switchgear assemblies must be at least type tested according to VDE 0660, part 500. DIN VDE 0110 shall be observed concerning insulation and creeping paths.

Each tripping of protective units shall cause an optical and acoustic alarm given at the panel and at the Central Control Room. The alarm is accepted by operating an alarm switch that is mounted at the switchgear panel. Unaccepted alarms have to be indicated by flashing indicator lights and an alarm horn, accepted alarms shall be indicated by steady lights without alarm horn.

Circuits for lighting and socket outlets must be equipped with automatic fuses. Socket outlets shall be connected to surge-proof, peak-current-sensitive and universal-current-sensitive current operated earth-leakage circuit breakers, providing a tripping current of 30 mA.

Circuits for heating units with a poor accessibility shall be equipped with current operated earth-leakage circuit-breakers with a tripping current of 300 mA.

Frequency Converter

If required, for pumps, blowers, etc. suitable switchgear assemblies including frequency converters have to be installed.

These switchgear assemblies have to be arranged in a way that provides following operating capabilities:

- Start of the drive with initial higher start-up (break loose) torque
- Starting with limited motor current, so that during the supply by Diesel-Generator all necessary drives can start and run without overload problems
- Manual operation of each drive including setting of variable speed
- Software for automatic operation via the separately specified PLC (e.g. in order to keep a constant level in the tank, fully automatic operation of the necessary number of drives, automatic changeover between the drives to keep equal running hours for all pumps, etc.)
- Soft stop of the drives to prevent pressure peaks in the pipes
- Automatic restart of the drives after power failure in the same mode as before power loss
- Sequential start in all modes
- Save emergency stop with complete isolation of the mains

The frequency converters have to be completely delivered, installed, carefully programmed according to the connected machines, tested etc. The contactors, fuses, circuit breakers required to complete the circuitry of the switchgear assembly have to be included in the service.

Electronic Motor Soft Starter

These units perform the soft starting, reduction of starting current, soft stopping, breaking, energy saving and motor protection functions. By use of thyristors the built-in microprocessor unit of a soft starter controls the voltage of the connected motor in a way, that during the starting phase the voltage is continuously increased while the motor current and the motor torque is monitored and limited to a preset value. To make sure that motors start in a reliable manner, the units can be programmed to send an initial pulse of a higher voltage to the motors. For soft

Stopping, the soft starters reduce the voltage so that the torque of the motor reduces gradually without sudden steps. Included are among others the power supplies for the electronic units, mains filter, motor filter, high power fuses suitable for semiconductor-equipped sets, circuit breakers with signaling contact for the control voltages, a set of spare control fuses, etc.. Included in the soft starter is also a temperature limit switch to protect the unit in case of excess temperature, a number of control inputs and outputs to control the associated motor starter circuitry, five LED indicators to display the operating condition and a covered control panel with following elements: adjusters for ramp time (0.180 sec), start voltage (20..100%), current limit (0.5...6x nominal motor current) and stop time. DIP switches to programme the operating modes.

Electronic Line Monitor

All Low Voltage Distribution Switchboards need to have Electronic Line Monitors. These devices must constantly monitor the three phase voltages and currents at the feeding point. The ratios of the connected current and potential transformers have to be field adjustable at the monitor unit. The units shall be mounted in the doors of the switchgear cabinets. All programmed and recorded data shall be kept in non-volatile memory. No batteries required. Data and limit values can be easily selected and keyed in by the user at buttons at the front panel.

Electronic Motor Monitor

For all electrical motors with a power of 30 kW and above electronic protection relays have to be installed together with the electric starter circuits of the motors to protect the motors against overcurrent and excess temperature. The motor monitors shall continuously measure the motor currents of the three phases and the temperatures of the windings and determine on the basis of true RMS calculations and on the basis of the user-programmable motor characteristics and limit values if there is normal operation, or if there is a trip or an alarm condition. The programmable motor characteristics must include: Full Load Amps, Locked Rotor Current, Locked Rotor Time, Ultimate Trip current. All programmed and recorded data shall be kept in non-volatile memory. No batteries required. For door mounting. Data and limit values can be easily selected and keyed in by the user by buttons at the front panel.

Field Control Units

For each valve, pump, aerator, etc. a field control switch box shall be mounted at a location where the function of the equipment can be observed. For this encapsulated switchgear assemblies according to VDE 0660 with the degree of protection IP 65 are required. They must be suitable for use in wastewater treatment plants and outdoor mounting. The casings for surface mounting are installed vertically, with cables fitted from below to a screwed watertight gland according to the cables. Labels, white with black inscription, have to be fixed with screws.

The switchgear assembly consists of:

- • Suitable number of pushbuttons with flat button and a cover plate resistant to abrasion, with inscription (e.g. "Open", "Close", "Stop", "On", "Off", "Slow", "Fast", etc.)
- • 1 keylock switch according to plant's locking system, for electrical blocking of the pushbuttons, with abrasion-proof label "Local control - Off - Central control", key removable in all switch positions
- • 1 mushroom-head emergency pushbutton (red), latching, including keylock according to plant's locking system and surrounding circular yellow label with black inscription "Emergency Stop".

The emergency-stop-button shall be equipped with three NC contacts. One emergency pushbutton may be sufficient for a group of drives that must be stopped together in case of an emergency.

The whole assembly is surface-mounted into a weather-proof casing made of high-grade steel (W 1.4301/ANSI 304) installed on a suitable pole with protective sun and weather roof, made of high-grade steel (W 1.4301/ANSI 304), each keylock provides a protective cap to protect the cylinder from being affected by dirt. The installation ready for operation and all mounting and installation material have to be included. Field control units must be readily accessible.

Automatic Control Systems

Purpose : Automatic operation of the WWTP

Location : WWTP and PS

Drawing :

The automatic control shall be realised with Programmable Logic Controllers (PLC), also called Stored Program Controllers (SPC). Each LV main- and process distribution shall be equipped with a separate PLC unit, further PLC shall be supplied for control and data acquisition at the control centre (mimic diagram), HV stations and other important parts of the plant, that may require a separate control unit.

The Contractor shall deliver a complete and functioning Automation System, including all engineering and all accessories that are necessary to get a very reliable system which meets the present state of the art.

All PLC units shall be of the same design and type, whereby the design and type shall be chosen according to the highest requirements of any task within the complete works.

Each PLC unit shall be equipped with marshalling cabinets and must be supplied by an UPS. The service also shall include the required PLC software, a programming unit, etc.

The Contractor shall carry out the realisation of the automation systems according to the following work programme, regarding the whole electrical systems:

- Creation of description of functions, lists of consumers and measurements, circuit diagrams, workshop- and installation drawings for the whole electrical equipment
- Creation of the plant identification system
- Design of mimic diagram and control computers
- Creation of program descriptions for PLC units and the bus system
- Creation, installation and implementation of the software, start-up
- Submittal of draft of the final documentation
- Training of operational staff
- Test-run for 6 months
- Multiple optimisation of the system according to the experience, gained by the operating personnel
- Creation and submittal of the final documentation, firmware and software

Each step includes the respective technical clarification, production of the required documents, multiple revision of documentation until approval by the Project Manager.

PLC System

Automation devices have to be installed within separate switchgear cabinets in the respective LV-Room. Switchgear cabinets have to be designed according to the specifications concerning the low voltage distributions. They must conform to other switchgear cabinets at the location of installation.

The electrical specifications are:

- • Operational voltage: 400 / 230 V, 50 Hz
- • Control voltage: 230 V, 50 Hz
- • Scanning voltage: 60 V, DC
- • PLC and light indicators: 24 V, DC

Following materials have to be included:

- • Cable ducts
- • Mounting material
- • Connecting material
- • Fitting material
- • Connecting terminals
- • Automatic fuses with signalling contact for 24 VDC, 60 VDC and 230 VAC in adequate number for each panel
- • Operator panel with LCD-display in order to show the operational status of the PLC, the controlled plant and to input control variables

The PLC shall be delivered uniform with front connections respectively front plug connectors, including connection wiring, interface element and build-in hardware-clock.

All PLC have to be equipped with identical CPU-modules. The type shall be determined according to the highest requirements of all PLC stations of the whole plant.

There have to be self-diagnostic routines within the CPU to check all systems constantly. The program memory and all status registers have to be buffered with a long lasting battery (minimum 3 years).

The service includes the technical project planning, generation and submission of all documentations and their careful storage within the switchgear cabinet.

The PLC shall be delivered and mounted completely functional with mounting racks, power supply units, overvoltage protection devices, circuit breakers, monitoring devices, interfaces, bus connections, connecting cables with plugs, coupling relays, isolating amplifiers, terminals, fitting material, etc. including the wiring of the switchgear cabinets.

The programs are to be stored on a flash card.

The in- and outputs of the PLC provide the following specifications:

- Digital inputs (DI) isolated, 24 VDC
- Digital outputs (DO) potential-free via coupling relays, 24 VDC, 2 A
- Analog inputs (AI) isolated, 0/4...20 mA, converter resolution 11 bit
- Analog outputs (AO) isolated, 0/4...20 mA, converter resolution 11 bit
- System interfaces, transmission speed min. 187.5 kbit/s

Each PLC unit shall be supplied by an uninterruptible power supply unit. A switch "UPS / Main" to select the power source shall be installed at the front of each PLC unit cabinet.

For important signals and signals for safety purposes the bus system may not be used. These signals must be transmitted directly by means of control cable with a transmission voltage of 60 VDC.

At least the following signals have to be processed and transmitted to the Central Control Room either via direct cable lines or via the bus system:

- For motors, drives and valves:
 - ☐ commands (on, off, faster, slower, high speed, low speed, open, closed, right, left, etc.)
 - ☐ status signals (fault, on, off, faster, slower, high speed, low speed, open, closed, right, left, active starting delay, etc.)
 - ☐ analog values (motor current, rotation speed, measurements, etc.)
 - ☐ further signals as required
- For measuring devices:
 - ☐ Status signals (fault, maintenance, limit alarms, etc.)
 - ☐ analog measuring values
- Electric switchgear:
 - ☐ commands (open, close, etc.)
 - ☐ status signals (open, close, fault, tripped, etc.)
 - ☐ analog values (current, etc.)
 - ☐ further signals as required
- Other signals from or to the plant:
 - ☐ electricity supply (voltages, frequencies, all signals from the generating sets, etc.)
 - ☐ from the process (calculated values, etc.)
 - ☐ all signals provided from machinery units with separate control devices
- All further signals that can be gathered from any device installed at the plant

Each PLC unit shall be equipped with a marshalling and instrumentation cabinet of identical design as the PLC cabinet and of sufficient size, installed as a switchgear cabinet according to the specifications for LV equipment. The marshalling and instrumentation cabinets shall provide a sufficient number of terminal blocks for the marshalling of all incoming signal cables to the I/O units of the PLC.

All signals must be connected potential-free by means of suitable coupling relays and isolating amplifiers.

PLC Software

The PLC software consists of the programs for the automatic control of the plants' devices and for the connection to the process control system, including in- and output via communication modules with the necessary communication software. It must be possible to process all in- and outputs and transfer respectively receive them to respectively from the process control system. The service includes the generation and implementation of the software according to the required amount of data. For further software extension a memory reserve of at least 30% is required.

The correct function of the programs shall be tested and optimised in all parts of the process while the machinery is working.

The price and the service includes all clarification necessary to define the exact functional requirements of the various parts of the plant and the necessary flow of manual and automatic control, written description incl. flow-charts of all details and functions of the control system and submittal for approval (4-fold), the complete software, project planning, programming and generation of the complete documentation, start-up, test run and optimisation. The software is delivered on and test run on the PLC is also included.

Laptop PC as Programming Unit

For programming the PLC, a programming unit based on a Laptop PC is required. The laptop shall be from latest technical development and shall provide the following characteristics:

- Standard operating system
- Office software package
- Anti virus software
- Software for parameterization, programming, on-line system maintenance, operation via menus
- Software for programming, diagnosis of the PLC via statement list, ladder diagram and flowchart, providing standard blocks, control blocks, etc., the software can be operated in on-line mode
- Programming module for the memory sub module of the PLC
- Connection and all necessary connecting cables
- Interface and cable for connection to the process control system, the star coupler and the PLC
- Power supply unit and battery
- Protective case

Uninterrupted Power Supply (UPS)

In order to supply emergency power 230 VAC, 50 Hz, sinewave to the different consumers during mains power failure some UPS-Systems, suitable for permanent power supply to all critical consumers are required. They shall supply all critical consumers for minimum 120 min. with electrical energy. The specifications of all well known computer producers must be fulfilled. At least the UPS must supply the following consumers:

- Central Control equipment
- All PLC-units and PLC bus-system
- Computers and printers of office rooms
- Telephone system
- Further critical consumers as required

Each UPS consists of a rectifier with a constant voltage / constant current curve according to DIN 41 773, a Battery-System (life-span at least 10 years) and an inverter with electronic power switch (EPS). The batteries have to be installed in separate battery cabinets.

Process Control Computer

State-of-the-art process-control computer system at the WWTP. This system shall comprise all hardware- and software-components and shall be from latest technical development and shall provide the following characteristics:

- Standard operating system
- Office software package
- Anti virus software
- Connection and all necessary connecting cables
- Power supply unit and battery
- The main process control computer makes all process-data and archive-data available at an inner-office data-bus-system (Ethernet-bus) and allows all connected computers to access the data and to inspect, utilise, input, modify and store the data and perform all process-control-functions.

Each computer shall be equipped with keyboard, pointing device (mouse), high-resolution colour screen, and printer.

Software for the Process Control Computers

The software consists of the operating software and the application software including all the engineering and programming. All services of the Contractor have to be performed in complete coordination and agreement with the Project Manager.

The Contractors engineering services, the software and the system's capabilities include additionally to the above mentioned general functions all the following features:

- All plants data processing and data presentation in English and Kenyan.
- Installation of the software in all computers and delivery of the complete software on 2 different sets of media (diskettes, CD)
- System suitable for and operating in a network environment
- Fully graphical man-machine interface
- Operation via menus

- Password system for special functions
- Clearly defined and completely documented interfacing of all software modules
- Hardware-independent software on the basis of standardised operating systems with multi-user and multitasking function
- Data-exchange for external data-processing on third-party systems via Ethernet
- All data have to be stored in a data bank
- Display of all process data as dynamical graphic plant images, trend curves, etc.
- Software for the process control
- Maintenance, additions or modifications of the software and the archived process data also via menu-operated software without interruption of the process control or other software tasks
- Operating hours counters for all motors of the WWTP, giving a warning if maintenance intervals are exceeded
- Input of laboratory data at a later point in time into the existing archive
- All process-data have to be pre-processed, stored, and archived in a way, that standard third-party software can be directly applied for further data-processing like: word-processing, data-base applications, spreadsheet applications, graphical applications
- Reports have to be generated, displayed at the monitor screens and printed automatically. The data to be subject to printing have to be software selectable
- Hardcopy of all monitor displays on the colour printer
- Maintenance software to create, modify, delete and install all data to control the flow of process data and their handling and presentation including creation etc. of the dynamically graphic plant images

The operation of the complete software system must be easy to learn and to handle for the personnel. All functions have to be menu-selectable, error-safe, self-explanatory.

The data are to be treated and stored as per DWA/ATV M 260 or equivalent harmonized International Standards.

1002 General Requirements

The Contractor shall design, manufacture, deliver to Site, erect, test and commission the Plant and its associated support and shall ensure that the completed Plant meets the performance requirements and objectives.

The Plant, material and equipment shall be finished complete in all respects to provide a complete installation. Any items necessary for the completion and operation of the Works as particularly specified in the Scope of Works shall be provided under the Contract. Any clause in the General Specification which relates to the work or materials not required by the Scope of Works shall be deemed not to apply.

The Contractor shall provide competent engineers and installation personnel to carry out the erection of the plant and the tests on completion, and to give instruction on the operation and maintenance of the Plant to the Employer's staff.

Where existing equipment is to be removed, the Contractor shall transport the equipment to a regional storage compound, or to an approved disposal area as directed by the Engineer.

Levels, Dimensions and Equipment Duties

Levels and dimensions shown on the Tender Drawings or stated within the Particular Specifications are preliminary, for the tender purposes, and shall be subject to confirmation by the Contractor who shall verify the levels and dimensions and obtain the Engineer's approval before any item of Plant for that installation is ordered.

Drawings for new installation show indicative building designs and layouts. These shall be adhered to as closely as possible, minor variations to the arrangement of the buildings and plant may be made to suit the Contractor's design for the particular Plant to be supplied or to suit particular Site requirements, and shall allow, where necessary, the work to be carried out whilst maintaining the operation of the installation.

Information to be Supplied by the Contractor

Within the times stated in this Contract the Contractor shall submit to the Engineer for his approval a detailed manufacturing and delivery programme.

In accordance with the requirements of the Conditions of Contract the Contractor shall submit to the Engineer for approval detailed Construction Documents giving information for all items of Plant. The information shall

include, but not limited to, pipework details and layouts, manufacturer's drawings, fixing details and the like. Where appropriate, performance curves shall be submitted. Electrical single line diagrams shall include make, type and ratings of all equipment, a systematic wiring identification system and a clear legend. The information submitted for approval shall be sufficient to enable the Engineer to check that the materials of construction and performance of the Plant are in accordance with the

Specifications and suitable for the purpose intended. The Contractor shall furnish additional information and calculations if requested by the Engineer. The Contractor shall allow 21 days for the Engineer to check the details, from the receipt by the Engineer of complete information. No Plant shall be manufactured or ordered from suppliers for a particular installation until the Engineer has given approval of the information.

At least 6 weeks prior to delivery of the Plant to Site, the Contractor shall submit to the Engineer for approval full and detailed designs and a programme for the erection and commissioning of the Plant.

All Drawings and Documents shall be submitted for approval in triplicate and subsequent to approval being given the Contractor shall supply a further five copies to the Engineer. Drawings and Documents which have been approved by the Engineer shall be adhered to strictly and not to be departed from without the approval of the Engineer.

1003 Spares Parts and Tools

Spare parts shall be interchangeable with the corresponding parts of the Plant. The quality of spare parts shall not be inferior to that of the original Plant. Spare parts shall be adequately protected and packed in suitable containers to withstand storage under site conditions and shall be handed over with four copies of a detailed and itemized list of the spare parts prior to issue of the Taking Over Certificate. Any parts needed within the Defects Liability Period shall be provided by the Contractor.

Complete sets of maintenance tools including spanners and special tools necessary for the servicing, maintenance and dismantling of the Plant shall be supplied by the Contractor and shall be contained in suitably fitted painted steel boxes marked with the contents and fitted with good quality locks and keys.

Tools shall be handed over to the Employer upon satisfactory passing the Tests on Completion. Instruments such as ammeters, voltmeters and vibration meters shall remain the property of the Contractor unless specified otherwise.

The Contractor shall supply sufficient spare parts and tools for five years operation in accordance with the requirements listed.

1004 Inspection and Testing During Manufacture

The Plant shall be subject to inspection, examination and testing during manufacture in accordance with the Conditions of Contract, to demonstrate that it complies with the Specification and that the performance is suitable for the intended purpose.

The Engineer shall be given three weeks' notice in writing before such tests are to take place.

The performance of each item of Plant shall be tested in accordance with the Specification, appropriate standard or regulations, and to the requirements of the Engineer.

Pumpsets shall be witness tested in accordance with ISO 3555. Each pump shall be tested with its motor as an integral pumpset, and with similar starting equipment and electricity supply conditions to those pertaining in the permanent installation, unless otherwise directed by the Engineer. Pumpsets shall be tested with suction conditions and water temperatures corresponding to those under which the pumpsets will operate on site.

The works test results shall be evaluated and the guaranteed duty point verified in accordance with Clause 9.4 of ISO 3555. The following tolerance values shall be used:

$$\begin{array}{rcl} X^{QV} & = & \pm 0.04 \\ X^H & = & \pm 0.02 \end{array}$$

The evaluated combined motor and pump efficiency shall be at least 0.975 of the guaranteed value stated

Technical Proposals.

All parts of a pump subject to pressure shall be submitted to a hydraulic test pressure not less than 1.5 times the maximum pressure which can occur within the pump under any site operating condition.

Pipework, valves and fittings shall be submitted to a hydraulic pressure test in accordance with the applicable Standard.

Valves shall be tested for operation against the maximum operational unbalanced pressure.

Electric motors shall be tested in accordance with IEC 34. In addition to routine tests, one electric motor of each type and size above 45 kW shall be subject to a full performance test including a temperature rise test.

All rotating machinery shall be tested for vibration in accordance with the principles of ISO 2372. The maximum vibration velocity acceptable for factory testing shall not exceed the limits set out in ISO 2372 for the particular class of equipment.

Switchboards shall be tested to the respective standards. All functions shall be tested by means of wiring auxiliary switches to the outgoing terminals. Protective relays and instruments shall be tested with their respective instrument transformers by injection of the operating current and voltage.

Tests shall include the following:

- a) Visual inspection;
- b) Inspection of provision for cable entries;
- c) Checking access, type of cable gland etc.;
- d) High voltage pressure test (2000V) for 1 minute followed by insulation test;
- e) Test relays with varied controlled supply to ensure relays close at 85% of nominal voltage and hold close down to 65% nominal voltage;
- f) Test tripping of relays occurs at 60% nominal voltage;
- g) Any special tests applicable to the installation;
- h) Injection testing of current transformer for correct polarity and ratio, and protection relays for correct operation;
- i) Functional testing including simulation of operation of sequence controls (e.g. level controls, etc);
- j) Checking of time delay settings and protection relay settings;
- k) Checking of fuses for correct type and rating;
- l) Any other tests required by the Engineer.

Test certificates in triplicate shall be submitted by the Contractor to the Engineer within two weeks of the date of the tests. Type tests are not acceptable. Test certificates shall be supplied for test carried out on the actual equipment being supplied.

Packing shall be subject to inspection.

Plant shall not be dispatched from the manufacturer's works until approval has been received.

1005 Tests on Completion

The Contractor shall submit to the Project Manager a detailed description and schedule of the tests to be carried out on completion. These descriptions shall be submitted not less than 21 days prior to the Contractor giving notice of the date for carrying out the Tests on Completion. As part of the Tests on Completion, each individual item of Plant shall be operated to demonstrate its correct functioning, and instruments shall be checked and zeroed. Copies of all test certificates shall be submitted to the Engineer.

Each item of Plant which is designed for continuous operation shall be operated for a period of not less than 24 hours. Items of Plant not designed for continuous operation shall be demonstrated to the satisfaction of the Engineer.

Plant Tests

Test on completion shall include the following:

- a) The Plant protective devices shall be demonstrated to operate satisfactorily;
- b) All rotating machinery shall be tested for vibration in accordance with the principles of ISO 10826-1; 1995. Vibration shall not exceed the limits set out in ISO 10826-1; 1995 for the particular class of equipment;
- c) All Plant shall be tested mechanically and electrically to show that each item functions safely as designed;
- d) The sequence of operation and control systems of all Plant shall be tested;
- e) The rotation of all pumps shall be checked. The performance of all pumps shall be tested and compared with the specified duties and characteristic curves prepared from tests at the manufacturer's works;
- f) All pipe work, valves and fittings shall be pressure tested to 1.5 times the working pressure unless specified elsewhere;
- g) All Valves must be pressure tested as per the manufacturer's recommendations. However, the valves (as a minimum), must have a perfect shut-off in all directions (no visible leakage to the naked eye).
- h) All meters will be removed from the pipework during pipework testing. Meters will be tested separately as per this general specification.
- i) Load tests shall be carried out on all lifting equipment. The lifting equipment shall be tested over the full range of travel in all directions;
- j) Calibration tests shall be carried out in all instrumentation;
- k) Greasing and lubricating systems shall be tested on all plant;
- l) Test of all alarm systems, overloads and safety equipment;
- m) Any other test requested by the Engineer.

Electrical Tests

The Contractor shall also carry out tests of all electrical equipment. The tests shall include insulation resistance and earth continuity for all cabling, polarity of switches and resistance of main earths. Tests, as applicable, shall be carried out on electrical installations and electrical panels prior to their use; such tests shall include:

- a) Visual inspection

- b) Test relays with Varia controlled supply to ensure relays close at 85% nominal voltage and hold closed down to 65% nominal voltage
- c) Test tripping of relays occurs at 60% nominal voltage
- d) Insulation resistance
- e) Injection testing of current transformers for correct polarity and ratio and protection relays for correct operation
- f) Functional testing including simulation of sequence and automatic controls
- g) Checking of time delay and protection relay settings
- h) Checking of fuses for correct type and rating
- i) Any other tests required by the Project Manager.

The Employer's operational staff will normally be in attendance during the Tests on Completion. The operation of the plant from start up procedures to closing down shall simulate fault conditions.

As well as affording the Employer's staff every opportunity to participate in the tests, the Contractor with reference to the Operation and Maintenance Manuals shall demonstrate the adjustment of timers and relays. The operation of the plant from startup procedures to closing down shall simulate fault conditions. The Contractor shall ensure that the Employer's staff is familiar with the manuals and aware of the appropriate diagnosis and rectification action to be taken in the event of a fault. The Contractor shall ensure that the Employer's staff is familiar with the manuals and aware of the appropriate diagnosis and rectification action to be taken in the event of a fault.

Tests – Cable Insulation and Earthing

On completion of the separate parts of the electrical installations the Contractor shall carry out, as and when required by the Engineer tests for the insulation of cables and continuity of conduits and earth connections, together with the ability to withdraw conductors from any and re-draw in conductors, and shall submit signed copies of the results of the tests in triplicate to the Engineer.

The following tests results shall be submitted:

- a) Insulation resistance tests to earth and between phases on sections of the installation as completed and also on the whole of the installations when completed;
- b) Earth continuity tests on each main, sub-main circuit and sub-circuit installed;
- c) Polarity of switches and socket outlets and continuity of ring main circuits;
- d) Resistance of earth main.

In addition to these tests the Contractor shall provide readings of potential drop at various points in the installation and current balance over the phases on all mains.

The Contractor shall provide all instruments necessary for carrying out such tests and shall provide attendance on the Engineer when tests are being carried out. The Contractor will receive notice in advance of the timing of such tests.

1006 Tools

Complete sets of maintenance tools including spanners and special tools necessary for the servicing, maintenance and dismantling of the Plant shall be supplied by the Contractor and shall be contained in suitably fitted painted steel boxes marked with the contents and fitted with good quality locks and keys.

Tools shall be handed over to the Employer upon satisfactory passing the Tests on Completion.

Instruments such as ammeters, voltmeters and vibration meters used during testing shall remain the property of the Contractor unless specified otherwise.

1007 Operation and Maintenance Manuals

At least two weeks before commencement of the Tests on Completion the Contractor shall submit to the Project Manager two draft copies of the Operation and Maintenance (O&M) Manuals for approval, and shall take account of any amendments or additions required by the Project Manager in the production of the final manuals.

Upon completion of commissioning of the works or section of the works the Contractor shall supply six sets of final operating and maintenance manuals for the respective section or part of the works. Each volume shall be bound in a stout plastic or other approved cover and shall be suitably labelled.

The manuals shall be compiled in accordance with BS4884-1 and -2 and shall include the following:

- a) Full and detailed instructions for operating the works. Such instructions shall be specifically written for the Plant provided under the Contract, manufacturer's standard instructions relating generally to the type of plant being provided will not normally be acceptable;
- b) Full detailed instructions, diagrams, etc. for maintaining the Plant, including dismantling and stripping down for repairs, and maintenance schedules for daily, weekly, monthly and annual servicing;
- c) Manufacturer's instruction leaflets for component parts of the plant, including instruments, switchboard components, and other specialist equipment;
- d) General arrangement, schematics and PI/Ds as appropriate including all pipework, equipment etc.;
- e) Comprehensive parts list for all Plant;
- f) Copies of approved 'As Built Drawings' of the Works, as completed. Amendments to the drawings required as a result of changes during erection shall be made by the Contractor;
- g) Records of factory and site test figures and all settings for timers, relays etc.;
- h) Operation and maintenance manuals shall be written in English language. All parts and equipment listing shall be in English.

1008 Guarding of Moving Machinery

All moving machinery shall be adequately guarded to prevent injury through accidental contact. In particular, exposed shafting and couplings shall be protected with suitable guards except where they are in normally inaccessible positions.

1009 Rating Plates, Name Plates and Labels

Each item of Plant shall have permanently attached to it, in a conspicuous position, a rating plate of durable material engraved with the manufacturer's name, type and serial number, together with relevant details such as the duty or output, speed, pressure or loading.

Each item of Plant shall be provided with a name plate or label designating the service of the particular item. The inscription shall be to the approval of the Engineer.

All switchboard cubicles shall be clearly labeled with their function and the function of each instrument, indicator or control. Each cable shall be fitted with identification labels. The type of labels and the inscription shall be to the approval of the Engineer.

All rating plates, name plates and labels shall be in English.

Labels shall be engraved onto durable material, metal or plastic and shall be securely fixed by screws on or alongside the item to which it applies. Sticking is not acceptable.

1010 Packing

The Contractor shall be responsible for the proper packing, storage and crating and clear identification of all Plant prior to dispatch and shipment from its place of manufacture.

All items of Plant shall be packed and marked in accordance with international standards for exports from the country of manufacture. The Plant shall be packed and protected against deterioration during shipment and for at least 12 months storage on site. Straw or similar organic materials shall not be used for packing.

Materials liable to deteriorate from water or moisture shall be packed in cases with waterproofing lining. Switchboards, control panels and similar items of plant liable to deterioration from moisture shall be specially packed to prevent ingress of moisture. Unless otherwise agreed by the Engineer the protection shall include placing in a sealed 0.13 mm thick polythene bag and silica gel or other approved air dryer shall be placed within the unit and sufficient air drawn out to cause the polythene bag to adhere to the outline of the unit.

Electric motors (and similar equipment) shall, where applicable, be dispatched with rotors locked to prevent damage to the bearings from vibration during transit.

All packages shall be clearly and conspicuously marked with the Contractor's identification mark and the Employer's reference mark.

All separate component part of the Plant shall be identified by metal tags tied by wire and reference to drawings, installation instructions, packing list etc. Details of the referencing system shall be submitted to the Engineer for approval.

10011 Corrosion Protection

Where dissimilar materials are in contact or close proximity and corrosion may occur through electrolytic action or differences in electrical potential, protection shall be afforded by electroplating, suitable gaskets, cathodic, protection or other means approved by the Engineer.

Chromium plated parts shall not be used on sewage works or in any other damp or corrosive atmosphere.

After cleaning and inspection but before the plant leaves the manufacturer's works, the machined surfaces of steel and ironwork shall be covered with a preserving fluid of an approved type, or otherwise protected to the Engineer's satisfaction.

All surfaces shall be adequately protected in transit, and any damage shall be renovated immediately on off-loading and on completion of erection.

All external screw fixings shall be supplied in the galvanised condition, stainless steel, or sheradised to comply with BS 4921, Class 1 or Class 2 passivation treatment.

1012 Pumps

Pumps shall be constructed from standard production parts and shall be well proven in design, quality of manufacture and operational reliability. Pump design shall give stable characteristics extending well beyond the specified operating range, and adequate net positive suction head when operating under minimum suction conditions. The head discharge curve of each pump shall have a suitable rising head characteristic with decreasing capacity over a range of 15% of the specified flow.

Pump casings shall be of robust construction cast in close grained cast iron or materials of a grade

suitable for withstanding the pressures, stresses and corrosive effects of the fluids likely to be experienced. Guide vanes integrally cast in pump casings shall be suitably contoured to guide flow from the impellers with high efficiency.

Pump impellers shall be cast from high grade non corrodible materials with flow passages hand finished to achieve a smooth surface with minimum efficiency loss. Where applicable balance holes shall be provided in the impeller hub to reduce imposed axial thrust.

Renewable wear rings of non-corrodible material shall be fitted to the pump casing to maintain close running clearances with the impeller and minimum efficiency loss.

Pump shafts shall be machined from high tensile stainless steel of a diameter sufficient to prevent distortion from stresses imposed on them. Critical shaft speed shall be well above maximum running speed.

Renewable shaft sleeves of non-corrodible material shall be provided to protect the shaft from wear at the pump glands.

Pump shaft sealing arrangements shall be suitable for the fluid pressures involved and for the shaft speed. Shaft seals shall be of the repackable type with stuffing boxes designed to facilitate adjustment or replacement of the packing materials.

Shaft bearings shall be grease lubricated ball and roller type adequately sealed in housings designed to afford protection against ingress of moisture and dust, and leakage of grease.

Air vents shall be provided on pump casings to permit the manual release of air during pump priming.

Stainless steel or copper drain piping shall be provided from pump Air cocks and sealing glands to discharge into the station drainage system. Drain piping shall be arranged for easy dismantling.

A strainer of suitable corrosion and abrasion resistant material, designed to prevent entry of foreign matter but permitting unrestricted flow of water into the pump, shall be provided on the pump suction pipework. The strainer shall be removed following the Tests on Completion of the pump.

1013 Bedplates and Motor Stools

Bedplates and motor stools shall be rigid cast iron or fabricated steel. All welding shall be stress-relieved. Mounting surfaces shall be machined for correct alignment of shafts.

The design of the bedplates shall make allowance for all stresses and vibrations from the plant. No reliance shall be made on the connections to the foundation structure to absorb such stresses. Bedplates will be bolted to plane concrete surfaces and shall not be required to be filled with concrete.

1014 Flexible Couplings

Flexible couplings shall be of the non-rigid rubber bushed steel pin type with easily removable coupling guards where necessary.

1015 Lifting Equipment

The lifting hoists and cranes shall be manufactured and tested in accordance with the relevant British Standard or equivalent approved. Load tests shall be conducted both in the manufacturer's works and after erection on site. Test Certificates in triplicate shall be provided and sent to the Project Manager before the crane is commissioned. All necessary test weights and slings shall be provided by the Contractor.

The crane/hoist manufacturer shall be responsible for and include in his extent of supply the following, unless particularly specified otherwise.

- (a) All hoist runway beams including trolley end stops complete with fixings.
- (b) All crane rails and gantry beams including all necessary fixings to secure the gantry beams to the concrete corbels and carriage end stops for fixing to the crane rails.
- (c) Where lifting and travel chains are specified they shall not be electro-galvanised.

The hoist shall be built into a geared travelling trolley designed to run on the lower flange of the runway beam and shall have a minimum possible depth between the hook seat and the lower flange of the beam. The hoist shall be fitted with lifting and travel chains. Alternatively the hoist shall be fitted to a geared trolley provided lifting clearances are suitable for the particular application. The trolley shall be provided with a travel chain.

Cranes shall be designed to fit and work within the existing clearances.

Cranes shall consist essentially of a crane bridge, end carriages, travelling hoist assembly, hoisting gear, chains, block and hook.

Cranes shall be of the single beam type securely attached to the end carriages which shall be carried by rails fully supported on steel gantry beams. Rails and gantry beams shall, unless shown otherwise on the Drawings, run the full length of the building.

End carriages shall be fabricated from rolled steel plates and sections and shall be of ample stiffness. Each end carriage shall be provided with two double flanged cast steel wheels of large diameter accurately turned on the tread to suit the track rails.

The lifting hook shall be of the swivelling type to BS 2903 with a displacement sling guard provided. Testing

where applicable shall be in accordance with BS 466, section 6.43 & 44.

1016 Foundation Bolts

All necessary foundation bolts required for the Plant shall be provided by the Contractor, and shall be complete with plates or hooks manufactured from suitable material and treated to prevent corrosion. All nuts and washers used with foundation bolts shall be either stainless or cadmium plated steel.

The use of 'Rawlbolts' or other approved foundation bolt with an expanding shell, or bolts utilising epoxy resin cement grout in sockets cast into the foundation concrete is to be preferred and the Contractor shall only use rag-bolts where, in the opinion of the Project Manager, their use is absolutely necessary.

1017 Motors

Electric motors shall be manufactured to the requirements of BS 4999 and BS 5000.

Motors shall be continuously rated at least 10% above the maximum power absorbed by the pump within the specified operating range.

The starting (locked rotor) current of any motor shall not exceed 6 times the full load operating current. Motor starting torque shall be at least 120% of the pump torque requirements throughout the starting sequence.

Motors shall be insulated to Class F with Class F temperature rise. Materials shall be based on a resin

bonded system being inherently water repellent. The complete motor interior including rotor and stator windings and core, shall be finished with 2 coats of suitable anti-tracking oil and water repelling paint.

Motors for both indoor and external use shall be constructed with Class IP.54 enclosure, Class IC.41 method of cooling, and shall be fitted with grease lubricated ball and/or roller bearings incorporating effective seals to prevent grease leakage.

Motors shall be rated to allow continuous running and a starting/stopping sequence of not less than six consecutive starts in any one hour.

Motor terminals shall be protected with corrosion resistant grease after installation.

Each motor above 5 kW rating shall be fitted with an anti-condensation heater of sufficient rating to maintain the motor at 5 °C above ambient when the motor is at rest. The heaters shall be connected into the motor starter circuit such that they are switched off when the motor is running.

1018 Motor Starting Arrangement

Motor starting arrangements and limitations shall be as follows:

- i. Motors above 100 kW: Auto-transformer or stator rotor as specified elsewhere, starting arranged to limit starting current to 2.5 times motor full load current;
- ii. Motors 18.5 to 100 kW: Star-delta starting;
- iii. Motors 18.5 kW and below: Direct-on-line starting.

1019 Power Factor

The overall power factor of the plant under any load or operating condition shall not be lower than 0.90 lagging. Power factor correction capacitors rated at 85% of the no-load kVA of the motor shall be provided for each motor of above 5 kW rated output. In addition capacitors shall be fitted to smaller motors as necessary to maintain the minimum power factor specified above.

1020 LV Switchboards and Control Panels

LV switchboards and panels shall comply with BS 5486, and be rated and ASTA certified to the levels specified in the particular part of this specification for operation on a 415 Volt 3 phase 4 wire 50 Hertz supply and a minimum prospective short circuit fault rating of 43 kA.

The panels shall be modular cubicle pattern and shall be floor mounted free standing unless specified otherwise. They shall be manufactured from fabricated mild steel not less than 2mm thick and shall be of uniform height, rigid construction and neat appearance, providing an enclosure to IP.54.

They shall be constructed so that normal maintenance may be carried out from the front, but removable covers at the rear shall be provided for cabling, etc, where rear access is possible when the panel is installed. Separate cabling compartments shall be provided.

For ease of handling on site, the panels shall be delivered in sections with removable eyebolts provided for lifting.

Bolted doors shall be of rigid folded construction retained with hexagonal headed captive bolts.

Hinged doors shall be fitted with neoprene or similar approved gaskets to provide effective dust and amp exclusion. Catches shall be designed so as not to damage the paint work if the door is shut with the

catch in the closed position. Hinges shall be designed so that there is no inherent tendency to displace gaskets.

Busbars shall be of copper fully complying with BS 5486 Part 2, enclosed in a separate chamber and shall be continuous over reach shipping section. Busbars shall not be drilled for outgoing connections, which shall be made with clamps.

The riser dropper bars shall be either air insulated tinned copper or an approved solid insulation phase segregated type, fault rated to the same level as the main busbars.

Live connections to and from busbars shall be either fully insulated or suitably screened and any covers screening the busbars and connections shall be provided with adequate warning labels.

A high conductivity copper earth bar shall be bolted and efficiently bonded to the main frame to run the full length of each panel.

Flexible earth continuity bonds shall be provided for all hinged doors and swing panels. Circuit

breakers shall be of the air break pattern fully complying with BS 4752.

Contactors shall be triple pole, air break, electromagnetically operated, of unit block construction with inherent no volt feature, rated in accordance with BS 5424 Part 1, 1977. Each contactor shall have a minimum of two spare auxiliary contacts.

Unless otherwise specified, all contactors and relay control circuits shall be connected to an a.c. supply of a maximum of 240 volts.

Isolation of a control circuit supply to one or a group of starters shall not interrupt supplies to other starters.

All fuses shall be of the HRC type to BS 88. Fuses rated 30A and below shall be mounted in approved withdrawable fuse carriers. Carriers containing links shall be coloured white, whilst carriers containing fuses shall be coloured black.

Time delay relays shall have a good repeat accuracy and the direction of adjustment for increasing and decreasing the timing period shall be clearly marked.

The fuse switch associated with each starter shall be a full shrouded, triple pole unit rated for stalled motor duty and shall comply fully with BS 5419. A padlocking facility shall be provided for locking in the OFF position.

The fuse switch shall be housed within the same compartment as the starter with which it is associated and shall be mechanically interlocked with the compartment door.

The control supply shall be broken by auxiliary contacts on the fuse switch in the open position.

Anti-condensation heaters of the 'black heat' type shall be provided at the bottom of each cubicle to maintain an internal temperature of 5°C above ambient. An adjustable thermostat with clear scale shall be installed at the top of each cubicle to limit the maximum temperature. Each heater shall be individually fused and provided with an isolation switch.

1021 Safety Devices

In addition to the electrical protection specified elsewhere herein, safety cut-outs shall be provided to protect equipment against any operating conditions which could arise and which would be liable to cause

damage to the equipment: for example, lack of water at pump suction.

1022 Motor Protection

Motor protection relays for electric motors above 11 kW shall be of the electronic composite type. The relay shall incorporate wide range adjustable over-current, IDMT and earth fault together with single phasing and successive start protection.

1023 Indicators and Alarms

The operating push buttons, switches or handles or all circuit breakers, motor starters, isolators, etc shall be located on the front of cubicles, or for cubicles of the desk type on the face of the desk. There shall be visual indications of the 'ON' and 'OFF' positions.

All operations of fault and alarm circuits shall be clearly individually indicated on the fascia of the switchboard, by lamps.

Fault and alarm lights shall remain on until the associated fault or alarm condition has been cleared and the system reset.

An audible alarm shall also be provided to indicate operation of any major fault or alarm function. Alarm lamp acknowledgement shall also cancel the audible alarm.

Push buttons fitted on the panel shall be of the shrouded type, unless otherwise specified, and shall have a label indicating their function.

Indicating lamps on panels shall be rated to withstand not less than 20% continuous over voltage and shall be so designed that the heat from the bulb does not discolour the panel.

Indication lamps and push buttons shall be coloured in accordance with IEC 73 and in particular as follows:

Indicating Lamps	Colour
On	White
Off	Green
Fault	Red
Alarms	Yellow
Heaters	Blue

Push Buttons	Colour
Start	Green
Stop	Red
Alarm Accept	Black
Emergency Stop	Red

All electrical indicating instruments shall comply with BS 3693, Part 1, be moving iron type and to Class 1.5 or better. Instrument mounting height shall not exceed 1.80 metres above floor level. Unless otherwise specified instrument full scale deflection shall be at least 120% of the normal operating point (i.e. nominal voltage or full load current).

Ammeters in motor circuits shall be capable of withstanding the starting current of the motors and shall have a compressed overload scale for this purpose. The full load current shall be defined with a red line. Voltmeters scales shall have a red line indicating normal volts.

All voltage circuits of instruments shall be protected by a fuse in each unearthed phase, situated as close as practicable to the point of connection.

Current transformers shall have short circuit ratings not less than those of the circuits with which they are concerned, and shall fully comply with BS 3939.

The secondary winding of all current transformers shall be earthed. The rated burden of each CT shall be a minimum of 150% of the designed load burden.

Where specified, capacitors for correcting power factor shall be incorporated in the panel. Such capacitors shall comply fully with BS 1650.

All motors shall be provided with emergency stop push button mounted adjacent to the motors which shall lock out the control circuit and shall require a key to reset the circuit.

1024 Instruments - General

Instrumentation including transmitters shall be of the solid-state electronic type, unless otherwise particularly specified elsewhere herein.

1025 Pressure Gauges

Pressure gauges on pump delivery and suction pipes shall be 150mm diameter and of an approved type and pattern, calibrated in metres water column generally in accordance with the requirements of BS 1780. Gauges shall be connected through a three way isolating cock so that air can be released to the atmosphere. All necessary connections piping and fixing clips shall be provided.

1026 Cables and Wiring

Cables shall be of approved design from a BASEC approved manufacturer having a certificate of Assessed Quality Management. They shall be manufactured within the 12 months prior to delivery and be delivered to site on cable drums or with protective wrappings.

The overall sheath of the cables shall be coloured as follows:

240/415 Volts	-	Black
Earth continuity conductor	-	Green/Yellow
Instrument	-	Grey
Intrinsically safe	-	Blue

Cables shall be of the voltage grade, conductor size and type detailed in the specific requirements. General specification of the cable type to be used are detailed hereunder.

i) Cross-linked polyethylene cables shall have stranded, copper conductors with cross-linked polyethylene insulation. Multi-core cables shall be laid up in an extruded bedding, single wire armoured and sheathed overall with PVC, to BS 5467 (XLPE/SWA/PVC type).

Single core cables shall have aluminium wire armour. Cables rated over 6350V shall incorporate graded semi-conducting tapes and core screens in accordance with IEC 502.

Low smoke and fume emission cables shall be as above except that the bedding and sheathing shall be of low smoke and fume emission material, all in accordance with BS 6724 (XLPE/SWA/LSF type).

ii) PVC armoured cables shall have stranded copper conductors with extruded PVC insulation, PVC sheathed, single wire armoured and sheathed overall with PVC (PVC/SWA/PVC type). Cables shall be in

accordance with BS 6346. Conductors of 1.5mm² and 2.5mm² shall have stranded conductors (7/0.50 and 7/0.67 respectively).

iii) PVC insulated wiring cables shall be 450/750 volt grade single core stranded copper conductors PVC insulated to BS 6004 (PVC wiring type).

iv) Telephone cables shall be thermoplastic insulated multipair cables having twisted pairs of copper conductors (telephone type).

v) Instrumentation cables shall be polyethylene insulated copper conductors with twisted individual pairs screened, polyethylene bedded, steel wire armoured and PVC sheathed overall, all in accordance with BS 5308 Part 1 Type 2. Conductors shall be 0.5mm² stranded 16/0.2mm (PE/IS/SWA/PVC type).

vi) Earth and bonding cables shall have stranded copper conductors PVC insulated and sheathed (PVC/PVC type).

vii) Flexible cables shall have stranded, tinned copper, flexible conductors, EP rubber insulated and CSP sheathed all in accordance with BS 6007 (flexible type).

viii) Flame retardant cables shall be EP rubber insulated, tinned copper conductors in a CSP sheath, braided with galvanised steel wire (single cores having phosphor bronze wire) and protected with a CSP sheath overall, generally in accordance with BS 6883.

Generally cables shall be installed on uPVC tray.

Where cables are buried the Contractor shall provide and install the cables, plastic marker strip and sand above and below the cables. Cables shall be laid directly in trenches and a plastic marker strip shall be positioned 300mm below the ground surface in all cases.

Where cables pass through walls, floors, etc. the Contractor shall provide a suitable sleeve through which the cable may pass. Under roads or hard surface uPVC ducts shall be provided and after the cables have been installed the sleeve and ducts shall be made watertight and vermin proof in a manner to suit site conditions.

Cable route markers shall be supplied at every 30m along cable runs and at changes of direction. All non-armoured cables shall be protected by conduit.

Where cables are run on open surfaces and exposed to the sun a metal shield shall be fitted over them. Similarly where cables are run up walls they shall be protected to a height of 2m above ground or floor level.

1027 Lighting and Small Power

Lighting and small power distribution boards shall comply with the relevant parts of BS 5486. They shall be complete with incoming isolating switches and fuse as required. The distribution boards shall generally be three phase type.

Light fittings shall comply with all relevant British Standards. Fluorescent fittings shall be of the switch start type with all control gear, and be complete with a capacitor to ensure that the power factor is a minimum of 0.85. The fittings shall have a high grade paint finish suitable for installation in a tropical climate.

Bulkhead fittings, where specified, shall be suitable for industrial installations and have a minimum degree of protection of IP 55.

The cable for this section shall be PVC insulated with PVC sheaths, complying with BS 6007.

Fused spur units shall be double pole 13A switched type with neon indicator in a surface mounted metal- clad box suitable for industrial installation and complying fully with BS 1362.

Socket outlets shall be twin 13A or single 13A switched type in surface mounted metal-clad boxes suitable for industrial installation and complying fully with BS 1363.

All switches shall be water and dust sealed suitable to provide a reliable installation in the environment of a water treatment works. The switches shall be of heavy duty design to match the switched sockets specified above.

Light switches shall be 5A rated with required number of gangs and ways in a surface mounted metal- clad box suitable for industrial installation and complying fully with BS 3676.

Weatherproof light switches are to have a minimum degree of protection of IP 55.

All equipment shall be securely fixed to the walls of buildings. Such fixings shall be of threaded stud type allowing removal of the equipment without removal of the wall fixings.

Site lighting standards shall be constructed from tubular steel and shall provide a lantern mounting height of 5m above finished ground level. All steelwork shall be galvanised after fabrication.

Each standard shall have a base compartment suitable to house fused service cut-outs, control gear, etc., with a lockable compartment door. An earthing stud shall be provided at compartment level within the standard.

As a minimum the site luminaires shall be side entry 70W SON-T with a metal/GRP canopy and a polycarbonate bowl protected to IP 55.

The wiring between the fused service cut-out and lamp-holder shall be carried out in 2.5mm² PVC insulation colour green.

The Contractor shall provide and install for each standard, one fused lighting cut-out and fitted with a fuse, the whole being suitable for looping in and out PVC SWA PVC cables. The cabling for the site lighting shall be run in the ground.

The lighting standards shall be set in concrete blocks below ground level, the base of the lighting standard root resting on the concrete slab. The Contractor shall be responsible for excavation of the foundations, positioning the lighting standards and placing of the concrete to form the foundation block. When forming the foundation block the Contractor shall ensure that the cable entry in the lighting standard root is kept clear of all concrete in such a manner as to permit entry of the supply cables.

1028 Earthing and Bonding

All metalwork forming part of the electrical installation and services other than the current carrying part of the electrical circuits, shall be efficiently connected to the main earthing system in accordance with IEE Wiring Regulations. All connections shall be by means of an approved mechanical joint or adjustable clamp which shall be accessible and made secure with brass nuts and bolts; only washers of non ferrous material shall be used.

Protective conductors shall provide earth continuity either through the conduit, armouring, lead sheathing, copper sheathing, steel trunking or by independent earth tapes or PVC sheathed wires, according to the system of wiring employed. Where PVC conduits or trunking systems are employed the protective

conductor shall be routed within the conduit or trunking.

Wherever cable armouring is used as a protective conductor, care must be taken to ensure an adequate earth bond and additional bonds to the metalwork shall be provided as required.

1029 Main Earth Connections

Where a main earth bar is to be installed it shall be connected in a ring with the earth bar provided on the switchgear and any existing main earth ring in the building. The glands and wire armour of cables shall be connected to the switchgear earth bar or directly to the earth ring.

The main earth bar shall be 31.5mm x 6.3mm and where necessary shall be increased to 50mm x 6.3mm. Connections to metalwork shall be made in copper bars or using flexible copper conductors having a green and yellow PVC sheath.

Reinforced concrete or sheet steel piling shall be connected to the earthing system. The steel structural frame of the building shall be bonded to the main earth bars.

Earth rods are to be 16mm diameter driven to a depth of approximately four metres. Spacing between rods shall not be less than the depth of a rod. Inspection pits shall be provided for each electrode to allow subsequent access for testing. Disconnecting links for testing purposes shall be provided at the main earth bar.

Where copper earth tape is buried below ground level it is to be served with PVC or double half lap wrapped with an approved grease impregnated tape.

The routing, dimensioning and arrangement of all main earth bars and connections shall be detailed on schedules and drawings.

1030 Lightning Protection - Structures

The lightning protection system shall be of the Faraday cage type with horizontal conductors on the roof structure and down conductors on the outside walls of the structure.

The horizontal conductors shall be installed along the outer perimeter of the roof ensuring that no part of the roof is more than 9m from the nearest horizontal conductor.

All metallic projections on or above the main surface should be bonded to and from part of the conductor network.

The number of down conductors should be decided as follows:

A structure having a base area not exceeding 100m² may have only one down conductor. Areas exceeding 100m² shall have one plus one for every 300m² or part thereof in excess of the first 100m² or one for every 30 metres of perimeter.

Down conductors should be distributed around the outside walls of the structure.

Earth electrodes of hard-drawn copper rods with minimum dimensions of 12mm diameter shall be driven into the ground as close as practicable to the structure and end of the down type conductor.

The horizontal and down conductor shall be copper strip 25mm x 3mm.

The rods shall be installed in sections coupled by screwed connectors where necessary to penetrate the

substrata of low resistivity.

Each of these earth terminations should have a resistance to earth not exceeding the product given by 10 ohms times the number of earth terminations to be provided.

The whole of the lighting protective system should have a combined resistance to earth not exceeding 10 ohms.

Each down conductor shall be provided with a testing joint in convenient position for testing.

The fixing clamps shall be leaded gunmetal type and fixing bolts and screws shall be phosphor-bronze.

1031 Platforms and Walkways

General

All necessary platforms, ladders, stanchions, handrails, chains and all associated fittings, support structures and curbing shall be supplied to provide a safe and efficient installation.

Steelwork

All mild steel items shall be protected to BS 5493 Section II by hot dip galvanizing after fabrication to BS 729 with a minimum thickness of 85 microns (0.0034") unless otherwise specified.

No cutting, drilling, bending, riveting, threading or similar operation will be permitted after galvanizing, and due care shall be exercised in transporting, handling and fixing galvanised metalwork to prevent damage to zinc coating. Under no circumstances shall damage to zinc coating be repaired with rust inhibiting paint.

Platforms

Platforms as indicated on the Specification drawings shall be provided. All platform panels shall be individually secured to the supporting structure and be of suitable size and weight for ease of handling. They shall be cut and fixed to maintain a continuity of pattern.

Platforms, walkways and floor covers shall be adequately supported to prevent undue flexing and have supporting rebates with a minimum landing width of 30mm. Where the supporting structure is concrete, galvanised mild steel angle curbs shall be provided and securely grouted into rebates left in the concrete such that the tops of the panels are flush with the top of the concrete.

Normal access ways shall be suitable for a minimum uniformly distributed load of 5 kN/m² (105 lbf/ft²). Where platforms and floor covers are specified for concentrated loads or machinery support, the uniformly distributed loading shall be not less than 15 kN/m² (315 lbf/ft²).

Plated flooring shall be aluminium chequer plate having a minimum base thickness of 8mm with a non-slip tread pattern, secured to the supporting steelwork with countersunk screws, which shall be cadmium plated when used with aluminium plate. For manoeuvring small-wheeled items e.g. switchboards trucks, plain floor sheeting 8mm thickness shall be provided over specified areas.

Open mesh platforms shall be open type, galvanised mild steel flooring.

Hinged Covers

Hinged covers provided in platforms shall have a galvanised, fabricated steel framework, covered to match the surrounding floor strength and pattern.

Covers provided for permanent man access shall be located as indicated on the specified drawings. They shall have a locking stay fitted, arranged so that in the fully open position, the stay will hold the

cover open until released. Provision for padlocking the cover in the open or closed position shall be provided.

Covers for valve keys or other small openings shall be sized to suit the application and not include either stays or padlocking facilities.

Ladders

Ladders shall be of mild steel construction except where they are subject to prolonged immersion in water where they shall be of stainless steel.

Permanently fixed ladders of the step type shall have flat section, non-slip, open type treads not less than 450mm wide between stringers, with handrails fitted to each side extended to meet the platform handrails at the upper end. Tread width shall be not less than 120mm with a pyramid pattern nosing.

Vertical or near vertical fixed ladders for emergency use shall be in accordance with BS 4211 with equally spaced rungs between 230mm and 260mm apart with a width between stringers not exceeding 400mm. Safety hoops shall be provided where ladders rise more than 2.3m from the ground or platform. The stringers shall be extended at least 1100mm above the upper platform, and suitably opened out for access, or where ladders are below manhole covers, a separate hand hold shall be fixed to the upper platform.

Railings

Guardrails shall be provided for all platforms elevated greater than 500mm and the upper rail shall form the handrail. A knee rail shall be included and located approximately at mid-height.

Stanchions and rails shall be of mild steel or aluminium alloy tubing as specified, not less than 31mm overall diameter and tube thickness 10 SWG set in a twin-rail arrangement with the upper rail not less than 1.1m above the platform level or 900mm above the stringer pitch line for stair flight. Ball type tubular standards are to support the rails at not more than 1.5m centres and arranged so that there is a standard not more than 300mm away from any bend and 150mm from any rail joint. Rails are to be secured to prevent movement within the standards. Standards and rails shall be attached to the platform/walkway and not to any non-structural floor or toe plates.

Any roughness on the external surfaces shall be removed in an approved manner to produce a safe surface to the satisfaction of the Project Manager.

A plastic coated finish shall be applied where specified and care should be taken to preserve from damage the plastic coating which may, if desired, be applied at a later date. The Contractor is to include all cleaning and derusting operations necessary.

Whenever possible, runs of guardrail shall be continuous and sharp vertical changes of direction shall be avoided. Handrails shall terminate in swept ends either to the wall or return to the knee rail by means of a U bend which shall not extend greater than 350mm beyond the centre line of the last standard.

Safety Chains

Access openings in guardrailing to ladders and platforms having a direct drop of more than 300mm shall be protected by a double row of safety chains of galvanised or electro-plated zinc mild steel 3 SWG x 3 links per 100mm complete with 'S' hook attachments at one end and permanently fixed at the other.

Trench Covers

Trench covers shall be of minimum or galvanised mild steel chequer plate (min 3mm thick) supported to prevent undue flexing and having suitable holes to allow removal by standard lifting keys. Support shall be by means of steel curbing rebates cast into the trench top edges, such that the top of the covers are

flush with the top of the finished floor level and providing a landing width of at least 30mm.

Additional or alternative support for switchboards etc. shall be from at least 75 x 35 mm channel section cross bearers and transverse trimmers, fixed or cast into the floor and located to suit equipment fixings, access requirements and floor cover spans.

To prevent differential deflection, butt straps shall be fitted to the underside of floor plates which have no other support.

Edging curbs suitable for mild steel chequer plate shall be painted in red oxide primer, the curbing may be tapped to accept cover securing screws. Where aluminium plates are used in contact with any mild steel supports, a bitumen coating on the points of contact shall be used.

1032 Mechanical Flow Meters

Mechanical flow meter shall be volumetric, jet or in-line helical vane (Woltman) type to Standards ISO4064/BS 5728 EEC Specification with integral strainer and matching Flanges. Meters shall be designed for minimum maintenance and shall incorporate best quality rotor bearings to ensure long working life.

Meter bodies shall be cast in spheroidal graphite iron to BS EN 1563. All internal parts shall be manufactured from non-corrodible materials.

Meters are for the measurement of potable water flow with a normal working temperature up to 30°C and a maximum working pressure of 16 bar.

Meters shall be generally in accordance with the following table.

Meter Size (mm)	Q _{max} : PEAK Instantaneous Flow (minutes only) (m ³ /h)	Q _n : MAXIMUM Continuous Flow At ±2% measuring Error (m ³ /h)	Q _{min} : MINIMUM Flow at ±5% Measuring error (m ³ /h)
80	200	120	0.70
100	250	180	1.20.
150	600	400	3.00
200	700	550	5.00
250	1200	750	10.00
300	1500	1000	12.00

Measurement mechanisms shall be removable from the meter body without the necessity to remove the meter from the main. Meters shall be equipped with a register indicating flow in metric units a sweep hand and six figure counter. Dummy cover plates to seal the meter after the mechanism removal shall be provided.

Tapers shall be provided, or non-standard bearings and propellers, if required, to obtain the specified degree of accuracy at the specified flow rates.

The meters shall be suitable for working pressures up to 16 bar unless otherwise stated.

An extension drive and extended head shall be fitted to meters as required. The drive shaft bearings and gears shall be designed for long life under continuous operation, and normal wear shall not significantly affect the accuracy of the meter.

Meters shall have a circular dial and rate of flow indicator registering flow in litres/sec. A flow totaliser

having at least six digits shall be incorporated in the head. The totaliser shall have a capacity of at least one years flow at maximum flow rate. A multiplying factor in multiples of 10 may be used in conjunction with the totaliser; the factor shall be clearly marked alongside the register.

Meters shall be individually flow calibrated at the manufacturer's works and shall be guaranteed to within 2% of true flow within the rated range of the meter. Each meter shall be supplied with a calibration certificate.

The spare parts shall include as a minimum spare gearing and bearings for each size of flow meter used.

Meters shall be installed with at least 10 diameters of straight pipe upstream and 5 downstream to minimise turbulent effects.

1033 Stoplogs

Standard mounting fixing arrangements are channel fixing into prepared rebates in channel walls and floor. Frames shall be supplied in three sections for ease of handling and Installation and shall be manufactured from stainless steel to BS EN 10088:1995 grade 1.4301 (304) or 1.4401 (316). Frame Seals shall be resilient EPDM (Ethylene Propylene Di Methyl) wiper type seals having an angled lip seal. Seals shall be fitted to the seating and unseating sides of the frame. The seals shall be fixed with corrosion resistant retaining strips and stainless steel fasteners.

Logs shall manufactured as a composite sandwich construction comprising a lightweight rigid, cellular core with a fully welded steel box section matrix between two other skins of rigid, compressed composite plastic which shall be asbestos free, ultra violet stabilised, rigid and non toxic. All materials shall be chemically bonded and sealed. Inter Log Seals shall be twin seals fitted to the bottom edge of each log to permit on or off-seating pressures.

Each log shall be provided with 2 stainless steel lifting pins, located on the log faces to permit manual lifting.

1034 Cranes and Hoists General

Cranes and hoists shall be of standard proven design in accordance with BS 466, rated for lifting the specified working loads, utilization and service conditions and shall be suitable for operation from the runway beams provided. Motions shall be motorized as specified with dual speed hoisting facility and controlled from a pendant push button unit via a crane control panel mounted on the gantry.

All operations, whether manual or electric, shall be controlled or performed from motor room floor level unless otherwise specified.

The lifting assembly shall be rated for the highest lift that could occur during installation and maintenance operations, including allowance for stiction.

The crane shall consist of a gantry or jib, crab and hoist assembly, ropes, block and hook together with the necessary running rails and all electrical supply requirements.

Chains used for lifting or travel shall be alloy steel and corrosion protected by an electro-deposited, zinc coated finish after manufacture. They shall not be hot dip galvanised.

Jibs or gantries shall be of plate or box girder design and securely attached to end mountings or carriages.

Hoist

The hoist unit on travelling beams shall be mounted to provide the highest possible lifting facility whilst maintaining adequate clearance between the crab/hoist assembly and the building structure and fittings. Hoist units fitted to single runway beams, fixed or jib mounted, shall be of the self-suspension type mounted on a single rigid trolley suitable for manual geared travel along the runway beam. Two end

stops shall be provided on the beam suitable for the trolley provided. The trolley shall have ball or roller bearings grease packed for life.

The hook shall be fitted with a swivel and a safety catch and be capable of touching the floor and providing a minimum lifting height as specified.

In the case of electrically operated hoist the normal hoist speed shall be approximately 4 metres/min and the creep speed shall be approximately 600mm/min or nearest standards. An overload device and overwind limit shall be included to prevent dangerous overloads. Raise and lower limit switches shall be provided at the maximum and minimum lift positions. Instantaneous fail safe braking in the event of power failure shall be provided.

Where operation is by electric motor a power supply shall be provided under the contract. Power shall be taken from a feed in the main distribution panel forming a part of the works and a wall mounted fused isolator shall be provided at a suitable location approximately 1.5 m above floor level alongside the lifting installation.

Power transmission to the moving installation shall be by pick up shoe running along the underside of shrouded rails, suspended concertina cable running on slides or a rail or a cable from a self winding cable reeling drum. In the latter case the tension in the cable shall be controlled and supported provided to prevent the cable dropping more than one metre below the crane rails(s).

Testing

All lifting equipment shall be tested at the manufacturer's works and on site. Tests on site shall comprise a full load test, including, where applicable, deflection checks on beams. Where the contractor wishes to use lifting equipment forming part of the permanent works for installation purposes he shall have the equipment tested and be in possession of a valid test certificate before using the equipment. All equipment must be tested or retested within one month of handing over to the Employer. Test certificates shall be provided in triplicate. The Contractor shall be responsible at his own cost for the provision of all weights, slings and other equipment required for testing.

Rating Plates

The SWL shall be clearly marked on the rating plate and shall be legible from the plant working level.

Paint Finish

The finish colour shall be full gloss Yellow Colour No. 356 to BS 381C or equivalent reference 08 E 52 to BS 4800.

Clearance Access

Where clearance permit, provision for safe maintenance shall be provided in accordance with BS 466 and shall include a walkway across the span having a height clearance of 2m and be fitted with double-tiered handrails and toe boards.

1035 Air Compressors and Blowers

Air Compressor/Blower

The compressor shall be an air cooled type capable of oil and dust free air delivery at the volume and pressures specified when directly or indirectly driven by an electric motor or diesel engine.

The compressor performance shall be in accordance with BS 1571 for the site condition and duty cycle specified and shall include the following components:

- Suction air filter/silencer;
- Solenoid operated unloader valve;
- Pressure relief valve;

- Non-return valve;
- Isolating valve;
- Low oil pressure switch (or pressure lubricated).

Where necessary, depending on load factor, the compressor shall include cylinder jacket and after cooler facilities for cooling the delivered air, the aftercooler having a suitable pressure relief valve and automatic drain valve.

Air Receiver

The compressor shall deliver air into an air receiver manufactured in accordance with BS 5169 Class III Grade E or F, to accommodate the specified design pressure and internal volume.

The receiver shall incorporate the following items:-

- One safety relief valve;
- One automatic drain valve;
- One pressure gauge (0 – bar);
- Pressure and temperature switched to suit the control;
- Inspection access to permit internal examination of the receiver;
- Lifting facilities as determined by the receiver weight.

The receivers shall preferably be located in low ambient temperature areas to minimize condensation and the inlet outlet pipe connections shall be arranged to promote air circulation.

Separators

The air distribution main shall include a separator to remove suspended moisture in the air main.

Compressed Air Filters

The air supply shall incorporate filters of the disposable element type as near as possible to the point of use.

Filtration shall be carried out using two filters in series, the first filter graded for coarse filtration and the second for fine filtration as defined in the Specific Requirements.

Drain Traps/Strainers

Automatic drain traps shall be provided for air receivers, filters and separators. Strainers shall be provided for protection of the drain traps. Ball traps shall have cast iron bodies with stainless steel internal parts (Spiraax Sarco or equal).

Air Pressure Control

The compressor shall be arranged to maintain the air pressure in the system within the specified limits by means of pressure switches in conjunction with unloader valves and timers to prevent prolonged off-load running.

The frequency of starting and stopping shall be within the limitations of the drive arrangement.

Where two compressors are operated on a duty/standby basis, the duty compressor shall operate whenever the low pressure switch closes and shall cease operation when the high pressure switch opens. Should the pressure fall to the standby low pressure, the standby compressor shall operate in conjunction with the duty compressor and shall similarly cease operation when the high pressure switch opens.

The circuits for the compressor motor starters shall be completely separate. Either unit shall be capable of duty or standby operation and periodically their modes will be reversed.

The blower shall discharge continuously the specified free air delivery at specified suction and delivery pressures.

The blower shall be of the centrifugal or positive displacement rotary type with cast iron casings capable of delivering oil-free air. The blower shall be fitted with mechanical seals and incorporate a mechanical oil lubrication system, including an oil flow indicator, level indicator, pressure gauge, filling and drain plugs.

The design of the blowers is to be such that the noise level is kept to a minimum. The impellers shall each be equipped with heavy duty spherical roller bearing at each end. Gear end bearings shall be axially located on the inner and outer races to control thrust and maintain factory set clearances at all times.

The two timing gears shall be accurately machined to position the impellers in the impeller case and shall be secured to the shafts by locking kits. Gears shall be enclosed in an oil-tight housing.

The shaft sealing arrangement shall comprise a garter spring viton lip seal and a piston ring seal with an intermediate space vented to atmosphere.

Gears and gear end bearings shall be lubricated by a splash oiling system from oil maintained in the gear housing. Drive end bearings shall be grease lubricated or lubricated by a splash oiling system from oil maintained in the drive cover, depending upon gear size.

Each blower is to be direct driven through a flexible coupling, or indirectly via 'V' belts, by means of an electric motor, the complete assembly being mounted on a cast iron combination base plat. Both driver and driven units are to be dowelled or otherwise positively located to the base plate and substantial guards provided over all moving parts.

All covers and flanges associated with spigotted joints should be provided with easing screws if possible.

Blower Accessories

Each blower shall include a tachometer, an adjustable weight operated lever type air relief valve, delivery pressure and suction gauges each with isolating cocks mounted on a panel secured to a blower. An automatic unloader vented to outside atmosphere or an approved by-pass system is also to be included if this will assist starting.

The air relief valve is to be of double flanged cast iron construction with gunmetal trim. The adjustable weight shall have provision for locking to prevent any unauthorized interference.

Bosses shall be provided on each blower discharge pipe, upstream of the non-return valves, suitably tapped for connection by capillary tubing to pressure switches.

Blower Filters

The filters shall be capable of handling the designed throughput of air with the minimum of pressure drop whilst excluding 99.7% of all particles down to 2 microns.

The filters shall be of the two stage type comprising a hand operated roller mounted first stage roll type element and a disposable cartridge type second stage having access from one side only. The first stage unit is to be mounted in a galvanized sheet steel case with easily removable covers, the roller handle being conveniently positioned for easy adjustment of the roll.

The second stage unit is to be mounted in a galvanized sheet steel case and the units connected by a transition piece, a further transition piece being arranged between the second stage and the silencer.

Connections with isolation taps are to be provided on both sides of each stage and suitable manometers fitted to allow for measurement of the differential pressure.

Each unit shall be supported from the floor on substantial steel frames with welded plate feet.

Air Silencers

Single inlet and outlet silencers shall be included for the blowers and manufactured of sheet steel, comprising a perforated inner tube and an outer galvanized casing, the space between being filled with a sound absorbing material. A flange is to be provided at each end, and all necessary supports extending to floor level are to be included. The silencers are to be designed for the minimum pressure drop.

Noise Attenuating Enclosure

The enclosure shall be removable pre-fabricated type designed to reduce the noise level by approximately 20 dB (A).

The enclosure shall incorporate access doors or panels such that routine maintenance can be carried out without removing the entire closure. It shall be possible to remove the enclosure without disconnection of the silencer mounted outside the enclosure. The operating sound pressure level of the set, measured in accordance with BS 4196 at a distance of 3 metres, with the exhaust silencer and the noise attenuating enclosure in position, shall be a maximum of 80 dB (A).

1036 Miscellaneous Equipment

Submersible Mixers

The mixer shall be of the propeller type where the motor, gear unit, shaft, and propeller comprise a compact unit which is completely submerged.

The complete unit shall be of materials suitable for the particular application.

The junction box shall be completely sealed from the surrounding liquid and from the motor unit to prevent ingress of liquids.

The gear unit shall be fitted with spur gears with helical teeth to provide the desired speed reduction to suit the particular application.

The motor shall be of submersible type in accordance with Section 6 – Electrical Specification. The mechanical shaft seal shall have working faces of material to suit the particular application.

Bearings shall be of the deep groove ball or roller type designed for an L10 life in excess of 25,000 hours of continuous operation.

The whole mixer unit shall be mounted on guide rails and shall be complete with all necessary chains and shackles for safe and effective removal.

A lifting davit suitable for removal of the mixer unit shall be provided which shall be tested in accordance with the relevant British Standards. Test certificates shall be provided and the safe working load shall be clearly marked. The lifting capacity of the davit shall exceed the maximum weight of the unit by 100% minimum to overcome binding of the mixer unit on the guide rail.

Tank Covers

Tanks shall conform to the following:

- Tank covers are to be provided where specified in order to retain odours. They shall be purpose designed and manufactured for the particular application from ultraviolet resistant Glass Reinforced Plastic (GRP) or glass-coated steel, and shall be provided with all necessary ribs and stiffeners on the underside to provide a rigid and robust structure;
- They shall rise from the tank walls to the centre of the tank, shall be self-draining and shall not sag or form hollows;

- They shall be suitable for use with sewage sludge and sludge gases, including those dissolved in water;

GRP covers shall comply with the relevant provision of BS 4994 as appropriate. Glass coated steel covers shall comply with the specification requirements for glass coated steel tanks, as appropriate;

Loading shall be in accordance with the provisions of BS 6399 (Roofs with no access) except where permanent access is specifically provided, in which case loadings shall be to BS 6399 (Roofs with access). In the case of GRP roofs, the maximum strain shall be limited to 0.3%. Calculations shall be provided for all roofs and covers;

The corners and edges of cover panel shall be smooth and uniform. All joints (viz. panels to wall, panels to bridge or panel to panel) shall be sealed with a flexible strip and pliant sealant to produce a close seal. The joints around openings, such as hatch covers, shall be sealed with a flexible strip firmly attached to the fixed portion of the covers;

Each cover shall incorporate 2 No. hinged, locking manholes at positions to be agreed, not less than 0.8m square. The lids shall be strengthened to prevent twisting on opening and shall be designed to fold back flat on opening with securely fixed handles;

The manhole and tank covers shall be provided a separate 200mm diameter stiffened opening with a sealing plate for instrumentation use. Where the covers are to be fitted to a tank at a roof height of more than 2m above ground level, suitable safety harness fixing points shall be provided adjacent to each manhole opening;

Each cover shall be provided with 2 No. 500mm square openings, one near the centre, one at the edge, in positions to be agreed, with stiffened edges, for fitting of ventilation equipment, and shall be sealed with removable plates; In case where the covers are to be supplied together with new tanks or new scraper bridges, then they shall be designed in co-operation with the relevant manufacturers to ensure compatibility;

Where specified and where necessary for machinery access, special sealed access openings shall be provided shaped to suit the machinery concerned;

The method of fixing and sealing to the tank walls shall be for the supplier to decide, and shall be stated in the Tender. All supports, fixings etc. shall be manufactured from corrosion resistant material. Galvanized or plated mild steel is not acceptable.

Section 11 Instrumentation and Control

1101 General

Design and Electromagnetic Compatibility

All circuits and equipment shall be designed in accordance with good engineering practices and particular care should be taken to ensure that no component shall exceed its maximum voltage/current/power ratings at any time, including during transient surges.

All instrumentation equipment shall be protected from interference emanating from radio frequency transmissions, either radiated or cable borne, such that it shall not cause malfunction of the system or damage to the components.

All equipment supplied shall not radiate any form of electromagnetic energy in amounts that might interfere with external equipment or instrumentation.

The latest standards on interference shall be followed and the principles of electromagnetic compatibility (EMC) applied to the design and application of the plant.

Interrelation with Other Sections

Requirements given in other sections shall be applicable whether relevant to equipment or materials specified in this Section.

Thus indicator gauges, metres, enclosures, panel construction, finish, components, wiring, terminations, cabling requirements and environmental operating conditions shall be in accordance with the relevant clauses of the Mechanical and Electrical Sections unless specifically amended in this Section.

Interrelation with other Contracts

Where the location, installation or connection of any components of instrumentation are arranged by the Engineer under other contracts, it shall be the responsibility of the Instrumentation Contractor to advise and provide all relevant information on such matters to the Engineer in order that the correct and proper performance of the Contractors instrumentation is not prevented or impaired.

Temperature and Humidity

All supplied equipment shall function without error and shall be constructed of such materials or so treated as to prevent the formation of mould, fungus or any corrosion over the ranges of temperature and relative humidity specified in the specific clauses for this site.

Enclosure Protection

Instrumentation and hardware mounted in the field shall be contained in suitable enclosures to provide ingress protection to BS EN 60529 rating IP54 indoors and IP65 outdoors as a minimum. Sensors installed below water level or liable to submersion shall be rated IP 68. Where items are fitted in a panel or other enclosure, they shall preserve the design IP rating of that enclosure.

Voltage and Frequency Tolerance

Equipment shall be capable of working from a supply whose voltage may vary $\pm 15\%$ and tolerate any transients that could be experienced in such an environment without programme corruption or system failure.

Instruments

Each instrument and sensor shall be selected considering all the relevant performance parameters for the principle of measurement adopted, its intended use and the particular process in question.

All instrument output signals shall be volt-free, clean contacts rated at 220V AC 2A for digital and 4-20mA continuous proportional linear signal for analogue. Pulsed outputs suitable for integration counter drives shall be 24V DC.

Inputs, Outputs and Signal Loops

Opto-isolation shall be provided on all input interfaces to card.

Digital signals shall be 24V DC with the power supply from either the associated power pack or the external instrument. Relays shall be used where more than one instrument including I/O are fed from a single signal.

Analogue signal shall be continuous linear scaled signals with a 4-20 mA operating range. Loops with instruments wired in series (e.g. panel mounted indicator and RTU input) shall have zener fitted across each subsequent instrument leg to ensure loop integrity.

Terminals

Signal terminals shall be the disconnect type. Power supply terminals shall be shrouded and clearly marked with the appropriate warning tags. LED's shall be provided for fault tracing, if not supplied on the I/O cards. LED's in either case must be clearly visible from the front, with only the enclosure door open.

For each incoming screened cable, a separate earth terminal shall be provided for screen termination to earth.

All equipment, isolators, terminals and cables shall be clearly marked. 20% spare terminals shall be provided.

Programming and Monitoring Unit

Hand-held portable devices shall be provided for the system allowing user configurable operation to enable the downloading or uploading of data or software and the local running of diagnostic software. For RTU plc's the device shall be fully compatible with the RTU and shall be supplied with:

- Software to enable the development of programmes and the subsequent downloading to the RTU.
- Software to enable full communications with the RTU and to:
 - upload data or alter data in the RTU;
 - access communications ports and I/O.
 - Full page process mimic display capability.

Discrete Components

All discrete resistors, capacitors, switches, relays, diodes, transistors and other electronic devices shall comply with the BS 9000 series specification for components of assessed quality.

The Engineer's agreement must be sought before using components that are not certified, but it will remain the Contractor's responsibility to ensure that all components are suitable for the application.

Similar types of components shall be of the same manufacture and design wherever possible.

Integrated Circuits

All integrated circuits shall be of a proven design and shall be clearly marked with the original manufacturer's identity and device number.

Sub-Miniature Switches

Where DIL or other sub-miniature switches are used they shall be provided with a cover, or other means of protection, to prevent accidental switching during handling.

Printed Circuit Boards

Printed circuit boards shall be made of glass fibre with copper trackwork, all exposed copper being tinned prior to assembly, and the board and components cleared of flux before a thin layer of clear varnish is applied for environmental protection.

The board and its components shall be identified by references relating to the corresponding circuit diagram which shall be printed on the component side of each board. Where a number of boards are mounted in a rack system, the rack and boards shall be clearly marked to identify each board to its particular position.

Sockets and Connectors

The use of plug-in connectors for electronic equipment shall be kept to a minimum, and all circuit components including integrated circuit chips shall have soldered connections where this is permitted by the chip manufacturer.

Where sockets and connectors are incorporated in the design, they shall have self-cleaning, hard gold alloy plated, wiping action contact faces, and incorporate polarizing keys or similar means to prevent incorrect mating. Insulation displacement type connectors shall not be used.

All light current wiring having a cross-section of 1.0mm² or less shall have tinned copper conductors.

Test Facilities

The electronic equipment is to include built-in test facilities to permit the detection and replacement of faulty modules without the use of oscilloscopes, signal generators, or other sophisticated test equipment.

Surge Protection

All telecommunication lines, data and signal cables and other items of equipment external to the building environment prone to damage resulting from induced surges due to lightning discharges, shall be fitted with lightning surge protection barrier devices at each end of the line to suppress and divert any transients likely to cause damage to the connected equipment.

All surge diverters/lightning arrestors fitted to telecommunication lines shall be of a design approved by the telecommunications authority.

Surge protection units shall be un-fused, solid state devices, designed to limit the transient over-voltages to not more than twice the normal working voltage of the line. They shall have low in-line resistance and automatically return to normal operation after diverting a surge.

The units shall have provision for either DIN rail or individual panel mounting or direct bolted connection to a suitable copper earth bar.

The location of the units shall be arranged such that the earth connection shall be routed clear of the protected signal cables and have short, straight connections without sharp bends to the main earth

points, using copper conductors not less than 16mm² csa and not greater than 5 metres in length to provide a low impedance path.

Surge suppression devices to provide protection from mains switching or other supply network disturbances shall be incorporated or fitted to all sensitive monitoring or control devices. They shall be designed to filter unwanted transients and limit the 'let-through' voltage to less than twice the working mains voltage, between all conductors and each conductor and earth. Protection monitoring status indication shall be fitted

High Pressure protection

It shall be possible to program a "high-pressure" safety cut-out, set 1.5 bar above the duty pressure. The pumps set shall automatically shut down in the event of the above pressure being identified. Following a shut-down the controller shall (a) re-start the pump set automatically once the high condition has disappeared, or (b) will remain shut down until manually re-started by an authorised person. (The preferred option shall be agreed with the end user prior to hand over and the controller programmed accordingly).

Low Pressure/pipe burst protection

It shall be possible to program a "Low-pressure" safety cut-out, set 1 bar below the duty pressure. The pumps set shall automatically shut down in the event of the above pressure being identified. Following a shut-down the controller shall (a) re-start the pump set automatically once the high condition has disappeared, or (b) will remain shut down until manually re-started by an authorised person. (The preferred option shall be agreed with the end user prior to hand over and the controller programmed accordingly).

Soft pressure build-up

The panel shall incorporate a slow-speed/one-pump-only start up, following a power outage or maintenance shutdown to gradually fill up the pipeline and reduce risk of airlocks and water hammer.

Redundant sensor

The controller shall have a feature that gives an alarm if there is incoherency between the two discharge sensor signals.

Testing and Commissioning:

Once installed on site, with all necessary permanent water services, power supplies, control and alarm systems completed and tested. The panel manufacturer shall be invited to site to commission, test and demonstrate the operation of the panel to the full satisfaction of the Engineer and End User.

1102 Instrumentation

General

Indicating instruments shall show the specified measured values in either electro-mechanical or electronic and analogue or digital form, as defined in the Specific Requirements.

Wherever possible, panel mounting indicating instruments shall be of matching size, appearance and orientation and suitably scaled, all in accordance with the general requirements for electrical panels.

Strip Indicators

Strip indicators shall be provided for the specified functions and arranged as shown on the proposed panel layout.

The indicators shall be solid state electronic type employing a column of neon gas plasma bars, illuminated consecutively in proportion to the input signal. The scale length shall be at least 100mm and allow on-line span and zero adjustment.

All indications shall be driven from transducers or inputs giving analogue signals of 4-20 mA.

Indicator/Recorders

Electro-mechanical indicator/recorder shall be a flush, panel, mounting, single/multi pen indicator/recorder, scaled and labeled as specified herein. The initiating signals for each pen and the trace colour(s) together with any event markers and/or alarm settings, shall be as specified.

Continuously running recorders shall run at a speed of 20mm/hour with date and time annotation at 4 hourly intervals. For intermittent running, as in storm pumping applications, the recorder chart speed shall be 60mm/hour and shall only be initiated when the level approaches the first pump start level and be stopped 30 minutes after the final pump cuts out. Starting and stopping times and dates shall be printed on the chart and each pump operation shall be individually annotated by means of a single trace for each pump showing its running time.

To provide minimum time lags between other channels on the recorder, dot print outs may be used where required.

The Z folded chart paper shall be 250/100mm wide, linearly scaled in half hourly divisions and the width shall be calibrated 0-50 divisions linearly or logarithmically scaled as specified to adequately show the normal range of operation and include the maximum possible signal. The chart shall run for a minimum period of 30 days and 24 spare charts shall be provided. Circular charts shall be 105mm wide, 7 day graduated.

Each channel shall provide a continuous ribbon strip visible indication over a calibrated scale (left hand zero) and an individually different coloured trace on the chart by means of either fibre tipped pens fed from disposable ink cartridges or electrical writing or sensitized paper.

Each input shall be separate and isolated from the conditioning amplifiers and all necessary computing modules shall be included in the unit to provide the required indications.

The following features shall be provided for the operator control, accessible from the front without withdrawing the unit during operation:

- Pen renewal (if relevant);
- Power on/off switch;
- Chart drive on/off switch;
- Chart replacement and adjustment.

Adjustable high and low, volt free alarm contacts shall be provided on each channel and incorporated into the control scheme as required to initiate the alarms as specified.

Time Indicator

A mains driven synchronous type clock shall be suitable for front of panel mounting and resetting.

The display shall either be digital or analogue as specified and based on a 24 hour notation. The digital display shall be of white figures (not less than 55mm high), on a black background. The analogue display shall be dual scaled showing 0-12 hour black figures and 13-24 hour red figures on a white faced dial of not less than 220mm diameter.

The mains supply for the clock shall be via a suitable fused clock connector mounted in the panel, connected such that the clock is energized from the live side of the panel isolator.

Capacitive Devices

Level monitoring shall be by means of a capacitance electrode suitable for the medium and environmental conditions specified such that the electrode capacitance varies in proportion to the immersed electrode length and be arranged to provide a 4-20mA output proportional to the specified level range on a scaled indicator giving a continuous read out.

Auxiliary switches shall be provided for high level alarm, low level alarm and control of external equipment. The position of all switches being adjustable over the level range.

Any fault in the electrode connection and in the electronic circuits shall provide an electrically isolated alarm signal for remote monitoring.

The electrode housing shall be a heavy duty pattern to IP 68 suitable for 2" flange mounting and incorporate a 20mm ET cable entry. The head shall be removable for cabling and servicing without disturbing the electrode mounting.

Pressure Transducers

Pressure monitoring shall be by a transducer suitable for the medium and pressure/level range specified herein.

Each transducer shall be ranged to provide adequate sensitivity over the working range and be capable of sustaining a 400% overpressure without damage. They shall be of rugged and waterproof design, employing a pressure sensitive element within a stainless enclosure having an isolation diaphragm, suitable for either free wire suspension in the medium or fitted with a BSP thread for external connection to the relevant pipe tapping.

Suspended sensors shall be mounted in accordance with the manufacturer's instructions within a uPVC 'stilling tube' of sufficient nominal bore to enable easy withdrawal of the sensor.

Sensors shall be enclosed to IP 68, offer a long life and shall be supplied complete with a suitable signal cable to reach the approved point of termination transmitter-converter without intermediate joints.

The position of the equipment shall be such that withdrawal and installation can be achieved easily.

Cable entry shall be integral sealed assembly or by 20mm conduit entry into a sealed watertight terminal enclosure with provision for transducer venting.

A transmitter shall be provided either integral with the transducer or separately mounted as specified, suitable for operation from the mains or battery supply specified (not greater than 24V) and converting the signals received from the transducer to a 4 – 20 mA signal proportional to the ranged specified which shall be used as follows:

To drive an indicator/recorder to give a continuous readout; To
operate separate on/off pre-set adjustable points.
The transmitter shall have provision for range and zero adjustment.

For use in hazardous areas as specified, the units shall be certified intrinsically safe Ex (1).

Ultrasonic Devices

Flow or level monitoring by non-contact ultrasonic measuring devices shall incorporate ambient temperature compensation and adjustable datum setting facilities. Where specified, the output shall be computed to give a flow reading for the given parameters and/or control of pumps.

Transducer

The sensor head shall be protected to IP68, mounted to provide an unhindered beam path, prevent unwanted reflections, within easy reach of maintenance personnel and, where possible, be clear of flood conditions. For sewer or foul pumping sumps, the units shall be certified intrinsically safe Ex (i) for use in hazardous areas.

Signal Converter

The converter shall be suitable for operation from the specified power supply and convert the signals received from the sensor head to a 4-20 mA signal proportional to the range specified, to be used as detailed in the Specific Requirements.

The converter shall comprise a base unit and a programming device, all in a polycarbonate enclosure to IP 65. Communication between the programmer and the signal converter shall be in such a manner that the IP rate is not prejudiced.

A minimum of 3½ digit liquid crystal display shall be used to indicate key programming features, settings and output conditions, including flow calculations to BS 3680 for flumes and weirs.

Accuracy of the signal converter shall be better than $\pm 1\%$ of reading and shall have the following programmable outputs:

- mA proportional to user definable engineering units.
- SPDT relay contact output closing upon failure of the signal converter,
- lost echo or multiple echoes.
- Off SPDT contact outputs with independently set trip points. These
- outputs shall be programmed to energise upon high/low levels, rate of change or to allow a number of pump sequencing operations. Contacts rated at 5A 240V ac, non-inductive.
- Serial ports RS 232 for down-loading data.

Electro-Magnetic Flow Meters

Electromagnetic Flow meters shall be sized and installed in accordance with the manufacturer's recommendations as approved by the Engineer, BS 5792 and BS 6739.

Flow meters shall be supplied with a calibration certificate. Electromagnetic flow meters shall be selected and sized to give a maximum velocity of between 1 and 7m/sec. The minimum velocity achieving the stated accuracy shall be not more than 0.1 m/sec.

The flow meters shall be of electromagnetic inductive type having a DC pulsed field with automatic zero error averaging and low power consumption. They shall have no moving or protruding parts nor cause any restriction in the flow path and be capable of setting adjustments without the need to stop the flow.

Each metering system shall comply with BS 5792 a

and comprise a flow sensor mounted in the pipework line and a signal converter, wither integrally mounted or remotely located preferably within the main control panel.

The system accuracy shall be a maximum at normal operating flow with an error not more than 1% of the reading. When operating in the lower 30% of the meter range, the accuracy shall be within $\pm 3\%$.

Flow sensors - these shall comprise electrodes located in ammeter tube which shall be of watertight construction, suitable for operation without loss of accuracy when totally submerged to a depth of 3 metres.

The meter tubes shall be made from a non-magnetic material lined with an inert material suitable for the medium and fitted with flanges to suit the pipework system, the lining material being applied such that it extends from the bore of the tube to fully cover the raised face of the tube flanges.

The measuring electrodes shall be continuously cleaned by means which do not interrupt the process flow or the measurement. A sensing electrode shall also be provided to detect when the flow meter is not fully charged with liquid.

The flow meter body shall be effectively bonded by non-corrodible, tinned copper braid links at each end, to the adjacent pipework to ensure a good connection between the body and the metered liquid, an earthing flange being inserted where non-conducting pipework is employed.

Signal Converter/Pulse Power Unit

These units shall be suitable for operation from the flow sensor into output signals having the following features: Single flow rate range adjuster suitable for the flow sensor.

Independent output signals shall be provided for each flow direction as follows:

- ☐ +5/0/-5 volts d.c. signal for telemetry purposes with magnitudes directly
 - proportional to flow.
 - 4-20 mA current signal, to be used for indication of flow, quantity, etc.
 - 24V impulse for integration counter drive.
 - Works presettable system response time.
 - Output driven downscale to zero on receipt of a 'flow meter empty' signal from the liquid sensing electrode.

The transmitter shall have the following programmable outputs:

- mA, proportional to use definable engineering units.
- off multifunctional SPDT relays. Individually programmed to allow a number of sequencing operations, rate of change or high/low flow indication. Contacts rated at 5A 240V ac, non-inductive.
- Serial port RS 232 for down-loading data.

Flow Meter Cabling

Where remote mounted converters are specified, cables shall be provided, installed and terminated between the sensor and converter/pulse power unit for the following purposes.:

- flow signal;
- reference signal;
- coil supply;

Such cables and sealing glands shall be suitable for submersible operation of the sensor to the depth specified. The length of each cable shall be as specified.

Spool Piece: A flanged steel spool piece shall be provided of the same diameter and length as the respective flow meter and flanged for insertion in the pipe should it be necessary to remove the flow meter.

Isolating valves shall be provided on either side of the flow meter. Differential

Pressure Flow meters and Differential Pressure Switches

Flow meters of the differential pressure type shall be designed and installed in compliance with ISO 5167- 1 or an Approved Standard. Primary devices shall be insertion probe type or carrier-ring type orifice

assemblies with stainless steel orifice plate, or venturi tubes shall include two sets of gaskets and fixing bolts for each primary device. Gasket materials shall be appropriate to the metered fluid and service conditions. Full details of orifice or venturi tube calculations shall be supplied.

Orifices shall be square-edged and concentric. The upstream edges of orifices shall be sufficiently sharp that the reflection of a beam of light from the edge cannot be seen without magnification. Drain holes shall be provided. The diameter ratio shall be between 0.20 and 0.70. Orifice assemblies shall have identification tags showing the direction of flow, orifice diameter and position of drain hole. The identification tag shall be welded to the plate before the orifice is machined.

Insertion probe type installations shall follow the equipment manufacturer's recommendations. The probe shall be mounted to a standard sized ferrule or flange plate and include appropriate 3-way valve block.

Differential pressure transmitters and switches shall have over-range protection up to 1.5 times the maximum line pressure.

Location of these devices should be such that no turbulence shall interfere with the measurement of pressure either side of the device.

Signal Converter

The sensor shall be of the inductive type giving an output of 4 -20 mA proportional to the flow rate and a totaliser. The sensor shall be protected to IP 66 and having the following characteristics:

- Accuracy: $\pm 0,25\%$ of FSD between 25 and 100% of the flow measured.
- Stability: 6 months period: $\pm 0,25\%$ of FSD
- Voltage supply: 200 Vac
- Sensitivity: 0,005%/V at 50% flow and more

Differential pressure switches shall have contacts with differing "cut-in" and "cut-out" values. The nominal values at which differential pressure switches operate shall be fully adjustable over the whole range of the instrument and the set value shall be clearly indicated by means of a scale and pointer. Contacts of differential pressure switches shall be hermetically sealed.

Mechanical Flow Meters

Mechanical flow meter shall be volumetric, jet or in-line helical vane (Woltman) type to Standards ISO4064/BS 5728 EEC Specification with integral strainer. Meters shall be designed for minimum maintenance and shall incorporate best quality rotor bearings to ensure long working life.

Meter bodies shall be cast in spheroidal graphite iron to BS EN 1563. All internal parts shall be manufactured from non-corrodible materials.

Meters are for the measurement of potable water flow with a normal working temperature up to 30°C and a maximum working pressure of 16 bar.

Meters shall be generally in accordance with the following Table:

Meter Size (mm)	Q _{max} : PEAK Instantaneous Flow (minutes only) (m ³ /h)	Q _n : MAXIMUM Continuous Flow At $\pm 2\%$ measuring Error (m ³ /h)	Q _{min} : MINIMUM Flow at $\pm 5\%$ Measuring error (m ³ /h)
15	3.0	1.5	0.036
20	5.0	2.5	0.050
25	7.0	3.5	0.082
32	10.0	4.5	0.127
40	20.0	6.5	0.182
50	80	40	0.55
80	200	120	0.70
100	250	180	1.20
150	600	400	3.00
200	700	550	5.00
250	1200	750	10.00
300	1500	1000	12.00
400	3000	2000	25.00

Measurement mechanisms shall be removable from the meter body without the necessity to remove the meter from the main. Meters shall be equipped with a register indicating flow in metric units a sweep hand and six figure counter. Dummy cover plates to seal the meter after the mechanism removal shall be provided.

Tapers shall be provided, or non-standard bearings and propellers, if required, to obtain the specified degree of accuracy at the specified flow rates.

The meters shall be suitable for working pressures up to 16 bar unless otherwise stated.

An extension drive and extended head shall be fitted to meters as required. The drive shaft bearings and gears shall be designed for long life under continuous operation, and normal wear shall not significantly affect the accuracy of the meter.

Meters shall have a circular dial and rate of flow indicator registering flow in litres/sec. A flow totaliser having at least six digits shall be incorporated in the head. The totaliser shall have a capacity of at least one years flow at maximum flow rate. A multiplying factor in multiples of 10 may be used in conjunction with the totaliser if required, however, if this is the case, the factor shall be clearly marked alongside the register.

Meters shall be individually flow calibrated at the manufacturer's works and shall be guaranteed to within 2% of true flow within the rated range of the meter. Each meter shall be supplied with a calibration certificate.

The spare parts shall include as a minimum spare gearing and bearings for each size of flow meter used.

1103 Electrical Works

Functional Precepts

Plant Operation

The plant will be unattended and all constituent units shall be arranged to be fully automatic and maintained ready for service at all times.

In order to simplify operation and maintenance, all control schemes shall, as far as possible, follow the same operating pattern, have similar control cubicle layouts, and employ similar items to minimize spares holdings.

Electrical system design shall reflect the hydraulic system design as far as possible and shall be directed to making each major item of plant capable of running substantially independent of others. Where common equipment is employed, then every effort shall be made to ensure that no single fault can affect the entire plant and particular care must be taken to protect the overall integrity of the system.

Provided that the principle of segregation is not infringed, solid state or microprocessor based equipment may be incorporated within the various control panels in lieu of electromagnetic relays, timers, etc., in order to perform the necessary control functions. In this event, full details of the proposal to achieve segregation shall be submitted for approval with the Tender. All costs for programming, setting-up, providing and training of purchasers staff in the operation and maintenance of such equipment shall be separately identified in the Bill of Quantities.

Power Supplies

The Supply Authority will be requested by the Employer to provide a reliable, secure and adequate power supply to each site. This supply may not be made during the period of the Contract and the availability of electrical power supplied cannot be guaranteed. The Contractor shall provide all necessary temporary power supplies, by use of mobile generators or otherwise, for purpose of construction, connection, installation, testing and commissioning of the Works. The Contractor shall be responsible for assessing the requirements, availability and reliability of all power supplies at each site and shall be deemed to have included in his tender for the provision of all necessary temporary electrical power supplies.

The electricity supply is a nominal 415 V, 3 ph, 50 Hz. The voltage may vary $\pm 15\%$ and equipment shall be rated to withstand this variation.

Power will be brought to the site by the client either at 11 kV or 415 V. Where the supply is at 11 kV, a stepdown transformer will be installed by the client. The Contractor shall provide all cabling and wiring from the transformer or from the client cut outs at the metering location. Buried cables within the station compounds shall be in duct.

The Contractor is responsible for ascertaining the exact details of the supply, including the type of earthing, the earth fault loop impedance external to the installation, and the prospective short circuit current.

The Contractor shall provide a certificate of completion from the Government Electrical Inspectorate (GEI) prior to the client installing the meter and cut-outs, and making the final connections.

The Contractor shall size all cables in accordance with the IEE Regulations or NEC. The Contractor shall submit all calculations for comment and approval prior to the installation being carried out. The Contractor shall also provide a single line distribution diagram showing equipment and cable ratings, earth loop and prospective short circuit values.

Pump Units

All pump units shall have means of isolation from their associated pipe work system.

In dry well installations, the suction valve will normally be left open, unless used for isolation when the pump is out of service.

The delivery side of the pump set shall include a non-return device to prevent back circulation when the set is not running. This shall be a fail-safe device such that in the event of pump failure or loss of external services, the device shall independently close. A gate valve will normally also be installed on the pump delivery side, downstream of the non-return device, for pump isolation.

Pump Unit Control

The pump unit control panel shall include all control and indication elements for the pump motor, together with any associated valve actuators, lubricating systems and valves, cooling fans, flushing pumps and other ancillary control equipment required by a pump drive, all arranged to operate in a safe and proper sequence.

Where external services are fitted to open the delivery valve, the control system shall initiate the valve opening procedure as soon as the pump is up to a speed sufficient to overcome any existing delivery pressure.

Failure of the valve to open within the time allowed or closure occurring whilst running, shall initiate an alarm and shut down the pump set.

Pump Duty Control (4 or more Pumps)

Each of the pump units shall be capable of operating in any combination of duty sequence. The Contractor should apply a clear and reliable method of pump duty allocation and duty rotation, to evenly distribute running times for each pump unit.

Any starting sequence, including those following restoration after a supply failure shall be time sequenced to prevent excessive load on the supply system. Each duty circuit shall include its own timer, arranged to be initiated in the selected duty sequence by the preceding duty, the delay periods between each restart being adjustable up to 20 seconds.

Where a microprocessor based pump control system is employed using common modules, two modules shall be provided, each capable of controlling at least 50% of the pumps available, the duty set points being interleaved between each module to limit the effect of failure of one module.

Level Control

The water level shall be monitored by a system providing the necessary duty set points, each being adjustable over the full range of control specified.

To achieve performance stability under all environmental conditions and variations, all necessary signal compensation devices shall be included.

The monitoring system shall be damped to prevent spurious switching due to transient wave motion but shall respond sufficiently to allow adequate time for plant reaction to stabilize in order to prevent hunting.

The system shall include a duplicate back-up monitoring device or have a built-in self-monitoring circuitry with alarm facilities.

Any high settings which may be provided as part of a level control system may be linked with the independent high level alarm sensors specified.

Alarms and Indicators

Separate indication of the following conditions shall be provided by means of annunciators grouped as indicated on the front of the panel. All indications shall have a lamp test facility.

Alarm annunciators shall be provided with accept and reset facilities together with an audible alarm and an audible/mute selector switch.

Each of the alarm conditions specified shall initiate its individual annunciator with a flashing indication which shall become steady when "Accept" button is pressed and be extinguished by the "Reset" button once the alarm condition is removed.

In specified unattended locations, self-reset facilities shall be provided to enable the system to restore itself to normal operation after the fault has passed.

With audible/mute switch set to "Audible", the audible alarm shall sound when the indication is flashing and be silenced when "Accept" button is pressed. In the "Mute" position the audible alarm shall be muted and any alarm initiation shall give a steady lamp indication only.

To prevent false alarms occurring during mains failures or on restoration of mains supply, the common alarms specified shall be supported by a battery backed supply, either directly or via an inverter.

Control Selector

A three position Hand/Off/Auto selector switch shall be mounted on the front of the panel to give the following control facilities; the switch shall be lockable in each position by means of a barrel locking device incorporated in the handle and the switch handle shall clearly indicate the switch setting.

In the "Hand" position operation shall be by means of the "Start" and "Stop" push buttons mounted on the front to the panel with all plant protective devices retained in circuit.

In the "Auto" position the plant shall be operated automatically under the control system specified together with the plant protective devices.

Emergency Stops

Where means of stopping are required adjacent to a motor of the driven plant to prevent danger, emergency stop push buttons, trip switched, or interlocks shall be provided, arranged to immediately isolate the supply, as long as a greater risk is not thereby introduced.

Emergency stop buttons shall have a stay-put lock off feature, with "twist to release" manually operated reset facility. Such a button shall be located on the motor starter panel. A key operated reset facility shall be provided where specified.

Where plant is normally enclosed or has fixed guards to prevent accidental contact from moving parts, stop buttons are not normally required adjacent to such parts.

Stop buttons shall be hard wired direct to all motor control circuits and not by way of any semi-conductor logic control circuitry.

Means of equipment isolation for maintenance purposes shall be provided. This may either be by use of key operated emergency stop buttons or lockable isolators, which may be at the control panel or local to the plant.

Mains/Standby Supply Changeover

If the site is supplied from two alternative mains supplies, the changeover section shall monitor the three phase voltages of each of the two incoming supplies and automatically close the contactor to the healthy supply. The two incoming supply contactors shall be mechanically and electrically interlocked to prevent paralleling two healthy supplies.

Where a bus section switch is provided for manual switching arrangements to allow both supplies to be utilized without paralleling, the contactors must be electrically interlocked between each other and the bus-section switch. Voltage monitoring settings shall be adjustable and nominally set to operate on a rising voltage of 90% nominal, with low/high voltage settings at $\pm 15\%$ nominal on each of the three phases.

Automatic Operation

Mains/Supply – Closing the incoming isolator or restoring a healthy supply will initiate the closing of the Mains contactor via the monitoring relays, subject to the generator operating condition.

Momentary supply drop-outs up to 5 secs. shall allow the plant to resume without further action. Breaks of supply greater than 5 seconds shall initiate the generator supply. Delayed start timer setting to be adjustable 0-3 min.

After any changeover of supplies, automatic or manual, the pump motor loads may be restored automatically or manually (remotely or locally) as specified but with sequential 20 seconds re-start delay timers incorporated in each pump starter circuit to prevent co-incidental starting surges.

Voltage Drop

The volt drop within the installation shall not exceed a value suitable for the safe functioning of any fixed current-using equipment.

Equipment and Cable Ratings

All busbars, cable, switchgear, fuses, motor starter, relay, instruments, panel wiring, etc. shall be sized and rated in accordance with normal operational requirements of the associated plant and equipment, taking into account maximum load currents, volt drop, frequency or motor starting, maximum ambient temperature etc.

Where specific voltage or current ratings have been included on the drawings and in the description of individual items of equipment in the Specification and/or Bill of Quantities the values stated shall be deemed to be minimum values. It shall however be the responsibility of the Contractor to ensure that all equipment supplied is properly insulated and adequately rated to handle operational loads and, in the case of fuse gear and circuit breakers, to deal with prospective fault currents.

m) Switchboard Components

Panel Construction

Panels shall be constructed of sheet steel having a minimum thickness of 2.0mm (14 SWG) or other approved material, and similar equipment shall be of the same manufacture and units of the same type and rating are to be interchangeable. The use of toxic, hygroscopic or flammable materials shall be avoided.

LV Panels shall be damp and dust protected (IP52) for indoor situations and hoseproof (IP65) for outdoor or wet situations, or as otherwise specified under the specific requirements.

HV Panels shall have covers and partitions affording a degree of protection IP53 to BS 5447 or equivalent for drawout sections. Internal partitioning, instrument and control sections etc. shall be to IP52.

Switchboards shall incorporate a rigid steel frame and be suitable for ready extension at each end without further cutting or drilling. Composite switchboards shall be assembled by the principal electrical manufacturer and shall be sectionalized as necessary to facilitate handling.

Switchboards shall include barriers between each of their units to ensure safe maintenance on any circuit during normal operation with the remainder of the board live. When a functional unit is isolated and open, the degree of protection to any remaining live part shall be at least IP20. Barriers or covers to live components shall have warning labels attached.

If any compartments are provided within a section of outgoing units which are not fully equipped, they shall be arranged so that they can be fully equipped without de-energizing that section of the switchboard.

Cubicle type switchboards shall be totally enclosed, flush front and rear patten, arranged in a multi-tiered formation if practicable, with at least 300mm clearance between floor level and any operational item of fuse gear or control gear. Kicking strip protection shall be provided by a 100mm high plinth forming the base of the switchboard.

The overall height of control panels, including plinths, shall not exceed 2300mm. Isolator handles, control switches, push buttons indicator lamps and instruments shall be centred not more than 1900mm above finished floor level.

All components mounted on the front of the panel shall be of matching uniform appearance, orientation and colour, with all bezels and escutcheons finished black. The layout and grouping of components shall be as approved or specified.

Within each control cubicle a reduced size schematic diagram of the control circuit, printed on durable material, shall be permanently fixed.

Doors and Covers

Each section or compartment shall be provided with full width access doors or covers, with individual doors or covers not exceeding 750mm width.

All doors and covers shall have returned edges for rigidity and incorporate dust seals of flexible material secured in channel rebates. Covers exceeding 0.5m² in area shall be provided with a supporting lip within the lower edge or have lift-off hinges. All doors shall be supported on strong hinges of non-corrodible material and shall be secured by adjustable quarter turn cams, operated by small TEE handles incorporating key operated barrel locking facilities or flush locks with drive key inserts. Covers shall be secured by similar fastenings or captive bolts.

All additional fittings such as handles, hinge brackets and locks shall be a black finish, polyamide moulding or epoxy coated metal.

Doors shall open at least 90° with the opening positively limited such that doors and their appurtenances are prevented from fouling adjacent panels when opened.

Switchboard Rating and Busbars

Switchboard busbars, droppers, switchgear and its associated cable boxes shall be mechanically and electrically designed to withstand the fault level and duration specified herein and (except for LV switchboards rated less than 900A) shall be an ASTA certificated design rated at not less than 80kA RMS for 1 sec. or 50 kA for 3 sec. LV switchgear and motor control gear shall comply with BS 5486 Form 4 segregation of busbars, functional units and terminal chambers, unless otherwise specified.

Busbars and droppers shall each be air insulated and formed from solid drawn high conductivity copper bars, having a constant current rating with a uniform cross sectional area throughout their length. Each shall be clearly marked with the appropriate colours to indicate each phase, neutral and earth. Droppers shall be as short and as straight as possible. Busbar compartments shall be fully segregated and shrouded from all other sections of the switchboard.

All busbar connections shall have at least two bolt fixings, and due considerations shall be given to high stresses at bolted connections on high voltage equipment. Where flexible busbar connections are used these shall be secured by high tensile steel and nuts with anti-vibration locking devices.

Earthing

All metal cases of meters, relays, instruments, starters, and control switches shall be connected to the switchgear frame earth terminal by means of green and yellow PVC insulated cable, not less than 2.5mm² cross section.

An earthing terminal or group of terminals shall be provided in the panel for termination of panel earthing connections and incoming cable earth or connection to a main earth bar.

A main earth bar of copper shall be provided to run the length of each board so that all cable sheaths and armouring may be bonded to it. Where the fault level at the switchgear is 33kA or less the minimum size shall be 31.5mm x 6.3mm x 6.3mm.

Panel Preparation and Finishing

The whole preparation and paint system shall be suitable for the operating environment specified and a painting schedule giving details of preparatory treatments, types of paint, number of coats and method of application shall be submitted with the Tender. Proprietary items may be used in their standard finish subject to the approval of the Engineer.

The system proposed shall conform to the following minimum requirements.

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- After all machining and forming has been completed all steelwork surfaces shall be thoroughly cleaned of rust, welding slag or spatter and other contaminations prior to any painting.
 - Panels for indoor location shall, immediately after cleaning, have all surfaces protected by an approved zinc-based corrosion resistant primer, followed immediately by one intermediate and two finishing coats of paint to give a minimum total dry film thickness of 560 microns (0.002").
 - Panels for damp situations or outdoors shall have the surfaces grit blasted and zinc sprayed within 4 hours to BS 2569 Part 1 to a thickness of 125 microns (0.005") at the works. The final paint finish shall be one of two pack epoxy primer and two coats of epoxy paint to give a minimum total dry film thickness of 75 microns (0.003").
 - Steel fixings and fastenings shall be treated to prevent corrosion by hot dip galvanizing to BS 729 or sheradized to BS 4921 Class 1 before painting. Chromed fittings shall not be used.
 - Any damage occurring to any part of a painting scheme shall be made good to the same standard of corrosion protection and appearance as originally employed. Any finish coat applied on site shall be considered for decorative purposes only.

Paint Colours

The colours of the primer, intermediate and finishing coats of a paint system shall be easily distinguishable from each other and the materials used shall be suitable for the application employed and preferably be supplied by one manufacturer who shall ensure that all coatings are compatible.

Electrical control panels shall be gloss finished in the following final colours:

DETAILS	COLOUR	BS 4800 Ref:	BS 381C Ref:
Panel Exterior	as advised by the Engineer		
Interior Equipment	White	10 B 15	-
Trays	White	10 B 15	-
Bushbar Shutters	Signal Red	04 E 53	537
Circuit Shutters	Lemon Yellow	10 E 53	309

Labels

Each switchboard shall be provided with a title label and have circuit designation labels fixed to the front and rear cover of each circuit compartment. Rear covers for more than one sub-section shall have labels for each sub-section. In all cases, the label shall be positioned so as to leave no doubt as to which item it refers.

All indicators, instruments, relays, control switches, push-buttons, fuses and other ancillary apparatus shall be provided with labels clearly stating their function.

Character sizes for mains title and circuit designation labels shall be at least twice those for ancillary items.

All label inscriptions shall be to the front of the switchboards/control panels/starters shall be of transparent Perspex with radiussed or chamfered front edges, reverse engraved with white infill then sprayed on the rear to match the colour of the board. Other labels shall be sandwich type white/black/white, or yellow/black/yellow for Danger labels, or as approved by the Engineer.

All labels shall be fixed square to the equipment by means of screws or rivets of nylon or non-corrodible material. Labels affixed with adhesive will not be accepted.

Cabling Facilities

Cable boxes and glands shall be accommodated within cubicles except where otherwise approved and all removable access, sealing and gland plates are to be provided with gaskets to form an adequate seal against the external atmosphere.

Adequate space within each compartment shall be allowed for external cable tails to be connected without stress on the terminations, bearing in mind the type and size of such conductors. Where multi-cores in excess of 95mm² or any single core cables are to be terminated, a minimum distance of 450 mm free space shall be allowed between the gland plate and the terminal connection point.

In multi-tier compartments, individual terminal covers and gland plates shall be provided for each circuit such that additional circuits may be terminated safely whilst the switchboard is energized.

For paper insulated cables, a suitable cable end sealing box shall be provided for each circuit as specified. Where the cable enters from beneath the panel, the bottom of the wiping gland shall be at least 150 mm above the panel floor level. Removable split ends sealing plates are to be provided for subsequent fitting around such cables.

Undrilled removable gland plates shall be provided for cables requiring compression glands entering from beneath the panel. The plate shall be located at least 300 mm above the panel floor level and shall form part of a compartment constructed within the panel to seal the interior of the panel. Access for glanding-off shall be provided by removable covers fitted to the available vertical sides which may extend the full width of the panel as necessary.

Where single core cables are to be accommodated, a non-magnetic or slotted gland plate shall be provided.

Terminals, studs or drilled holes shall be provided to accommodate all necessary cable terminal lugs and, prior to manufacture, The Contractor shall confirm cabling termination requirements with the Engineer.

Panel Wiring

Panel wiring should be run neatly within the cubicle in suitable cable looms or panel trunking, and in the case of instrument, intrinsically safe or safety extra-low voltage circuits, run in separate groups accommodated within the cubicles. The looms or trunking shall be adequately secured without the use of adhesive material. Wiring carried across door hinges shall be neatly loomed and rolled in torsion in the plane of the hinges to minimize flexing of the wiring, thus wiring shall enter and leave at different levels as widely spaced as practicable. Bushings or grommets shall be used where wiring passes through sheet metal or plastic.

All components and auxiliaries in repetitive units shall be wired in an identical pattern to match the arrangement of each component.

Wiring cables shall be adequately rated, tinned copper stranded conductors or not less than 1.0mm² (32/0.2) PVC insulated 600V grade, except wiring to PLC or other light current equipment which shall be not less than 0.5mm² (16/0.20).

Wiring insulation shall be coloured as follows:

AC Circuits

Mains supply (LV)	- Black
Uninterruptible power supply (LV)	- White
ELV supplies (up to 50V AC)	- Yellow
Intrinsically safe circuits	- Blue

DC Circuits

Battery supply (ELV, not exceeding 120V DC) - Grey

Where various voltages exist within the above definitions, the colour coding shall be subject to agreement with the Engineer.

Each wire shall be terminated with suitable ring or spade crimps or bootlace ferrules and identified at both ends by means of white or resistor colour-coded ferrules imprinted to correspond with the diagram connections.

Wires linking common points in the circuit shall bear the same reference at each termination. Alternative identification methods require prior approval of the Engineer.

Terminals

All terminal blocks for the connection of small wiring shall comprise shrouded anti-tracking mouldings or melamine phenolic or comparable material with provision for securing conductors either by high tensile screws and clamps or be solder tag connection.

Terminal blocks shall be arranged so that both terminals and wiring ends are readily accessible and have separate terminals provided for incoming and outgoing wire, together with insulated barriers between adjacent connections and transparent insulated covers. Blocks accommodated on common mounting rails shall have a foot designed to ensure a secure fit to the rail. Foot springs shall be of stainless steel and have a locking device fitted to prevent accidental release of the block.

Each terminal shall be labeled to correspond with the diagram of connections and terminal identification labels shall be attached to the fixed portion of the terminal blocks only. Terminals for intrinsically safe circuits shall be clearly segregated and coloured blue.

Terminal which may be 'live' when the equipment is isolated from the main supply shall be adequately shielded from accidental contact and be clearly identified and inscribed accordingly.

Current Transformers

Each current transformer shall bear a label showing the ratio, class, short time factor and accuracy limit factor. The inscription must be reasonable when the transformers are installed within the gear without the necessity of dismantling any equipment other than removing cover panels.

Bar type current transformers shall be supplied in preference to those with wound primaries. Short time current factors shall relate to the full fault level specified. For over-current protection, the product of VA rated burden and rated accuracy limit factor shall be 150 unless otherwise agreed with the Engineer.

One secondary terminal of each current transformer shall be earthed at the switchgear.

Voltage Transformers

Voltage transformers shall be vacuum impregnated or encapsulated resin insulated type. Each transformer being fully isolatable and accessible for maintenance purposes and fitted with primary and secondary fuses.

Indicating Instruments

All indicating instruments shall be of a similar flush vertical mounting, rectangular pattern, enclosed in black coloured, dust and damp-proof cases, one side being not less than 90mm (3.5") long or as specified. Scaling shall be in approved metric units normally ranged from zero to 20% - 40% above the system designed operating value,

except where finite limits exist (e.g. p.f. indicators, synchroscopes) or where restricted ranges are specified. Instruments having a mechanical movement shall provide at least 90° scaled arc. 240° arc scales shall be employed on principal specified indicators.

Ammeters for motor circuits shall have an extended scale to cater for the starting current. These shall be adjustable red pointers or red markings on the scale to indicate the normal circuit current for the associated plant and shall be connected to each of the three phases of a three phase motor circuit.

Indication Lights

Indication lights shall be flush panel-mounted types with bodies fastened and keyed to that the lamps shall be capable of replacement from the front of the apparatus without disturbance to the lamp-holder or panel wiring. Lens colours shall be specified in the Specific Requirements. Bezels shall be coloured black.

All light sources shall be operated at Extra Low Voltage. Single units shall be dotted with MES caps and be illuminated by LED clusters where colours permit otherwise filament lamps shall be used.

To extend lamp life, filament lamps shall be arranged to operate approximately 20% below their rated voltage and details of voltage and type of indication lamp shall be submitted for the Engineer's approval. Particular consideration shall be given to circuits operated from a battery supply permanently floating across a charging circuit, where terminal voltage may be higher than the nominal voltage.

When annunciator style indicators are used they shall incorporate two lamps wired in parallel for each fascia which shall have a window area of not less than 48mm x 24mm. the engraved characters shall be not less than 3mm in height and shall be filled black on a translucent background coloured as specified.

Alternatively where specified (particular for unattended situations) self-contained LED annunciator display modules shall be used and configured for panel mounting. Legend plates shall be provided adjacent to each indicator. Where message display indicators are used, they shall have programmable legends and adjustable pulse rates.

Push Buttons

Push buttons shall be heavy duty, double break pattern with fully shrouded moulded buttons having a spring return action through a flexible oil-tight seal. Each button shall be coloured in relation to its function accordance with Appendix 2 or as otherwise specified herein and bezels shall be coloured black.

Emergency stop buttons shall be arranged to de-energise without delay the drive motors for the whole of the associated plant whatever control mode of operation may be selected. They shall be of the 'stay put' type having a large red mushroom head with twist-to-release manual reset, suitably labeled and have at least two poles, 1 N/O and 1 N/C with contacts suitable for the circuit operation.

Where key reset heads are required, the key shall be common for all buttons.

Control Relays

Control circuit relays for switching 5A/250V or less shall be of the multi-pin plug-in type having the following features:

- Neon or LED indication of relay energisation;
- mechanical ON/OFF indication;
- manual test button with provision for retention of the button in the operated condition for test purposes;
- legend plates on relays and base;
- relay retaining clip;
- be mounted on moulded bases having recessed screw terminals.

If sufficient contacts are not available in one relay, not more than two relays may be connected in parallel.

Any relay used to switch an external alarm circuit shall have a volt-free contact for the purpose.

Protection Relays

Electro-mechanical protection relays and associated devices shall be provided as specified, suitable flush mounting in dust proof cases; withdrawable types being provided where they are fitted in fixed panels.

Where not mounted on a battery sourced alarm monitoring display, the relays shall have hand-reset flag indicators unless a self reset or electrically-reset facility is specifically called for. Hand-set indicators shall be capable of being reset without opening the relay case. Flag indicator relays shall be de-energised once the flag has fallen.

Where two or more elements are included in each case, separate indicators shall be provided for each element.

Fuse Links and Holders

Suitable rated fuses shall be provided at all points necessary for circuit protection and isolation, separate fuses being provided for instruments, indication, alarm, heater and coil circuits. Fuse ratings shall be rationalized as far as possible to limit spares.

LV Fuses in circuits exceeding 50V shall, where practicable, be housed in all insulated carriers with fully shrouded bases of matching colour, which shall not be interchangeable with carrier and bases provided for removable solid links which shall be coloured white.

LV fuse links shall be HRC cartridge type to BS 88, Class Q1, having provision for screw fixings for attachment to the carrier.

Control and Instrument Fuses may be accommodated in moulded terminal blocks suitable for DIN rail mounting. Fuses rated up to 6.3A 250V shall be 20 x 5 mm (G type DIN 41660) having a hinged fuse carrier housing.

Fuses rated up to 13A 250V shall be 25 x 6.3 mm cartridge type to BS 1362, secured by a screw cap. The live connection being made to the lower terminal.

Locks and Keys

Lockable selector switches or panel doors in a multi-unit installation shall employ a common interchangeable operating key but keys for each function may be non-interchangeable, subject to the approval of the Engineer.

For each key pattern employed, three keys shall be provided; each having a permanently attached brass identification label, embossed with the following:

- key number
- location of lock/item of equipment reference.

Lose padlocks and keys for security locking switchgear, isolators, shutters etc. shall not be included but will be provided by the Client to suit their master key suite to permit locking. Hasps shall not have less than 9mm diameter holes suitable for 6mm diameter shackles.

Key Cabinets

Key cabinets shall be provided to accommodate, on suitably numbered/coloured, adjustable hook bars, one set of all the above keys and padlocks. The keys shall be fitted with corresponding number/colour coded tabs.

The cabinets shall be of stove enameled sheet material, suitable for surface wall mounting and be fitted with lockable hinged cover doors.

Insulating Mats

Black rubber matting shall be supplied complying with BS 921 and shall be supplied for all indoor control or switch gear panel. It shall extend the complete length of the control panel and the minimum width shall be one metre.

n) HV Breakers and Disconnectors

Circuit Breakers

For AC circuits, circuit breakers shall be triple pole of the vacuum interrupter, SF6 or air break type as specified, suitable for short circuit fault duty specified herein. Low voltage breakers shall incorporate a neutral link, unless in special cases a neutral pole is called for on the breaker under the specified requirements. Air or oil break circuit breakers shall be 'trip free' and the whole of the operating mechanism shall be suitable for such conditions of operation.

The whole equipment shall be robust and capable of withstanding repeated closing and opening impacts satisfactorily.

Each breaker shall be provided with the following:

- Mechanical 'Flag' indicator giving reliable indication that it is either "Off" (open) or "On" (closed);
- Means of isolation so that the breaker may be maintained with busbars alive;
- An operating handle that can be concealed when not required, ensuring a flush fronted appearance;
- An adequate number of auxiliary switches with the addition of one normally open and one normally closed spare switches, all to be wired to a terminal board of approved design in the fixed portion of the switchgear and arranged in the same sequence on all equipment;
- Protection relays and tripping devices as specified;
- Facilities for connection of appropriate auxiliary circuits when the circuit breaker is in the isolated position to permit operation of the breaker for test and indication purposes;
- Key operated interlocks between breakers as specified.

H V Disconnectors

HV disconnectors shall be triple pole, oil free switch-disconnectors rated for fault making/load breaking duty to IC 265, mounted on a non withdrawable chassis and enclosed in a metal clad enclosure in accordance with BS 5527 or equivalent.

The contact breaking mechanism shall incorporate expulsion quenching techniques to ensure positive arc extinction and high closing speeds to enable the switches to close onto existing short circuits without harming the equipment or the operator.

The switches shall be either manually or electrically closed and manually or electrically tripped as detailed in the Specification Requirements. All operations shall be effected with the panel door closed and include an ON/OFF indicator. Contact separation shall be clearly visible through a viewing window on the cover.

Safety Shutters

Where withdrawable circuit breaker units are used, the housing shall be arranged to accurately locate the movable portion prior to engagement and accommodate automatic safety shutters.

Each group of busbar and circuit spout orifices shall be fitted with an individual automatically operated safety shutter, the appropriate shutters being positively opened or closed when the circuit breaker is racked in or out.

When closed, the shutters shall effectively prevent any contact with either the busbar or circuit connections and seal the spouts against the ingress of dust. The shutters shall be painted in bold characters 'CIRCUITS' as appropriate, the busbar shutter being coloured red and the circuit shutter being coloured yellow (see Appendix 8).

For testing and inspection, each shutter shall be separately hand operated from the front of the unit and latched in the open position. Any movement of the circuit breakers either in or out of the housing shall automatically restore the automatic feature.

Provision shall be made for each shutter to be locked only in the closed position.

Non-withdrawable HV switchgear shall have a three phase test access point incorporated in the design such that cable tests may be carried out on each circuit. The test access point shall be fitted with a lockable cover and interlocked to prevent access to live circuits.

Provisions for Earthing

Provision shall be made for earthing the busbars and each circuit outlet through the circuit breaker, either integrally or by means of a portable device as specified; such an arrangement being suitable to withstand the full short circuit rating of the switchgear.

Where integral earthing facilities are included, selection of the locating mechanism shall prevent the breaker being engaged into any position other than that selected. Visual indication of such circuit breaker locations shall be clearly marked, e.g. "CIRCUIT EARTH", "BUSBAR EARTH", "SERVICE/ON" and "ISOLATED/OFF".

Facilities shall be provided so that padlocks can be fitted to prevent the selection of either "EARTH" positions.

Facilities shall be provided for padlocking the circuit breaker while it is closed on to an earth circuit to prevent unauthorized tripping electrically or mechanically.

The circuit breaker truck (or carriage) and oil tank if applicable, shall be effectively earthed when in the "SERVICE/ON" position.

HV switched shall have facilities for earthing the circuit by means of a selector at the ON, OFF and EARTH positions shall be visibly indicated, appropriately labeled and provided with locking facilities in each position. Inspection windows shall be provided so that the position and condition of the selector contacts and insulators can be observed.

Interlocks

Each circuit breaker unit shall be provided with mechanical interlocks to prevent incorrect operation or accidental contact with live metal, and to protect the equipment and operator from the dangers of mal- operation and designed to prevent the following where relevant:

The circuit breaker being closed unless it is in the fully-engaged or fully-withdrawn position.

The circuit breaker being engaged and plugged into the busbar and circuit spouts unless the tank is bolted to the top-plate.

The circuit breaker being engaged or withdrawn unless the main contacts are open.

The circuit breaker unit being withdrawn from or pushed into the unit housing unless the breaker is in fully-withdrawn position.

The circuit breaker being positioned in the unit in any position other than that indicated on the locator. Access to voltage transformers unless they are in the isolated position.

Handling Track

For each switch board and different type of breaker supplied, on purpose designed, manually operated lifting and handling track shall be provided to enable safe removal of a circuit breaker from its compartment.

Switch Oil

The first change of switch oil shall be provided for each oil circuit breaker or switch. An oil level indicator shall be provided on each tank with maximum and minimum limits marked.

o) LV Distribution Switchgear

Switches

Switches shall be of the air break pattern, enclosed zinc sprayed heavy duty, cast metal or sheet steel cases providing enclosure protection to at least IP55 unless otherwise specified, suitable for industrial surface mounting or flush cubicle mounting as specified.

They shall be rated in accordance with BS 5419 or equivalent and be fitted with solid or HRC fuse links as appropriate in each phase and a neutral link, all contained within the switch case, with the terminals accessible from the front of the switch. Phase barriers and contact shrouds shall be provided with an interlock to prevent withdrawal or access when the fuse switch is in the 'ON' position.

Each switch shall have a free handle control mechanism to prevent inching and damage to contacts, be fitted with 'ON' and 'OFF' position indicators and have provision for locking in the 'OFF' position. When padlocked in the 'OFF' position, interlocks shall prevent the unit door being opened.

The moving contacts of fuse switches shall be readily withdrawable as a complete unit for maintenance when the remainder of the board is live.

Distribution Fuseboards

Fuseboards shall be of the rust proofed, zinc sprayed, heavy gauge sheet steel, having a flush fronted door with concealed hinges and a resilient gasket, providing enclosure protection to at least IP 55 unless otherwise specified.

The interior shall be assembled from all-insulated shrouded fuse carriers and bases of the 380V pattern, fitted with phase dividing barriers and all live parts being fully shrouded, all in accordance with BS 5486 or equivalent.

Circuit identification charts shall be fitted to the inside of all fuseboard doors.

All fuse carriers shall be fitted with fuse-links rated to suit the circuit duty. Spare ways shall have fuse links of the same current rating as the carrier, unless different current ratings are called for under the specific requirements. The Contractor shall however confirm fuse ratings with the Engineer before fitting fuses to the carriers. Fuse-links shall be of the HRC cartridge type to BS 88, Class Q1, having screw fittings to the carriers.

Molded Case Circuit Breakers

Molded case circuit breakers shall be of the quick make, quick break, and trip-free type complying with BS 4752 and shall be complete with thermal/magnetic releases, except for those units serving as isolators only. Multiple breakers shall have a common trip bar and trip elements on each pole to ensure that any abnormal condition on any one pole will cause all poles to open simultaneously.

Visual indication of open, close trip conditions shall be provided. Facilities for padlocking in the 'OFF' position shall also be provided.

Miniature Circuit Breakers

Miniature circuit breakers shall be of the quick make, quick break, trip-free type complying with BS 3781 Part 1. Circuit breakers shall be complete with thermal/magnetic or magnetic/hydraulic releases.

Multiple breakers shall have a

common trip bar and trip elements for each pole to ensure that any abnormal condition on any one pole will cause all poles to open simultaneously.

Visual indication of open, close trip conditions shall be provided. Facilities for padlocking in the 'OFF' position shall also be provided.

MCB Distribution Boards

Miniature circuit breaker distribution boards shall be totally enclosed, metal clad, flush fronted units, with a hinged front door, all in accordance with BS 5486 Pt 12. The interior shall be assembled from all- insulated miniature circuit breakers with bolted connections and with switch dollies arranged for vertical operation. Phase dividing barriers shall be provided and all live parts shall be screened from the front. Circuit identification charts shall be fitted to the inside of all distribution boards.

Terminals

All terminal boards and terminal blocks shall provided a positive mechanical clamp type connection. Pinch screw type terminals shall not be used. Terminals for the connection of all external cabling shall be situated at least 100mm from their respective gland plate or further if the cable size requires a greater distance for dressing.

All main phase terminals shall be suitably marked to ensure correct phase identification.

Labels and Circuit Lists

All electrical equipment enclosures shall be clearly labeled to indicate the plant designation.

Individual items not subject to switchboard requirements shall have labels of non-corrodible, Traffolyte sandwich type white/black/white, or yellow/black/yellow for danger labels or as approved by the Engineer. They shall be fixed square to the equipment by means of screws or rivets of nylon or non- corrodible material. Labels affixed with adhesive will not be accepted.

Inscriptions on labels and circuit lists shall be in English and Arabic and be submitted for the approval of The Engineer. Abbreviation 'No.' shall not be used.

A list of circuits in approval form shall be supplied and fixed behind a "Perspex" sheet on the inside of the all distribution boards which are provided or rewired under this Contract.

Residual Current Circuit Breakers

The circuit breaker shall be arranged to isolate each live conductor simultaneously within 30ms if the residual leakage current through the device exceeds 30mA.

It shall be housed separately or incorporated into other composite enclosures, include provision for testing the tripping operation under earth leakage conditions by means of a built-in resistor and push button, and require manual resetting.

p) Motor Starters

General

Each starter shall contain all the necessary equipments to control the circuit load and isolate it from the supply in the event of a fault and shall be equipped to comply with the following general requirements unless otherwise specified under the relevant starter duties.

For starting LV Motors direct on line, the starter shall be rated for intermittent duty class 0.3 (up to 30 operating cycles/hour) and utilization category AC-3 in accordance with BS EN 60947, or as otherwise specified.

Unless otherwise specified for particular cases, pump starting shall be by autotransformer. Small motors may be direct-on-line or star-delta started as applicable.

The ratio of the starting intensity and the nominal intensity shall be inversely proportional to the power of the motor; the following values shall be used for determination of starting requirements:

For plant which is not supplied by a standby generator set:

$$\frac{I_s}{I_N} = 6 \quad \text{when the nominal current of the motor is between 15 and 40 A;} \\ \text{and if the starting current lasts less than 1 second;}$$

$I_s = 3$ when nominal current if the motor is between 40 and I_N 125 A;

$I_s = 2.5$ when the nominal current of the motor exceed 125 A. I_N

Where plant is supplied by a generating set, the above mentioned values are respectively the following: 4-2.5-2.

Unless stated otherwise, power factor correction shall be provided at all sites to give a power factor of not less than 0.9 lagging at duty point load. Except for smaller installations where the capacitors may be located within the starter sections(s), power factor correction capacitors shall be generally housed in their own separate section, complete with a switch fuse isolator. Panel sections that are fitted with capacitors shall have a prominent warning label in English and Arabic stating that the capacitors may remain charged.

Power factor correction circuitry shall be arranged such that the capacitors are not in circuit whenever the panel is being supplied from a standby generator.

Isolation

Each unit shall be housed in a separate compartment or enclosure and be completely isolated by means of an isolating switch interlocked with the door or cover to allow access only when the switch is open. The isolating switch shall be operated by means of an external handle and shall have provision for padlocking in the "OFF" position.

When in the "ON" position, interlocks shall prevent the unit door being opened. Any components still live after this switch has been opened shall be adequately shrouded and have warning labels attached thereto.

The switch shall be rated for making and breaking stalled motor current duty as specified in BS 5419. Off-load isolators shall be suitably interlocked to ensure that they do not make or break load currents and be provided with locking facilities in the "OFF" position.

Additional physical isolation by means of withdrawable units for ease of maintenance may be offered but is not a specific requirement. For such an arrangement the live poles shall be automatically shuttered when the unit is withdrawn and the shutters have provision for padlocking in the closed position.

Contactors

All contactors shall be of the air-break electromagnetically held-on type. All contact pieces shall be readily replaceable and the necessary auxiliary contacts for control, indication and alarm shall be mounted in accessible positions and arranged in the same sequence on each contactor.

Vacuum interrupters shall be used for high voltage circuits. They shall be solenoid operated and designed to fail-safe, so that in the event of failure of any part of the closing mechanism the contacts will open.

Protection

Each starter shall be provided with an adjustable motor over-load and single phase protection device suitable for the motor load and have adjustable trip and rest delays provided, together with manual resetting facilities. Ambient temperature compensation shall be provided where relevant. Other protection features shall be as specified relevant to the particular drive.

Protection devices shall be arranged to trip the load and initiate the fault indications as specified and accept normal switching of load.

Where starters are fed directly from busbars or other systems having a high prospective fault level, suitably rated fuses or other means shall be provided within the starter to limit the fault let through to a value within the rating of the starter components.

Protective overload devices shall be arranged to ensure that any such fault is cleared by such fuses and provide Type '2' co-ordinated protection to BS EN 60947.

Control Circuit

All control circuits shall operate at not more than 110V and be derived from a double wound, screen earthed isolation transformer with one side of the secondary winding connected to neutral/earth. The primary supply shall normally be from one phase to neutral if available.

Individual transformers shall be provided for each starter but sequence groups of starters having a common isolator shall use a common control transformer.

Fuses shall be provided on each primary and secondary supply and be clearly labeled and segregated. A link shall be fitted in the neutral/earth connection.

The control circuit in the main supply must be isolated before opening the cubicle door but provision shall be made to re-energise the control circuit when the main supply to the cubicle is isolated, so that the operation of the control gear may be inspected without de-energizing the motor. The necessary control circuit Normal/Test switch shall be mounted within the cubicle and so arranged that it is not possible to close the door with this switch in the 'Test' position.

Control and Monitoring

The method of control and operation shall be as called for under the specific requirements for the starter.

Control selector switches fitted to the front of starters shall have matching operating handles which are clearly shaped to show the selected position. Specified function switched shall have a key operated barrel locking device in the handle, or be key operated alone, with the key removable in each lockable position.

All fault conditions relevant to each mode of operation shall stop the drive and prevent it re-starting until the particular fault is cleared and individually reset; lock-out relays and a reset button being provided for any self-resetting devices such as excess torque switches etc.

Specified fault conditions shall be identified by separate indications on the starter. Volt-free contacts shall be provided and wired to terminals in each starter unit for remote signaling of all status indications specified. Minimum status indications shall be Auto Available/Un-available and Running/Fault.

Where the starter is to be remotely controlled by a remote terminal unit (RTU), interposing relays with 24 volt DC coils complete with back EMF suppression diodes shall be provided in each starter unit to facilitate remote control and watchdog capability (See Instrumentation and Control Specification).

"Hours-run" meters shall be of the non-resettable cyclometer type indicator having a flush fascia and driven by a synchronous motor controlled to show the hours (up to 99,999.9) run by the main motor. They shall incorporate visible indication of operation but need not necessarily be of the same bezel size as the instruments.

All starters of motors of 3 kW and above shall have ammeters, local 'running' indicator lamps being provided for loads less than 3 kW.

Heaters

Anti-condensation heater shall be fitted in each starter (and motor, where specified), fed from a separate fuse through the starter isolating switch and an auxiliary contact on the motor contactor, arranged so that the heaters are disconnected when the motor is running.

In multi-tiered starter panels, the heater shall be located at low level within each tier and fed from a clearly identified common distribution supply with local isolating links in each tier.

Star/Delta Starters

Star/Delta starters shall be of the closed transition "Wauchope" type, having starting resistors, mechanically and electrically interlocked Star and Delta contactors plus a timing relay in addition to DOL starter requirements, all rated for up to 10 starts per hour.

Protection

The thyristors shall be protected by high speed semi-conductor fuses and heat sink thermal cut-outs.

The device shall be shut down in the event of single phase loss or open circuited thyristors.

In the event of short circuited thyristors, the drive shall continue to run at full voltage by automatically transferring to an override condition.

Indicators

Alarm indicators shall be provided for each of the above faults.

An auxiliary relay shall be used to control the function of the main contactor.

Energy Saving Facility

For continuous running devices, an energy saving control shall be provided where the voltage applied to the motor is automatically matched to the actual power demand. The control shall be effective after run-up and a dwell time at full voltage has been allowed to enable the motor load to stabilize.

The device shall respond immediately to any sudden load changes to prevent a potential stall condition.

Frequency Converters

The motor speed control shall be a frequency converter of an approved type and manufacture, providing a variable frequency of adequate capacity to drive the specified motor over the specified speed range and suitably matched to the starting torque and the speed torque characteristics of the driven plant. (Details to be determined by the Contractor from the driven plant/motor manufacturer during the Contract).

The converter unit with the associated control electronics shall be housed in a steel, free standing, drip protected (IP21) panel, mounted in the position specified. The unit shall be suitably air-cooled by means of an integral fan and all the components within the unit shall be readily accessible for easy servicing and removal without disturbing other components. Chassis units shall be suitable for rack mounting.

The incoming supply shall be via an isolator interlocked with the panel door and have suitable fuse protection.

The drive unit shall be capable of operating with the motor disconnected for test purposes. A current limiting circuit shall be incorporated to give short circuit and over-current protection in the output circuit, and under-voltage detection shall be incorporated

to protect the drive against fan failure. A thermostat shall be fitted for protection against fan failure and overheating.

Harmonics

The unit shall be protected from any harmonic distortion or switching surges in the power supply system and incorporate contractors to automatically isolate the input and output and to protect the unit from component damage arising from a power supply interruption which shall, if necessary, include automatic shutdown. If the converter will not perform correctly when running from a specified standby generator an interlock shall be provided to prevent such operation.

To prevent disruption of the supply system wave form (and dependent instrumentation), harmonic voltage and current distortion introduced into the mains supply by the drive unit shall be within the limits specified in Electricity Council Engineering Recommendation G5/3. The point of common coupling shall be regarded as the output connection of the first upstream transformer.

The supplier shall list with the offer the expected harmonics generated by the drive under running conditions (worst case).

Where an input filter is used to limit the harmonic currents, the design shall minimize the possibility of resonance with any power factor correction capacitors fitted.

The supplier shall include any shielding necessary in accordance with BS 800, to prevent any interference that may affect other surrounding instruments.

Monitoring and Control

The control of each of the variable drive unit shall normally be from a PLC outstation which will provide a start/stop facility and a 4-2mA speed control signal. Where the distance between the drive unit and PLC exceeds 20m, special care shall be taken to ensure radio frequency interference and distortion is kept to a minimum.

The following signals will be required from the drive unit and wired to clearly marked terminals:

- Common fault (motor overload, emergency stop operated etc.)
- Control status indicating Hand/Off/Auto
- Control 'on'
- Motor available
- Motor running
- RS 232 Serial Interface (where required by the specification).

The following items shall be included along with other control devices and instrumentation:

- Control potentiometer for speed setting on hand control, (scaled with liner graduations over the range and arrows indicating clockwise rotation to 'INCREASE SPEED' and anti-clockwise rotation to 'DECREASE SPEED');
- Output ammeter;
- Frequency/speed meter;
- Test and fault diagnostic card for circuit checking, having a front panel display and facility for serial link remote indication.
- Isolated inputs for 0-20/4-20mA auto control, stop/start, external reset, etc.
- Adjustments for ramp up/down, duration, frequency range, base/maximum speed, current limiting facility and economy made.

The following items shall be monitored for fault conditions:

- Phase failure;
- Earth fault;
- Over current;
- Over voltage;
- High temperature/fan failure;
- DC link fuse failure.

q) Rotating Electrical Machines

General

Machine type and starting or driving arrangements together with type of enclosure protection shall be as specified herein. Vertically mounted machines shall be fitted with a drip-proof top end cowl and those fitted with skirts shall have a skirt depth in excess of the shaft extension.

Each machine shall comply with the current BS 4999 and the relevant parts of BS 5000 and shall be designed to run at a high power factor and efficiency at the prescribed plant duty.

Rating

The output of each machine shall be a continuous maximum rating (Duty type S1) determined by the Tenderer in relation to the power requirements and the normal environmental conditions for the plant offered in accordance with this Specification.

The maximum temperature rise of any machine winding shall not exceed 90°C above a 40°C ambient when operating at the above rating. Where the insulation is rated up to 120°C only, the maximum plant loading shall not exceed 95% of the rated output of the machine.

Generators

Alternators shall be star connected machines producing a 3 phase 4 wire 50Hz supply at the specified rated voltage within a standard waveform deviation, when being driven at the rated speed and connected to the plant load specified herein.

Regulation

The generator automatic voltage regulation system for single set running shall be capable of maintaining the voltage for all loads between no load and rated load at rated power factor.

Due allowance shall be made for the current peaks associated with starting the motor loads connected to the alternator, and the regulation system shall be designed such that the transient voltage reduction following the load application does not exceed 15% of the rated voltage and shall be restored to within 97% of rated voltage in less than 1.5 seconds. The transient voltage rise when the rated load is thrown off shall not exceed 25%.

Where voltage regulation equipment is mounted on the alternators, the components shall be readily accessible and detachable for servicing, having terminations separate from the main terminals.

Excitation

The alternator shall be the brushless self-excitation type with rotating armature and verifier assembly mounted on the alternator shaft, electrically interconnected with field winding. Radio noise suppression shall be in accordance with BS 800 and the exciter field shall be safely discharged when the alternator is tripped.

Motors

Motors shall be suitable for operation from a 3 phase supply having the star point earthed and the phase sequence running R-Y-B anticlockwise. Motors rated less than 0.5kW may be arranged for single phase operation.

The torque available during starting of each motor shall be at least 10% in excess of the maximum required at any speed to satisfactorily start and accelerate the mechanical plant load under all service conditions.

Overspeed and Reverse Rotation

Each motor shall be capable of satisfactory performance during a period of 2 minutes whilst it is run at 1.2 times its rated speed and subsequently at normal speed continuously.

Where specified (to cater for backflow consequent upon delivery valve failure), pump motors shall be capable of reverse rotation up to these speeds without damage.

Electromagnetic Brakes

Where an electromagnetic brake is fitted to drive, the brake shall be continuously rated. It shall be suitable for direction connection across the associated motor terminals or for individual supply and interlinked control, depending on the method of operation and control specified herein.

The brake shall be arranged to fail-safe by holding on under spring return passage when the coil is de-energized and have provision for hand easing for maintenance purposes. All control circuits for brakes shall be arranged to fail-safe.

Coil and terminals shall be totally enclosed in a fully waterproof housing.

Power Factor Correction

Where specified, a power factor correction capacitor complying with BS 1650 and suitable for operation over the temperature range $-10^{\circ}\text{C}/+40^{\circ}\text{C}$ shall be supplied, connected, tested and commissioned to improve the overall power factor of each machine to not less than 0.9 when running at full load.

Each capacitor bank shall be fitted with HRC fuse protection enclosed within a sheet steel housing having a terminal box with separate bolted access over an external earthing terminal.

Means shall be provided for monitoring fuse failure visually. For HV applications, striker pin fuses shall be provided and arranged to operate a trip bar which shall initiate an alarm contact for remote indication.

Resistors shall be fitted to the capacitors and motor terminal boxes, inscribed as follows:

“WARNING - EQUIPMENT CONNECTED TO STORED ELECTRICAL CHARGE. ISOLATE AND EARTH ALL TERMINALS BEFORE HANDLING.”

Submersible Pump Motor

The pump and its associated motor shall form a compact integral pumping unit suitable for installation within the area specified. The motor shall be of squirrel-cage construction suitable for starting method as called for in the particular specification, and rated for continuous submerged operation in water having a maximum temperature of 22°C . Where a sealed coolant motor is used, the coolant shall be distilled water.

The stator winding shall be insulated against heat and humidity to Class F and shall incorporate at least three thermal overload devices.

A length of butyl rubber insulated, CSP sheathed flexible cable shall be provided and connected to the motor. Unless otherwise specified, the cable length shall be at least 20 metres without joints. The cable cores shall be phase coloured and be suitable to carrying the motor full local current under the specified operating conditions. The cabling sealing gland shall be a water tight design and, where included within the pressurized pipework, shall be capable of withstanding a water pressure of 1.5 times the closed valve head generated by the pumping plant.

Terminal Boxes and Connections

Terminal boxes shall be provided, suitable for PVC/SWA/PVC cables for all external cabling connections.

All boxes shall be bonded to the main frame earth and the frame of each machine shall be provided with means of connecting an earth protective conductor.

Each machine rated 10kW or above shall have at the six ends of the stator winding extended to the terminal block with the necessary linking effected there, adequate clearance being provided between phase terminations to permit the use of cable sockets.

For high voltage machines the terminal assembly shall be capable of satisfactorily withstanding the full fault capacity specified herein for one second.

Heaters

Anti-condensation heaters shall be provided in all non-submersible machines as an integral part of the machines and wired with butyl rubber insulated tails to a terminal box adjacent to the main terminal box, the cover being clearly labeled 'Heater Supply – 220V'.

Heaters shall be of the embedded element type having a low surface temperature and be impervious to moisture. They shall be arranged to operate on a 220V supply from the associated control unit when the motor winding is de-energised.

Maintenance Facilities

Machines rated over 50kW shall have lifting ears or eyes forming part of the main frame of the machine lifting and pulling facilities with a single tapped hole in accordance with the tables given in BS 4999 (Part 10). Depth of tapped hole shall be 1.5 times the diameter.

Bearings

Bearings shall be of the heavy duty ball or roller type greased for life enclosed in a substantial housing designed so that lubricant cannot escape on to the windings and fitted with adequate seals to prevent contamination or escape of lubricant down the rotor shafts. Means of lubrication shall be made available from outside the machine carcase of enclosure. The shaft shall be suitably located to prevent the rotor from moving out of magnetic centre while starting or running.

The rotor of any vertical spindle machine shall be provided with a suitable thrust bearing to support the weight of the rotor and its half coupling only.

Slip Rings

All machines which incorporate slip rings shall be so designed that the slip rings and associated slip ring mountings shall form a single unit which can be readily detached from the shaft for repairs and replacements. The slip rings shall be continuously rated and of the totally enclosed type.

r) Cabling and Wiring

Electrical Installation

The electrical installation shall comply with the current edition of the Regulations for Electrical Installations published by the Institution of Electrical Engineers (IEE Wiring Regulations) and the requirements specified herein where these differ from the IEE Wiring Regulations.

The installation shall be arranged in a neat and orderly manner which may involve running out of direct lines in order to conform to building outlines etc. and to utilize any holes provided for a cabling purposes in the structure. Unnecessary crossing of cables will not be accepted and due care should be given to this when selecting runs. Each cable shall be in one continuous length and no straight through joints will be permitted except as agreed with the Engineer.

It should be the entire responsibility of the Contractor to programme the whole of his work and co- operate with other contractors to ensure that the various parts of the electrical installation are executed at the proper stages of the construction, special care being taken with concealed work.

Care should be taken that sleeveings and sheathings of cables are not damaged during installation. Should any part be damaged, the damage shall be made good to the entire satisfaction of the Engineer. Cables shall only be installed when the ambient and cable temperature is above 0°C and has been for the previous 24 hours.

Cables shall, wherever possible, be arranged to enter equipment from below, particularly equipment located externally or in damp situations. Cables entering cubicles provided with sealed covers of timber or sheet steel shall be accommodated by drilling or dividing the covers with clearance holes as

necessary to allow the cable to pass through and be terminated at glands or gland plates provided within such cubicles, so that the cover when replaced, prevent entry of dust and vermin.

Protection of Exposed Cables

Where cables emerge through steel platforms or concrete floors, the Contractor shall provide and position protective curbing or sleeves made from galvanized material extending 75mm above finished floor level.

Sleeves shall be finished flush with the underside of the floor. Final details shall be agreed with the Engineer on site in respect of all situations.

Cables rising into or against floor mounted equipment shall be secured to the equipment in a neat manner to ensure that the cables are properly supported and that no undue strain is put on the cable termination or the plant. Where vibration or expansion is a consideration, adequate precautions and vibration loops shall be made at the appropriate position.

Where cables emerge in an area exposed to vehicular traffic and no overhanging projection exists up to one metre above ground level, a galvanized steel pipe or protection cover fabricated from 3.00mm (10SWG) galvanized mild steel (or heavier as appropriate) shall be provided and fixed to the associated structure for a minimum height of 1.5 metres above the local finished ground level.

Selection of Cable Runs

The routes and arrangement of all cables and the position of equipment and wiring points shall be marked out on site by the Contractor and agreed by the Engineer before any work is put in hand. Where cable routes have been agreed, the Contractor shall be entirely responsible for measuring the lengths of cable to be ordered and ensuring that the cables are supplied in the correct length.

Cutting away and Making Good

The Contractor shall be responsible making out the agreed positions of all chases, holes and fixings required for the passage of cables and conduit, and shall arrange with the Main Contractor for making good with a week mix of concrete.

The Contractor shall carry out all the necessary drilling for fixing up to 25mm diameter in the building fabric for the support and fixings of all items supplied or specified herein. Such work shall be carried out in a neat and workmanlike manner without unduly defacing concrete or brick surfaces. The use of stud fixings employing cartridge guns will not normally be permitted.

Where indicated on the Specification drawings, holes have been incorporated in the structures for the passage of cables and any additional cutting away and making good necessary to such structures will be done by the Main Contractor with the agreement of the Engineer.

Cable Materials

Cables shall be of approved design from a BASEC approved manufacturer having a certificate of Assessed Quality Management. They shall be manufactured within the 12 months prior to delivery and be delivered to site on cable drums or with protective wrappings.

The overall sheath of the cables shall be coloured as follows:

- | | |
|------------------------------|----------------|
| • High Voltage | - Red |
| • Low Voltage | - Black |
| • Earth continuity conductor | - Green/Yellow |
| • Instrument | - Grey |
| • Intrinsically safe | - Blue |

Cables shall be of the voltage grade, conductor size and type detailed in the specific requirements. General specification of the cable type to be used are detailed hereunder:

Paper insulated mains cables shall be stranded plain annealed copper conductors, insulated with helically wound paper tape, mass impregnated with non-draining insulating compound.

Multi-core cables shall be laid upon in a belted construction having a lead sheathing applied overall, protected by a steel wire armouring and having an extruded PVC sheathing overall (PLSW/PVC type).

Single core cables shall have a lead alloy sheath without armouring but with extruded PVC sheathing overall (PLY/PVC type).

Cross-linked polyethylene cables shall have stranded, copper conductors with cross-linked polyethylene insulation. Multi-core cables shall be laid up in an extruded bedding, steel wire armored and sheathed overall PVC, to BS 5467 (XLPE/SWAP/PVC type).

Single core cables shall have aluminum wire armour. Cables rated over 6350V shall incorporate graded semi-conducting tapes and core screens in accordance with IEC 502.

Low smoke and fume emission cables shall be as above except that the bedding and sheathing shall be of low smoke and fume emission material, all in accordance with BS 6724 (XLPE/SWA/LSF type).

PVC armored cables shall have stranded copper conductors with extruded PVC insulation, PVC sheathed, steel wire armored and sheathed overall with PVC (PVC/SWAP/PVC type). Cables shall be in accordance with BS 6346. Conductors of 1.5mm² and 2.5mm² shall have stranded conductors (7/0.50 and 7/0.67 respectively).

PVC insulated wiring cables shall be 450/750 volt grade single core stranded copper conductors PVC insulated to BS 6004 (PVC wiring type).

Mineral insulated cables conductors and sheaths shall be solid annealed high conductivity copper separated by highly compressed mineral insulating powder. The cable shall be sheathed overall with PVC.

Light duty rated up to 600V, heavy duty up to 1000V, all as BS 6207 (MICS/PVC type).

Telephone cables shall be thermoplastic insulated multipair cables having twisted pairs of copper conductors (telephone type).

Instrumentation cables shall be polyethylene insulated copper conductors with twisted individual pairs screened, polyethylene bedded, steel wire armored and PVC sheathed overall, all in accordance with BS 5308 Part 1 Type 2. Conductors shall be 0.5mm² stranded 16/0.2mm (PE/IS/SWA/PVC type).

Earth and bonding cables shall have stranded copper conductors PVC insulated and sheathed (PVC/PVC type).

Flexible cables shall have stranded, tinned, copper, flexible conductors, EP rubber insulated and CSP sheathed all in accordance with BS 6007 (flexible type).

Flame retardant cables shall be EP rubber insulated, tinned copper conductors in a CSP sheath, braided with galvanized steel wire (single cores having phosphorous bronze wire) and protected with a CSP sheath overall, generally in accordance with BS 6883.

The sheathing shall have heat and oil resisting characteristics to BS 6899 with an oxygen index value not less than 35 (HOFR type).

Compression Glands for Cables

All the glands shall be supplied by the Contractor and shall be of the brass compression pattern, so designed that any strain on the cable is taken by the steel wire armouring. The glands shall incorporate watertight seals on both inner and outer sheaths and have a separate armour clamping ring to ensure a good mechanical connection for the earth continuity path. The glands shall be secured with heavy duty locknuts and the whole assembly is to be protected by an overall plastic sleeve, suitably sealed to prevent atmospheric attack.

Glands fitted to unthreaded gland or adaptor plates, non-metallic equipment, or where specified for circuits likely to pass high fault currents, shall include brass earthing tag and connections arranged to effectively bond the gland body via a protective conductor to an effective earth point. Where instrument

cable screen terminations need to be isolated, insulated gland adaptors or non-metallic plates shall be used.

Glands and earthing tags shall be compatible with the gland plate and cable armouring materials to prevent electrolyte corrosion, e.g. brass for steel wire armouring described above, but shall be classified EX (d) in accordance with BS 5501 Pt 5 and be suitable for use with Apparatus Groups IIA and IIB.

Where cables to BS 6346, BS 6116 or BS 5467 having extruded or taped bedding are used for direct entry into such apparatus Groups, a sealing stopper box or compound sealed barrier gland shall be used in accordance with BS 5345 Part 3.

Termination of Glanded Cables

All cable compression glands shall be fitted by the Contractor, with the insulated conductors and sheathing being carried through the gland. The sheathing shall be preserved where required within the equipment and the insulated conductors properly connected to the terminals of the equipment concerned.

The armouring shall not be cut off short of the gland but shall be properly laid up and secured under the clamping ring provided. The gland shall be fitted finally with an overall PVC sealing sleeve.

All cable tails shall be of sufficient length to connect up to the equipment terminal boards, and in addition to making off the gland the Contractor shall strip, insulate, ring through and identify the individual cores, fit suitable termination lugs, ring or spade crimps or bootlace ferrules as appropriate, and fit numbered reference ferrules, lace the tails in a workmanlike manner and finally connect up.

All spare conductors within multi-core cables shall be terminated as shown on the connection diagram or be folded back with sufficient surplus to allow them to be connected if required in the future.

Wiring Ferrules

These shall be of durable materials suitable for permanently affixing to the cable cores and be of the interlocking slide-on type, such that the interpretation of the reference is unambiguous.

All control circuits consisting of more than two wires shall be identified by means of wiring ferrules attached to the individual cores at each end of the conductor where it is connected to any apparatus or junction box.

Unless otherwise specified, it shall be the responsibility of the cabling contractor to obtain interconnection terminal data and references from the equipment manufacturer to enable proper connections to be made.

Cable Cleats

Cleats for fixing cables to walls, structures, etc. shall be of the non-corrodible hook and clamp type made of high impact plastic or cast aluminum comprising two halves fixed by means of galvanized rawlbolts or on to galvanized backstraps where the number of cleats makes this more economic.

All assemblies to be complete with necessary galvanized bolt, nut and washers. The spacings of supports or cleats for cables shall in any case be not greater than shown in the following table but, where circumstances merit, closer spacing arrangements may be required by the Engineer.

The vertical spacings shall be applied to runs sloping up to 30° from the vertical. For greater deviations, the spacing for horizontal runs shall apply.

For outdoor and damp situations, fixing bolts or studs for cleats shall not be less than 13mm overall diameter unless otherwise agreed by the Engineer.

Cable Support Spacing (mm)

Cable Type	XLPE/SWA/PVC OR PVC/SWA/PVC with stranded copper conductors	
Overall dia (mm)	Horizontal	Vertical
Up to 15	350	450
15 – 20	400	550
21 – 40	450	600
41 – 60	700	90
Over 60	110	1300

Segregation of Duties and Services

Cable of different circuit categories shall be segregated as defined in the IEE Regulations. Instrument control cabling shall as far as possible be routed separate from electrical power cables and long parallel runs to them or pipework should be avoided. Where parallel routes and crossovers are necessary, a minimum separation of 250mm shall be maintained. Power cables shall not occupy the same ducts as instrument cables.

Similarly, separation between the three categories of instrument cables shall also be maintained as scheduled below:

Categories to BS 6739	Cat 1	Cat 2	Cat 3
CATEGORY 1 Instrument power & Control (over 50V, under 10A, AC or DC)	-----	200 mm	300 mm
CATEGORY 2 High level signals (5V to 50V DC)	200 mm	-----	300 mm
CATEGORY 3 Low level signals (Less than 5V DC)	300 mm	300mm	-----

Only conductors carrying signals of the same category shall be contained within any one multicore cable. Similarly, conductors forming part of intrinsically safe circuits shall be contained within multicore cables reserved solely for such circuits.

All screens for instrument cables shall be earthed at one point only, preferably at the main control centre.

Cables in Concrete Trenches

Where cables are run in concrete troughs or trenches, they shall be run on the floor of trenches less than 300 mm deep. In trenches deeper than 300 mm, cables shall be supported along the side of the trench on galvanized mild steel hangers, racking, cleats or on a suitable tray run supported from the side of the trench, whichever is specified. The spacing cleats or hangers shall be as specified under 'Cable Cleats'.

Where use is made of existing trenches with existing cables installed, it may be necessary to reposition certain existing cables so that the new cables can be laid in a proper manner and the whole of the cables (new and old) left in an arrangement which is tidy and fulfils engineering requirements. Such repositioning work shall be carried out to the directions of the Engineer.

Galvanizing Fastenings

Where manufactured or purpose-made steelwork, ladder, racking tray supports and all fixings nuts, bolts and washers are specified as galvanized, this shall mean hot dipped galvanized finish to BS 729 as far as practicable. Bolts and nuts shall be in matched condition.

Fixings screws for boxes, saddles, clips and other accessories shall be of brass or other non-corrodible type e.g. cadmium plated steel.

Racking

Cable racks shall be robustly constructed of mild steel, not less than 2.5 mm (12 SWG) in thickness and galvanized after manufacture. Where cleats are not used, the rack shall be provided with a toe at the outer end. Racks of proprietary construction may be used subject to approval.

Main rack supports, where fixed to brickwork or concrete, shall be secured with bolts of not less than 13mm diameter. The fixing bolts shall be of the self-securing type with expanding sockets and shall not require grout to hold them in position.

Where fixed to walls in places subject to dampness and in cable subways, the racks shall be set off from the walls by 35mm x 18mm thick galvanized packers placed at the bolt fixing positions.

In cable basements, the lower tier of any row of racks etc. shall be not less than 100mm above finished floor level.

Cable Ladders

Cable ladder shall be heavy duty type, fabricated from mild steel not less than 2mm thick and galvanized after manufacture. The side rails shall be at least 120mm deep with rungs set towards one edge, spaced at regular intervals of approximately 300mm and having elongated slots to accommodate the cable fixings.

Lengths of ladder shall be coupled and changes in direction, level and width shall be achieved by means of standard accessories designed for the system, such as radiused risers and gusseted intersections. Cable tray shall be accommodated on the ladder system for cables less than 15mm overall diameter.

Cable Channels

Cables requiring mechanical support across voids may be accompanied in not less than 40mm square galvanized channel sections fitted with plastic closure strips and suitable end caps in preference to tray, and subject to the Engineer's approval.

Cable Tray

Cable tray shall be heavy duty pattern formed from galvanized sheet steel, perforated with elongated holes for cable fastenings. The tray shall have side flanges not less than 25mm deep with returned edges and be galvanized after fabrication. Material gauge shall be 1.5mm (16 SWG) minimum, except that for tray widths less than 400mm the gauge may be reduced subject to the flange depth and the approval of the Engineer. Factory made tee sections and bends shall be used where possible.

The cutting trays shall be kept to a minimum but where unavoidable, all cut edges shall be rounded or folded over and protected with zinc rich cold galvanizing paint, holes for cable shall be bushed with nylon/PVC strip edging material. Mushroom headed bolts and nuts shall be used to join sections of tray and accessories and arranged not to present any obstruction on the tray. Capacity amounting to 25% usable tray area shall be left spare.

Where specified herein for damp or corrosive conditions, the trays shall be of un-plasticized PVC with non-corrodible nuts and bolts.

Cables on Tray or Ladder

Cables shall be laid flat and straight, properly dressed into position and fastened by cable ties or straps of metal reinforced PVCC strip material, secured at intervals not greater than 1m for horizontal and vertical runs. Where the runs is horizontal but arranged in the vertical plane, support spacing shall be as specified under 'Cable Cleats'. Care shall be taken to space the cables to allow adequate cooling. Not more than seven cables shall be embraced by one group tie and not more than two layers of cables shall be run on one tray.

Cables in Ducts

Before drawing any cables in ducts, the Contractor shall ensure that they are clean and free from obstructions.

Adequately spaced temporary supports and cable rollers shall be provided for the drawing in of cables such that abnormal strains and damage to the cable is prevented; approved lubricants shall be used as necessary. Cable stockings shall be used for general drawing work, core pulling eyes being specially fitted for heavy hauls.

Stresses shall not exceed 10MN/m² (1500 lb/sq in) on the lead sheath and 70MN/m² (10,000 lb/sq in) on the core.

Maximum pulling tension shall not exceed 20 kN (4500 lb).

Duct Seals and Cable Transits

After the cables are drawing, the Contractor shall seal the ends of all ducts, pipes or trenches leading into buildings, passing through walls or floors within buildings or underground chambers containing equipment for cabling associated with this Contract, whether occupied or not.

All cables, conduits or pipes shall be sealed into the ducts by means of a secure and effective water, gas, vermin and fire-proof material which will accommodate settlement and vibration. This may be a self-supporting non-settling mastic packed into the annuls to a depth at least equal to the sleeve diameter, or approved multicable transit units with appropriate fillers and insert blocks. All steelwork on such transit assemblies and frames shall be hot dip galvanized.

Where shown in the Specification drawings, transit frames will be incorporated in the construction by the Civil works contractor.

Cable Laid in Ground

Where cables are laid direct in the ground, they shall be well bedded in fine soil or sand and shall be covered with protective tiles. A minimum of 60mm thickness of fine soil or sand shall be supplied around the cables. All cables running along any one portion of route shall be laid at the same time and no extra payment will be made do re-excavation should any cable be overlooked at the time of laying. The Contractor shall be responsible for all excavation, for the supply of fine soil or sand for bedding, and for the backfilling and reinstatement of cable trenches along previously agreed runs. Trenches shall not be backfilled until the installed cables have been inspected by the Engineer.

Clearance and Coverage for Buried Services

Trenches shall be excavated or ducts laid at such depth that where cables are laid in the ground the minimum coverage to the top of the duct of the cable shall comply with the following:

Minimum Coverage

Type of Service	Vehicular Roadways	Open Ground Footpaths
HV	1000mm	750mm
Others	750mm	500mm

Where possible, electric cables and their ducts shall be routed so that subsequent excavation to expose another service will not disturb cables and electrical ducts. Where separated routes are not practicable then the following clearance shall be ensured:

Minimum Clearances

Type of	To HC	To LV	To Other	To Gas/Water etc.
Cable	Cable	Cable	Cable	Pipes
HV	150mm	300mm	300mm	300mm
LV	300mm	150mm	240mm	300mm
Others	300mm	250mm	150mm	300mm

The spacing of cables installed at the same time shall be generally in accordance with the above table, but where circumstances permit a more economical arrangement may be specified by the Engineer.

As far as possible electric cables shall avoid the same route as other services except where otherwise directed. Where such segregation is not possible then 50mm thick concrete slabs may be used as separators with the Engineer's approval. Adequate slack shall be left at each bend for cables laid direct.

Protective Cover Tiles

These shall be of the concrete apex pattern engraved 'Danger – Electricity' or similar, of dimensions appropriate to protect the number of cables along a particular route.

Following the installation and compaction of the bedding soil or sand over the cable, covers shall be laid by the Contractor so that they overlap at approximately 30mm each side of the cable run. Where cables are displaced by no more than 300mm vertically, covers shall be installed only over the upper cable run.

Backfilling and Reinstatement

Reinstatement of soil following laying of cable shall be effected by backfilling in 100mm layers. Hand ramming shall be employed for the first two layers and power ramming for subsequent layers.

After hand ramming to a depth of 200mm, a yellow coloured plastic tape approximately 150mm wide with the words 'CAUTION CABLE BELOW' shall be provided and run over the centre of the route of each cable run by the Contractor.

Top soil is to be placed and the level of the finished reinstatement shall not protrude more than 50mm above normal ground level.

All surplus spoil is to be removed from the site and areas surrounding the excavation shall be restored to their original condition.

Where tarmac surfaces have been excavated, the final 200mm backfilling after allowing the settlement shall consist of 120mm of compacted, graded hardcore, followed by a 60mm concrete screed and a 20mm top dressing of tarmacadam.

Route Markers

These shall be of reinforced concrete with the words 'ELECTRIC CABLES' cast in one face. They shall either be of the flush block type approximately 300mm x 150mm or the pillar type approximately 600mm high erected with 300mm projecting above the ground, as directed by the Engineer.

As soon as site conditions allow, the location of each group of buried cables and every joint shall be accurately marked. Concrete marker posts or blocks shall be set at the origin, changes of direction, joints and otherwise at intervals of 20 metres or as directed by the Engineer.

Cable Identification

Identification labels of durable material shall be provided suitable for permanently affixing to the cable sheath by means of buckle type straps and shall carry the cable reference in PVC channel strip. The reference character sizes shall be not less than 4mm (5/32") high (Crtitchley Unilabel or similar).

Cable identification labels shall be fitted to each cable end below its respective gland, also where the cable passes through ducts or trenches and at each entry and exit to a room or building.

Trunking Materials

All trunking, bends, cover plates, tees, flanges, supports, fixings, etc. shall comprise an approved complete system capable of adaption and erection without size modification and with compatible manufactured bends and accessories being used as far as practicable. The trunking access covers shall comprise easily removable convenient sized lengths retained over the entire length by clip-on features or suitable fastenings which shall not obstruct cable entries. Overlapping covers and internal flanges or coupling sleeves shall be provided at all trunking junctions. All cable supports, edges, sharp internal angles etc. shall be protected with PVC or formed to present a smooth edge.

Metal trunkings and fittings shall be zinc coated or galvanized mild steel not

less than 1.2mm thick (18 SWG). Copper earth bonding straps shall be fitted at the junction of adjacent lengths of trunking and fittings.

PVC trunkings and fittings shall be of high impact heavy duty rigid PVC.

Trunking Installation

As far as possible, trunking shall be installed clear of other services and positioned so that future access is not restricted. Drawings detailing supports, terminations, sizes and centre lines of trunking shall be submitted to the Engineer for approval prior to commencement of the installation. Provision for expansion of the trunking materials shall be made in accordance with the manufacturer's instructions. Trunking shall include fire barriers of fiberglass wadding fitted at each point where the run passes through fire walls and floor levels. All cable and conduit exits shall be fitted with bushes without decreasing the effective cross-sectional area of the trunking.

When connecting adjacent sections of trunking or when fixing trunking to a wall or supports, round or mushroom headed bolts or screws shall be used such that no sharp edges project into the inside surface. When installed in damp situations the trunking shall be spaced from the wall by means of short tube collars.

All trunking shall be protected against damp and corrosion and where entries, joints and/or bends have been installed, cut and/or sawn edges exist, all damaged galvanizing shall be made good by a minimum of two coats of aluminum paint of an approved quality. For extensively damaged galvanized coatings the items shall be re-galvanised or replaced with acceptable components.

Conduit shall be connected to the trunking by means of couplings and male bushes to obtain a good earth connection.

To assist identification within trunking, final circuit wiring shall be formed into groups held by buckle clips or PVC straps. Each group shall be labeled where wiring enters or leaves the trunking and at intervals of approximately 600mm centres to be used as cable supports.

Separate conductors comprising the same circuit shall be run enclosed together throughout their length.

Cables in Conduit

For wiring installations carried out with PVC insulated cables in conduit, the wiring throughout is to be on the "looping in" system and no "Tee" or other intermediate joint between fittings will be permitted, and in no case must the cable be drawn into the conduits until all such conduits, bends, boxes, or other fittings have been fixed permanently in position and approved by the Engineer.

Any water which may accumulate in the conduit during erection shall be removed before any cables are drawn in. Sufficient slack shall be allowed at each point to ensure that all conductors are under no physical strain or tightness.

Separate conductors of the same circuit shall always be drawn into one conduit, but cables forming final circuits shall always be drawn into one conduit, but cables forming final circuits connected to different distribution boards shall not be drawn into the same conduit or box.

The cables shall be coloured RED or BLACK as required to distinguish opposite poles, a BLACK conductor shall be used throughout for neutrals and connected to the neutral pole of the supply system.

No reduction of the strands forming the conductors will be allowed at switch or other terminals; all the strands shall be efficiently secured by screws, nuts and washers or other approved means and all conductors shall be so proportioned that the drop of potential does not exceed that indicated by the IEE Wiring Regulations.

After the Contract award a Table (in duplicate) showing the proposed arrangement of wiring circuits and the size of cables to be used shall be submitted to the Engineer for his approval before any work is put in hand.

Conduit Materials

i) Metal All conduits and fittings shall be Class 4, galvanized steel, heavy gauge welded and welded and screwed smooth bore tube employing threaded couplings and complying with BS 31 and BS 4568. As an exception, lengths of conduit completely encased in structural concrete may be finished with black enamel.

Conduit boxes shall be of malleable cast iron. For surface work the lid shall be of cast iron machined or ground to make good contact with the boxes. Adaptable boxes for surface work shall be of malleable iron.

ii) PVC All conduits and fittings shall be heavy duty gauge PVC in accordance with BS 4607.

iii) FlexibleFlexible conduits shall be water proof metallic type PVC sheathed and adaptors to rigid conduit shall be of the internally rifled split brass type.

Flexible conduit shall only be used for bridging expansion joints in a building or for final connections from the rigid conduit system to the terminal boxes of equipment subject to vibration or adjustment. All such conduit shall have an earth continuity conductor connected through the flexible adaptor at each end. Individual lengths of flexible conduit should not exceed 400mm.

Conduit Installations

The conduit system shall be continuous throughout so that the cables are fully protected. No conduit smaller than 20mm shall be used. Provision shall be made for draining condensed moisture where directed by the Engineer.

The conduit throughout shall be of adequate capacity in accordance with IEE Wiring Regulations, and shall be arranged with draw-in boxes to allow for easy draw in or out of any one or all the cables in the conduit. For multiple parallel conduit runs, draw boxes may be combined by an appropriately sized adaptable box provided segregation of services is maintained.

Wherever possible conduits shall be installed either horizontally or vertically and changes in direction shall be effected by easy or well formed sets without altering the section or opening joints; solid or inspection tees shall not be installed.

The inside surfaces of the conduit ends and all fittings shall be smooth and free from burrs and all other defects.

For surface work the conduits shall be fixed by means of spacer and saddles or substantial distance saddles. Where conduits pass directly through concrete or similar floors and where washing down is likely to occur, the conduits shall be sleeved. The sleeve shall be grouted flush with the underside of the floor and extend 75mm above the top surface of the floor. Where conduits are run on steel work, they

shall be fixed by means of purpose-made clips. If the Contractor requires to drill any steel work, permission in writing must be obtained from the Engineer.

If exterior situations, all joint box lids etc. shall be made waterproof with compound or gaskets as appropriate.

Metal conduit installations shall be electrically continuous throughout, and at all terminations conduits shall either be screwed into approved spigot boxes or coupled by means of screwed couplings and smooth bore hexagon bushes. In no cases shall the length of the thread into which the conduit is screwed be less than the outside diameter of the conduit. Where tapped entries are provided and where internal space permits, a ring bush shall be used as a lock nut.

All exposed threads and damaged galvanizing shall be cleaned and thoroughly coated with zinc rich paint. If black enamel conduit has been approved for use, then where the black enamel is damaged the conduit shall be satisfactorily repainted to the approval of the Engineer.

Contact between conduit and gas pipes shall be prevented wherever possible by adequate spacing, or by means of insulating distance pieces. Where the conduit is or may be in contact with any other pipes or metal work and efficient metallic connection shall be made between the conduit and the pipes or metal work and the incoming gas, water and electricity services shall also be bonded together, all as required by the IEE Wiring Regulations.

PVC conduit installations shall have couplers and spouted fittings joined with a permanent solvent adhesive, and provision shall be made in surface conduit installations for expansion by using semi-permanent mastic jointing seal in expansion couplings as necessary.

Conduits shall be fixed by means of spacer bar saddles spaced as defined in the IEE Wiring Regulations.

These figures apply to surface runs at normal room temperature. Where high ambient temperature or rapid fluctuations are likely these spacings shall be reduced as agreed with the Engineer. Conduit shall also be secured 150mm either side of a bend.

The bending radius of PVC conduit shall be not less than 4 times the diameter of the conduit and bending shall be achieved by the use of the correct size bending spring.

If bending is to be carried out in temperatures below normal room temperature, frictional heat shall be applied to the conduit before bending commences.

Potentially Explosive Area conduit installation shall employ metal conduit and comply with the relevant Parts of BS 5345 for the specified zone classification; Ex(d) protection for Zone 1 and Ex(n) protection for Zone 2 Applications.

All screwed joints whether entering into switchgear, junction boxes or couplings, must be secured by a standard locknut to ensure a tight and vibration-proof joint which will not be slacken during the life of the installation and thus impair continuity and flameproofness. The length of thread in the conduit must be the same as the fitting plus sufficient for the locknut. Due to the exposed threads, the use of running joints is not permitted and specially designed flameproof unions shall be used for securing conduit to an internally screwed entry. All unwanted outlets shall be plugged with approved blanking plugs.

When a conduit passes from a hazardous to a safe area, the flame-proof section must be terminated by a stopper box or sealing device mounted in the safe area.

All conduits entering directly into a flame-proof enclosure where exposed terminals are fitted shall be sealed at the point of entry by means of stopper boxes which must be entirely filled with a non-oxidising compound. Conduit boxes or indirect entry compartments not containing exposed terminals do not require sealing.

Conduit stopper boxes of certified design must be used, having splayed, plugged filling spouts in the cover to facilitate the entire filling of the interior with compound.

Intrinsically Safe Conduits

Circuits complying with the requirements of BS 5345 for intrinsically safe circuits shall be arranged such that all cables are identified and segregated as detailed in BS 6739. Conductors forming part of an

intrinsically safe circuit shall only be contained within multicore cables reserved for such circuits and must be terminated separately.

Intrinsically safe circuits shall be connected to a separate earthing system as detailed in BS 6739 and any shunt diode barriers shall be installed in accordance with the certification requirements.

Mineral Insulated Cables

Cables shall be installed saddled to trays, run on the surface or as otherwise specified. The spacing saddles shall be in accordance with the IEE Regulations. Cable termination accessories and saddles shall be brass or copper and shall be supplied by a particular cable manufacturer. All cables shall have a temporary mastic seal applied during installation. Once cut to length, each cable shall be permanently terminated without delay by using an approved seal. Termination seals shall be anchored in approved glands and locked into screwed conduit entries or gland plates forming part of accessories or equipment.

Wherever possible, glands shall be locked in position with locknuts. Shrouds shall be fitted over glands except where they are encased in the structure of the building.

In cables where dampness may be present or where dissimilar metals are present, corrosion inhibiting paste shall be interposed in all voids between surfaces in contact.

Where MICS cable serves an inductive circuit liable to voltage surges or circuits subject to lightning surges, appropriate surge diverters shall be connected across the inductive sources (coil etc.) or between lines and earth at the point of entry in the case of lightning protection.

Sealing Boxes for Lead Sheathed Cables

For terminations at plant items, these will be provided by others except as specified herein and will be of cast iron, compound filling type, provided with filing plugs in the appropriate position for filling with compound when mounted on the associated equipment. Each will be complete with wiping cone armour clamp. For through joints or tee joints, the Contractor shall provide suitable boxes as detailed herein.

All necessary jointing materials, filling compounds and earthing requirements shall be included for all joints to be made under this Specification.

Lead Sheath Cable Terminations

The Contractor shall submit to the Engineer for approval the proposed method for terminating lead sheathed cables. Terminations must ensure that moisture cannot creep along the cores of the cable nor in between cores.

Where cable tails are to be brought out, cores shall be cut back below the level of the sealing compound and connected to the tails using a brass ferrule sweated to provide a solid damp and oil migration barrier between tail and core.

Paper insulated tails shall be double half lapped with an approved non-hygroscopic insulating tape. Alternatively for LV cables, instead of an approved tape, a length of temperature sensitive, PVC sleeving may be heat shrunk over the tail, joint and cores.

The continuity of armoured cables shall be maintained by an efficient bond between the cable armour and, the gland and the metalwork of the equipment at which the cable terminates, in order that a reliable path is provided for fault currents.

When the lead sheath has been wiped on to the cable gland, the steel armouring shall be brought over the wiped joint and clamped to the top of the gland to provide additional earth continuity and mechanical strength to the plumbed joint. The armour clamp shall sandwich a copper braid between the clamp and the armouring to ensure a bedded connection.

Compression gland shall be to an approved pattern provide adequate bonding and armour clamping facilities.

Cable cores shall be fitted with suitable termination lugs and be phase coloured as appropriate and marked with an approved label to correspond with the diagram of connections.

Glands exposed to weathering shall be totally wrapped in impregnated tape to exclude all moisture from the gland connection and have an outer wrapping of PVC tape.

Jointing

Personnel employed for jointing power cables including all types of terminations for aluminum conductors shall have received specialised training. Joints on all buried or stranded cables shall be sweated, but compression joints will be permitted for stranded copper or solid aluminum conductors at terminations only.

Joints shall be completed without pause of unnecessary delay. Reduction in the number of strand is not approved but limited reduction in the cross sectional area of solid conductors by an approved method is permitted. Cable cores shall be cut with due regard to fanned out terminations, leaving a neatly arranged minimum of slack core between cable and terminal. As far as practicable all HV joints shall be made to avoid crossed or twisted cores, final phasing out being arranged at the cable box termination.

Where crossed joint is approved, a sleeve at least 30% longer than standard shall be used to minimize the distortion of cores. The engineer shall witness the final termination in order that the Contractor may prove the phasing before the last joint in a cable run is made.

Cables shall be jointed colour to colour or number to number. Where numbered cores are to be jointed to existing coloured cores etc. the Engineer will direct the system to be used.

A reliable continuity path shall be provided for fault currents flowing via the lead sheath and/or armouring by means of an efficient earth bond between the cable armouring and sheath on each side of the joint.

Any semi-conducting screens incorporated in HV cables (e.g. XLPE rated at 6350/11,000V) are to be thoroughly removed before application of any stress control components supplied with the necessary cable jointing kits.

Sealing Compounds

The outer protection boxes for joints or termination shall be filled with compound of the hot or cold pouring variety of a type compatible with the cable materials to be agreed by the Engineer.

Compound which require heating shall be evenly heated, well stirred and the temperature maintained within the recommended pouring ranges. Cable accessories shall be thoroughly dried before filling and pre-warmed where possible.

Where cable sealing boxes are fitted beneath oil-filled compartments or where inverted cable sealing boxes are used due to cables entering from overhead, the compound shall be of the oil resisting type to prevent any risk of softening due to contamination from the insulating oil.

Cold pouring resin encapsulation materials shall be carefully mixed to avoid entrapped or uncured filler materials.

Single Core Cables

Circuits utilizing single core cables shall be installed under IEE 'Defined Conditions' but to minimize mutually induced voltages, three phase circuits shall be run for as long as possible throughout the route in close trefoil formation. Where a circuit employs more than one cable per phase, each trefoil group shall contain one cable of each phase, allowing at least 50mm clearance between adjacent groups. Cleat spacing shall not exceed 1.2 metres.

Ferrous screens or armour shall not be used on such cables and associated termination or enclosure must avoid the use of magnetic material which would provide a flux path in service.

To control induced voltages, single core cables shall have their metallic sheathing and/or aluminum armouring bonded together at both ends of the run, the bonding being connected directly to the system earth bar or other approved points. Cables having no insulating oversheath shall have their metallic sheaths or armouring bonded together by the use of normally spaced, well fitting, non-magnetic metallic trefoil cleats.

In all cases the bond shall be sized to carry the prospective fault current and have a conductivity not less than that of the cable sheath and/or armouring. Bonds for cables laid in a flat formation shall also allow for the unequal sheath currents.

To prevent circulating currents, bonding and earthing at the supply end only of short runs of single core cables will be permitted where it can be shown to the satisfaction of the Engineer that the induced voltages are safe under fault conditions.

Busducts

Connections between major electrical items shall (where specified) employ a fully integrated, totally enclosed, busduct system to BS 5486 (IEC 439-2), comprising HDHC copper conductors embedded in a non-flammable, self-extinguishing, cast epoxy resin insulation.

The complete assembly including junctions shall be completely free of condensation and watertight to IP68. Fire resistance shall be Class M1 (F) and Class B1 (D) to IEC 332.

All parts of the system shall be from the same manufacturer and comprise factory made lengths, bends, tees and terminating pieces to suit the physical application and layout of the installation.

The voltage and prospective fault ratings of the system shall be suitable for the application and the current rating shall be based on the most onerous method of installation for the circuit. The cross sectional area of the conductors shall not be reduced throughout a given circuit.

The installation shall allow for any necessary expansion, be properly supported and connected in accordance with the manufacturer's instructions. Fire and damp-proof barriers shall be provided when passing through walls, floors/ceilings etc.

Conductors shall be jointed by means of double junction plates, one on each side to ensure low joint resistance. The junction shall be compressed by means of high tensile steel nuts and bolts. After assembly, all junctions shall be overcast with the same materials mixed under vacuum, as used for the busduct elements, thus maintaining a homogenous and weatherproof enclosure throughout.

Provision for conductor shifting, transfers and paralleling, shall be made within the terminal elements.

Earthing and Bonding

All non-current-carrying metal parts of the electrical installation and other services shall be properly bonded together and connected by means of a protective conductor to an efficient earth in accordance with IEE Wiring Regulations.

All connections shall be by means of an approved mechanical joint or adjustable clamp which shall be accessible and made secure with brass nuts and bolts. On no account shall plain or spring washers of ferrous metal be used.

Protective conductors shall provide earth continuity either through the conduit, armouring, lead sheathing, steel trunking or by independent earth tapes or PVC sheathed wires, according to the system of wiring employed.

Where PVC conduits or trunking systems are employed the protective conductor shall be routed within the conduit or trunking.

Wherever cable armouring is used as a protective conductor, care must be taken to ensure an adequate earth bond and additional bonds to the metalwork shall be provided as required.

Main Earth Connections

Where a main earth bar is to be installed it shall be connected in a ring with the earth bar provided on the switchgear and any existing main earth ring in the building. The glands and wire armour of cables shall be connected to the switchgear earth bar or directly to the earth ring.

The main earth bar shall be formed from high conductivity, hard drawn copper bar Grade C101 to BS 1433 of not less than 31.5mm x 6.3mm cross-section. Any joints in the earth bar are to be brazed

together using brazing alloy type CP1 to BS 1845 or pan head riveted and sweated. The bar overlap/thickness ratio shall be not less than 5.

The earth bar shall be secured to an inside wall in an accessible position. Connections to the metal work of electrical plant shall be made in soft drawn copper tape or equivalent sized cables. Where plant is subject to vibration, connections shall be made using flexible conductors. All earthing conductors and equipotential bonding cables shall

have a green and yellow PVC sheath, and earth bars shall have a green/yellow marker tape or sheathing applied.

Reinforced concrete or sheet steel piling shall be connected to the earthing system as directed by the Engineer. Structures of steel framed buildings shall be bonded to the main earth bars.

Earth rods are to be 16mm (5/8") diameter driven by an automatic hammer to a depth of approximately 4 metres. Spacing between rods is not to be less than the depth of the rod. Inspection pits shall be provided for each electrode to allow subsequent access for testing.

Where copper earth tape is buried below ground level it is to be served with PVC or double half lap wrapped with an approved grease-impregnated tape for a distance of at least 300mm above and below ground level.

The routing, dimensioning and arrangement of all main earth bars and connections shall be detailed on the schedules and drawings forming part of this Specification as called for in the specific requirements. Disconnecting links for testing purposes shall be provided as shown therein.

s) Civil Works for Cable Installations

General

The works involved are associated with the cable installation and comprise trenching, excavation, supply, laying and jointing of cable ducts; building of jointing and draw-in pits; application of bedding sand and soil; temporary reinstatement of ground. The installation of cables, supply and laying of cable covers and preparation of route record drawings will be carried out by the Contractor appointed to undertake the cable installation. Excavation, duct and cable laying and backfilling shall proceed in accordance with an agreed programme ensuring that all cables and ducts are satisfactorily covered immediately following laying and after approval from the Engineer.

Trenching Measurements

The depths and widths of individual trenches for cables or ducts and the clearances from other services shall be determined by reference to the clauses in this part. For contracts let with scheduled rates it will be assumed upon re-measuring that excavations have been in accordance with this specification unless the engineer has been sent an advice to the contrary.

Coverage for Buried Cables or Ducts

Trenches shall be excavated or ducts laid at such a depth that the minimum coverage to the top of the duct of the cable shall comply with the following:

Type of Services	Vehicular Roadways	Open Ground or Footpaths
HV	1000mm	750mm
Others	750mm	500mm

Clearance between other Services

Where possible electric cables and their ducts shall be routed such that subsequent excavation to expose another service will not disturb cables and electrical ducts.

Where separate routes are not practicable then the following clearances shall be ensured:

Type of Cable	To HV Cable	To LV Cable	To Other Cable	To Gas/Water etc. Pipes
HV	150mm	300mm	300mm	300mm
LV	300mm	150mm	250mm	300mm
Others	300mm	250mm	150mm	300mm

Where such spacings are not possible then 50mm thick concrete or stone slabs may be used as separators with the Engineer's approval. Each cable shall be at least 50mm clear of the side of the trench excavation.

Excavations and Precautions

Turf and topsoil shall be carefully removed and positioned where indicated on the drawings or as directed by the Engineer for subsequent reinstatement in their original position.

Broken land drains and damage to other services shall be reported to the Engineer and marked on site.

Excavations shall be kept free of water and properly shored up. Other services uncovered shall be adequately supported by slings or other means and protected.

Bedding for Cables

Prior to laying the bedding for the cable, the bottom of the trench shall be cleared of loose and projecting rubble etc. and evenly graded.

A sand bedding shall be applied below and around the cables and shall be thoroughly compacted. Thickness of bedding around the cable shall be 60mm except where soil contains coke, ash or other corrosive matter where the thickness shall be 200mm. Bedding shall be well graded sand, free of clay with minimum particle size of approximately 0.08mm (BS sieve No. 200) and maximum particle size of approximately 2 mm (BS sieve No.7). 60% of the material shall pass through BS sieve No. 72. Where the engineer directs, local soil may be used for bedding after passing through a 10mm mesh sieve provided the material is evenly graded.

Ducts and Couplings

Buried cable ducting shall be smooth bore uPVC pipe to BS 4660 (or medium density polyethylene, where greater flexibility is required) jointed by spigotted ends or couplings of compatible, non- deteriorating material. These couplings shall be a self-aligning, push fit and incorporate seals to prevent the ingress of water and other fluids as far as possible and the joint so formed shall be equal in internal diameter to the duct itself.

Ducts entering below ground level into a building or structure shall emerge inside the building either directly into an accessible trench or void, or the duct shall have an upturned bend to emerge adjacent to an inside wall face, or as otherwise specified. All exposed upturned duct ends shall project at least 75mm clear of the finished floor or ground level to prevent unwanted collection of water or debris and protect the cable exit.

Bedding of Ducts

Prior to laying ducts in trenches, the trench bottom shall be evenly graded, cleaned of loose rubble etc. and compacted to form a solid foundation. In rocky soil a layer of loose, rock free earth shall be used for this foundation.

Where ducts are laid beneath vehicular access roads, the ducts shall be haunched in C20 concrete for the full width of the road and extend each side beyond the curbside by at least 300mm.

Duct Alignment and Cleaning

Ducts shall be laid in a straight line as far as possible with minimum deviation. Where bends are required, these may be manufactured, pre-formed bends with a radius of not less than 10 times the bore

diameter. No continuous duct run shall incorporate more than two bends nor turn through a total of more than 135° in any plane. No single bend shall exceed 90°.

Where greater changes of direction are necessary, cable draw pits shall be incorporated in the run as required or defined by the Engineer.

A non-corrodible draw wire or rope shall be left in each duct and plugs shall be inserted at the ends of each section of duct to prevent entry of soil or stones. On completion of the ducts and prior to drawing in cables, a circular wire brush 6mm greater in diameter than the duct shall be pulled through each duct.

Cable Draw Pits

Cable draw pits shall be of brick enclosed construction fitted with suitable removable access covers and have bellmouthed duct entries into the pit interior. The interior dimensions shall be determined by the Engineer but shall be not less than 750 x 600mm in plan and the depth shall be determined by the invert of the lowest duct with a minimum of 50mm clearance to the base of the pit.

Where specified, a pulling eye for the use of 2000kg pulley block shall be provided opposite each group of ducts in the wall of the pits, and positioned to facilitate as straight

a pull as possible in the cables with the use of a pulley block. The base of the pit shall be formed with a fall towards a sump, suitably placed for pumping dry.

Backfilling and Reinstatement

Reinstatement of soil following laying of cable shall be effected by backfilling in 100mm layers. Hand ramming shall be employed for the first two layers and power ramming for subsequent layers. Backfilling shall only proceed in the presence of the Contractor responsible for laying cables.

After hand ramming to a depth of 200mm, a yellow coloured plastic tape approximately 150mm wide with the words 'CAUTION ELECTRIC CABLE BELOW' shall be provided and run over the centre of the route of each cable run.

Top soil is to be replaced and the level of the finished reinstatement shall not protrude more than 500mm above ground level. All surplus spoil is to be removed from the site, and areas surrounding the excavation shall be restored to their original condition. Where tarmac surfaces have been excavated, the final 200 mm backfilling after allowing the settlement shall consist of 120mm of compacted graded hardcore, followed by 60mm concrete screed and a 20mm top dressing of tarmac.

Cable Trenches

Trenches cast in floors of ground shall be of specified internal dimensions to suit the specific installation. They shall have smooth vertical sides and bottom with provision for cover plates to finish flush with the finished floor surface.

Inside bends shall be either radiussed (150mm min) or chamfered at least 100mm back, equally angled from each direction. Such radiussing or chamfers shall extend the full height of the trench, however the top 100mm may be corbelled out to simplify the cover plate arrangement.

Trench covers shall be of aluminum or galvanized mild steel chequer plate (min 8mm thick) supported to prevent undue flexing and having suitable holes to allow removal by standard lifting keys. Support shall be by means of steel curbing rebates cast into the trench top edges, providing a landing width of at least 300mm.

Additional or alternative support for switchboards etc. shall be from at least a 75 x 35 mm channel section cross bearers and transverse trimmers, fixed or cast into the floor and located to suit equipment fixings, access requirements and floor cover spans.

To prevent differential deflection, butt straps shall be fitted to the underside of floor plates which have no other support.

Edging curbs suitable for mild steel chequer plate shall be painted in red oxide primer, the curbing may be tapped to accept cover securing screws. Where aluminum plates are used in contact with any mild steel supports, a bitumen coating on the points of contact shall be used.

Cable Troughs

Pre-cast concrete trough sections shall be laid either flush or upon the finished ground level as specified.

The sections shall be sized and provided with rebated covers to suit the span and any imposed load conditions specified, e.g. at road crossings. Provision shall be allowed for handling/removal of such covers. Pre-formed junctions and turn-outs shall be provided with suitable chamfers inside bends.

Transformer Bays

The dimensions and weight of the transformers are specified herein in order that access clearances and loadings may be determined. The transformer bases shall be located at ground level, accessible from a made up road or hard standing to the bays.

Each transformer bay shall be separately enclosed to prevent unauthorized access and be portioned by plain brick blast walls up to a height of 2.2m, with one side being fitted with full width, lockable open- mesh gates or louvred doors for access and ventilation. Where roof covering is necessary, it shall be of non-flammable construction and allow 800mm clearance at least for natural ventilation of the transformer.

The bay shall be sized at least 1.5m greater than the transformer width (across terminal boxes) and at least 1.0m greater than the transformer depth. A level concrete mounting ramp shall be located within the bay area suitable for rolling the transformer into position, and a pulling eye shall be fitted centrally in the rear wall at the ground level.

Provision shall be made for the oil to be conducted to underground drainage tanks having access for pumping out, separate tanks being provided for each transformer.

Cable ducts shall be arranged to suit the cable routes and have up-turned spouts projecting clear of the designed oil/pebble level for the bund.

Alternatively, the area surrounding the plinth within the bay, and enclosed after the transformer installation by a low bund wall if required, shall be excavated sufficient to accommodate 10% in excess of the transformer oil capacity when filled with fire quenching 50mm graded pebbles having 30% voids. Provision shall be made for drainage if accumulated rainwater.

For silicon cooled transformers of sealed construction, quenching pebbles will not be required, but an oil catchment area shall be provided where specified.

Earthing Connections

Two earthing connection tab shall be welded to the concrete reinforcing bars in the positions shown on the specification drawings and be incorporated in the concrete encased, reinforcing steel network of the building foundations. The network shall be not less than 30m in length, buried at least 1m below ground level. The total length may comprise more than one bar, welded together to form the required minimum length.

Each earthing tab shall be of hot dip galvanized flat bar steel 50mm wide x 6mm thick, attached by welding to at least two parallel reinforcing bars (9mm diameter minimum) and of sufficient length to project beyond the finished concrete surface by at least 100mm in an accessible position.

The welding shall be of good mechanical strength over the full 50mm tab width and shall be located within an area of the rebar not required to provide structural strength, such as a trimmer or surplus length of the bar.

The reinforcing steel of existing buildings may be used to provide the electrode for a new installation or to replace a damaged or deficient conventional earthing system. A substantial rebar of a main beam or column shall be exposed by chipping away its concrete cover. The earthing terminal plate shall be welded to the rebar and the removed concrete replaced by mortar.

t) Electric Actuators

General

Electric actuators shall be suitable for outside installation and all components shall be housed in waterproof enclosures to IP67 or better, which shall incorporate an anti-condensation heater.

The whole actuator shall be of easily maintained, robust construction and shall be sized to guarantee the penstock or valve opening or closing at the maximum differential pressure specified herein. The operating speed shall be approximately 300mm/minute unless otherwise specified.

All actuator component items shall be coupled via flanged mating faces secured by stainless steel bolts, except valve mounting fixings subject to thrust forces which shall be by means of suitably sized, high tensile steel bolts.

The gearbox shall be of the wormgear totally enclosed, oil bath lubricated type, having a cast iron enclosure suitable for operating at any angle and provided with the appropriate filling and drain plugs. The actuator drive bushing shall be easily detachable for machining to suit the valve stem or gearbox input shaft and the length of the drive nut shall be less than 1.25 x the spindle diameter.

The drive shall incorporate a lost motion feature to provide the additional torque required to unseat the valve from the 'Open' or 'Closed' position in the event of the valve being in either position for an extended period. This movement shall give a hammer blow of sufficient force to free the valve.

The output shaft shall be hollow to accept a rising spindle where appropriate, and incorporate thrust bearings of the ball or roller type. The design shall preferably permit the gear case to be opened for inspection without releasing the spindle thrust or taking the penstock/valve out of service.

Motors

All motors fitted to actuators shall be specially designed for the application and of the squirrel cage induction type for operation from the supply system specified.

The rated output of the motors shall be determined by the tenderer in relation to the requirement of the mechanical plant described elsewhere in this specification, and starting torque shall be at least 10% in excess of maximum service requirements.

The motors shall preferably be 4 pole 1440 revs/minute machines designed with adequate thermal capacity to ensure that the actuator and starter can adequately perform, without overheating, the number of successive opening and closing operations called for in the specific requirements, and in no case shall this number be less than three.

Each motor shall be fitted with a thermostat or thermistor arranged to stop the motor in the event of dangerously high temperature in the motor windings due to overcurrent or an abnormally high number of starts per hour.

Manual Operation Interlock

The actuator shall have a handwheel for manual operation which will be at standstill during motor operation. A lever shall be provided for engaging the handwheel drive, and this shall be interlocked so that when starting the motor the handwheel is automatically uncoupled without danger to the operator. Provision shall be made for the lever to be padlocked in either position to prevent hand or motor operation as required.

Position Monitoring

A mechanical position indicator, showing the open, closed or intermediate positions of the valve on a visible dial, shall be incorporated in the actuator housing. Alternatively, where specified, a continuous position indicator shall be provided.

Remote position indicators, where specified, shall be controlled from a suitable potentiometric drive arranged to provide a continuous proportional signal from 'Open' to 'Closed' positions.

Position Control

Where specified for control purposes, a current position transmitter shall be provided to give a positive 4- 20mA signal proportional to the valve position, and shall incorporate zero and span adjustments to suit the actual valve travel.

Torque and Limit Switches

All switches shall be accommodated within the actuator housing and all contacts and mechanism shall be of sealed, rustproof and robust construction and have a self-cleaning wiping action.

Adjustable torque limiting devices and switches shall be provided to trip the starter in the event of mechanism overload due to obstructions or jamming etc. They shall be mechanically latched to prevent torque tripping during unseating.

Limit switches shall be arranged to trip the starters when the 'fully open' or 'fully closed' positions are reached. Should the manufacturer consider it desirable (to ensure proper seating) the travel may be stopped in the 'fully closed' position by the torque limit switches, but in this case the 'fully closed' limit switches shall still be provided, although they will be adjusted to be inoperative.

Auxiliary Switches

Auxiliary changeover switches shall be provided to operate at each end of the travel, in order that they may be used for remote controls or indications monitoring the 'Open' and 'Closed' positions.

Terminal Facilities

All electrical components shall be wired out to terminal blocks in a common terminal chamber incorporated in the actuator housing but separated from all actuator components by means of a watertight seal.

Each terminal shall be labeled to correspond with the diagram of connections and shall be capable of accommodating not less than 2.5mm² copper conductors. AC and DC terminals shall be clearly segregated.

Terminal blocks shall comprise shrouded anti-tracking mouldings of melamine phenolic or comparable material with provision for securing conductors by screw clamp connectors or other vibration-proof devices.

The terminal chamber shall be provided with three tapped conduit entries, 1 x 32mm and 2 x 25mm ET or as otherwise specified. These holes shall be plugged with suitable plugs during transit and storage to prevent ingress of moisture or foreign matter.

Any conduit entries not used after cabling is completed shall be plugged with threaded aluminum blanks and the threaded joints made watertight by using suitable tape or jointing compound.

Starters and Control Gear

The actuator motor shall be controlled through integrally mounted electrically and mechanically interlocked contactors, rated for switching the motor direct on-line, adequate for the duty requirements and complete with all necessary auxiliary contacts for the functions specified herein.

The control circuit shall operate at 24V DC derived from a suitably rated transformer/rectifier with one side of the secondary winding connected to earth or as otherwise specified. Primary and secondary windings shall be protected by cartridge type fuses.

The method of control and operation shall be as called for under the specific requirements and the actuator shall be provided with any facilities called for therein to suit the method of control, whether this be automatic or by hand. Local controls integrally mounted on the actuator shall consist of push buttons for 'Open', 'Close' and "Stop" functions, together with a Remote/Off/Local selector, lockable in all positions. The "Stop" button shall be effective in both local and remote settings and operate directly on the contactor control circuit.

Facilities by means of volt-free contacts shall be provided for remotely monitoring:

-
- motor running
 - actuator is available for remote operation
 - actuator is opened and actuator closed.

Paint Finish

The finish colour shall be gloss, Crimson, Colour No 540 to BS 381C (or 04 D 45 to BS 4800).

Actuator Isolators

The switch shall have a slow make and break mechanism of the two position rotary pattern arranged to isolate the 3 phase supply and all other control circuit supplies to the actuator. The ratings and number of poles required for each duty shall be as detailed in the specific requirements, the isolator rating being based on the actuator average load current being switched normally off-load, but emergency on-load.

Each switch shall be incorporated in a heavy duty, hoseproof, cast aluminum enclosure to IP65, having external fixing lugs and adequate seals and drip shields on the operating shaft and cover. Austinlite rotary type EXO 190 or equal.

Switch positions shall be 90 apart, clearly and permanently inscribed or embossed as 'OFF' and 'ON' on the cover, and the switch handle shall incorporate provision for the switch to be padlocked in both the 'OFF' and 'ON' position. The 'OFF' position to be to the left of centre or vertical, the 'ON' position to the right or horizontal.

It shall be possible to remove the switch cover for access to the terminal without disturbing the switch or its mounting base. The enclosure shall be suitable for mounting on, or adjacent to, the penstock pedestal. If mounted on the penstock pedestal, cabling between the isolator and the actuator above may be arranged through conduit connections, suitable for disconnection should it be necessary to remove the actuator assembly complete.

(This item preferably to be provided by the contractor who is responsible for the cabling).

u) Miscellaneous Equipment

Warning Signs

'Automatic Plant' warning signs shall be provided and erected by the Contractor in the building or on the plant in a prominent position to be agreed.

The 500mm x 300mm x 0.7mm (22SWG) signs shall be located approximately 1.6m above the adjacent floor level to the sign centre.

The sign shall be off 22swg, vitreous enameled aluminum sheet or plastic, having black letters on a yellow background, (see Appendix 5) inscribed as follows:

CAUTION

PLANT UNDER AUTOMATIC CONTROL

AND LAIBLE TO START WITHOUT WARNING

ISOLATE AT SOURCE BEFORE ATTEMPTING ANY

MAINTENANCE OF MECHANICAL AND ELECTRICAL PLANT

Equipment for Potentially Explosive Atmospheres

Equipment for use in potentially explosive atmospheres shall be selected and installed in accordance with BS 5345, subject to the temperature classification of the specified gas, vapour or liquid. Ex(d) and Ex(i) classified equipment shall be certified for Apparatus Groups IIA and IIB.

In such areas, aluminum and other light metal alloys shall only be used for enclosure of electrical apparatus and fittings where such enclosures conform to the material requirements of BS 5501 Part 1.

Aluminum and light metal alloy fans on motors may be used if adequately protected, or if plastic fans or cowls are used they shall be of anti-static material.

Where no British Standard is applicable, equipment to an equivalent European standard may be submitted, subject to the approval of the Engineer.

Field Mounted Equipment

Individual starters, fuse-switches, distribution boards and other equipment shall be housed in robust, heavy gauge, rustproofed, metal-clad enclosures having external fixing lugs except where otherwise specified.

Components, fittings and housings shall be as specified elsewhere in this specification.

Equipment housings shall be mounted such that the terminal and covers are readily and safely accessible and are not obstructed or affected by the adjustment or mounting arrangement.

Push button stations shall be single or composite units suitable for accommodating the required buttons in the above enclosures. Each button top shall be fitted with a durable protective flexible boot.

Junction boxes shall be equipped with rail-mounted, deed-through terminals adequately sized to accommodate the cables to be terminated. An earth connection facility shall be provided for each box.

Auxiliary switches shall be mechanically and electrically suitable for the duty and circuit operations specified herein and intended by the switch manufacturer. Roller-lever operated switched shall be of the snap action type.

Where employed for crane or gantry duty, spring failure within a limit switch shall not render it inoperative.

Handgear interlocks shall be fitted to any driven equipment which has provision for manual operation to ensure that it is not possible for drives to start with the handgear in position.

Heavy Duty Electrodes

Each electrode shall comprise a single element mounted in an insulating high impact phenolic moulding, impervious to corrosion and having separate fixings for the flange mounting base and for the cover.

The base shall have a 20mm screwed conduit entry and be suitable for accommodating the electrode length by means of a substantial clamping collar which shall also have a provision for terminating the cable conductor.

A sealing gasket shall be fitted between the base and cap and the whole head shall be sealed to prevent ingress of water after installation is completed.

The electrodes shall be formed of ¾" BSP galvanized steel tubes (approximately 27mm diameter) sealed at one end and cut to suit the specified length, cut ends being dipped or coated with galvanizing paint or similar. Where intermediate steady brackets are required or when otherwise specified, the electrodes shall be sheathed with an insulating material to within 150mm of the electrode tip.

Spacing between electrodes and to the adjacent wall shall be not less than 150mm.

Light Duty Electrodes

Each electrode shall be mounted in an insulating moulded body having a 20mm screwed conduit entry and a screwed cover such that the whole head may be sealed to prevent the ingress of water after installation is completed.

The electrodes shall be formed from not less than 6mm diameter stainless steel rod and should not exceed 1.5m in length for light duty applications. Spacing between electrodes and to the adjacent walls shall be not less than 100mm.

Electrode Circuits

All electrode circuits and components shall comply with BS 5345 and the BAASEEFA requirements for intrinsically safe system for Apparatus Groups IIA and IIB.

The system shall operate by the circulation of an AC current when the circuit is completed by the liquid coming into contact with the electrode, this current operating a

relay to initiate the events specified herein. The relay operation shall incorporate a five second time delay 'On' and 'Off' to allow for spurious initiation.

Intrinsically safe electrode circuits shall be completed by a separate return electrode for each circuit.

Electrode Mounting

The electrode heads shall be mounted on a suitable support bracket at a height well above the expected maximum water level as shown on the specification drawings.

Intermediate steady brackets shall be provided and fitted for every 2m of electrode length, insulated lengths of electrode being fitted where these are used.

Support Brackets and steady brackets shall be hot dipped galvanized to BS 729 or otherwise protected to prevent corrosion.

Emergency Lighting

Emergency lighting shall be provided to maintain sufficient illumination in accordance with BS 5266 for escape routes within the building during mains supply failures.

The luminaries shall comprise at least a single 8w fluorescent tube with a solid state changeover circuit and high efficiency, high frequency, inverter all contained within a die-cast aluminum bulkhead body, having a corrosion resistant, stove enamel finish. The diffuser shall be of unbreakable, opal polycarbonate material, secured by an oil and water proof sealing gasket to result in a laminate rated to IP65.

The luminaries shall be self-contained and shall incorporate a maintenance free, nickel cadmium battery, capable of preserving the light output for a period of at least 3 hours without mains supply, together with an automatic recharging circuit to restore the charge within 24 hours of total discharge. Each luminaire shall incorporate an indicator to show that the charger circuit is healthy and have a hinged gear tray and fused terminal blocks.

The luminaries shall be either of the following forms, as detailed in the Specific Requirements:

- maintained from, normally lit from the mains and automatically switched from mains to battery during mains failure;
- non-maintained form, energized automatically from the battery supply only when the mains fails and the associated local lighting circuit is switched on;
- sustained form, having two lamps, one of which is mains fed only, the other operating from the battery supply during mains failure.

LV Outlet Transformer

Isolating transformers shall be of air cooled, double wound construction in accordance with BS 3535, fitted with an earthed metallic screen between primary and secondary windings and suitable for operation from a 220V 50HZ single phase supply.

The secondary winding shall have a rated output of 100VA continuous (1500VA intermittent tool rating) at 110V and have a centre tapping connected to earth.

The transformer shall be enclosed in a wall mounted sheet steel or moulded casing with external fixings lugs and separate cabling connections. The secondary output shall be via fuses incorporated in the enclosures.

Water Heater

Single point water heaters shall be thermostatically controlled free outlet 'single point' heater suitable for wall mounting. The water inlet shall be 0.5" BSP fitted with a control tap and the outlet swivel spout shall have a reach of approximately 300mm. The heater shall have a capacity of approximately 1.5 gallons (7.0 litres) and an electrical loading of approximately 3kW.

Space Heater

Wall mounted single tier tubular heaters rated at 250 watts/metre and suitable for 220V operation shall be provided.

The heaters shall be mounted approximately 300mm above floor level in the positions indicated on the drawings. They shall be directly connected to heater circuits controlled by the room thermostat, the final connection to the heaters being made by means of flexible conduit and a protective conductor. The flexible conduit shall enter from below the heater.

Space Heater Thermostat

The thermostat shall be a surface mounting 14 Amp bi-metallic strip type, adjustable over the range 0- 30°C and lockable to prevent unauthorized adjustment of the setting.

The room thermostat shall be mounted approximately 2.0m above floor level in the position indicated.

Electric Trace Heating

Heating cables shall comprise a self-regulating, conductive polymer core or double heating elements within a waterproof outer PVC sheath having sealed ends with a cold lead at one end. The cable shall have a flat section to provide efficient heat transfer.

The cable shall be straight laced along the underside of pipes and secured with cable ties at 300mm spacing or be spiraled around the pipe and secured at each end.

All heating cable must be in intimate contact with the pipe and must not be overlapped on itself, additional ties being positioned on either side and close to all flange joints. To avoid mechanical or leakage damage, the cable shall be run over the sides of flanges at 90° to the invert on horizontal pipe runs.

After any thermal insulation has been fitted, wiring labels shall be fitted in prominent positions in the pipework to indicate the presence of trace heating.

Trace Heating Thermostat

A wall mounting, air sensing thermostat set at 5°C shall be provided and arranged to switch on the heater for frost protection. If non-self-regulating heating tapes are used and where lagging is applied, or on PVC pipework, a thermostat shall be located on the pipework and arranged to switch off the heater if the temperature exceeds 60°C.

Liquid filled sensing bulbs and capillary tube connections to the thermostat shall be of stainless steel with a stainless steel flexible sleeve fitted over the capillary tube for mechanical protection.

The air measuring thermostat shall be mounted on the outside wall, 600mm above ground level and adjacent to but not above the protected pipework.

Enclosure and terminal arrangements to be as specified for field mounted equipment.

Lightning Protection

The building shall be protected against lightning strikes by a system consisting of an air termination network, down conductors and a ground termination network. Ground Termination shall be achieved by installation of electrode rods (in pits) connected via tape tails to the bottom of the down-conductor.

The installation shall be complete with a binding connection taken from a down-conductor position to the building main earth terminal bar.

The protection system shall be designed and installed in accordance with BS 6551 by a specialist contractor; with horizontal conductors on the outside walls of the structure.

All metalwork on or around the structure shall be bonded to the lightning protection system. Where connection between dissimilar metals are made, precautions shall be taken to prevent corrosion.

The horizontal and down conductors shall be of 25mm x 3mm copper strip, fixed with leaded gunmetal clamps, secured by phosphor bronze screws or bolts. Each down conductor shall take the most direct route from the air termination network to the earth termination and be provided with a bolted test joint in a position accessible from the ground level.

Earth electrodes of 16mm² copper bonded, steel cored rods shall be driven into the ground as close as practicable to the structure at the end of each down conductor. The rods shall be installed in sections connected by screwed couplers and driven to a depth sufficient to achieve a resistance to earth such that the whole of the lightning protection system shall have a combined resistance to earth not greater than 3 Ω ohms. The screwed couplers shall be long length aluminum bronze material, counterbored to protect the threaded ends from damage and corrosion.

v) Mobile Plant Components

Crane Controls

The electrical controls shall be designed to prevent excessive acceleration, retardation, skidding and load swinging and all motions of the crane shall be arranged to be switched through the slower speed where provided.

The control circuits for the crane/hoist shall operate at not more than 110V and be derived from a double wound, screen earthed isolating transformer with one side of the secondary winding connected to neutral/earth. The primary supply shall normally be from the phase conductors.

Fuses shall be provided on each primary and secondary supply and be clearly labeled and segregated. A link shall be fitted in the neutral/earth connection.

Pendant Controls

A heavy duty, industrial pattern pendant push-button control station shall be provided, having sets on non-maintained push-buttons for each hoist speed and function specified.

Each set of buttons shall be electrically and mechanically interlocked so that conflicting operations are prevented and only one function can be initiated at one time. The push-button enclosure shall be of a tough neoprene rubber suitable for withstanding arduous duty and provide full electrical safety, each button being suitably labeled with its function.

The pendant shall be divorced from the crab and capable of independent cross travel. It shall be suitable for vertical adjustment for operation from alternative levels by means of spring loaded reeling drum fitted with a ratchet device or motor driven reeling drum and have a cable guide runner to assist re-coiling.

Pendant control cables shall be designed for reeling drum application and have stranded copper flexible conductors, ERP insulated 300/500V, multicores laid-up with an internal central textile strain carrier and heavy duty, textile braid reinforced, PCP sheath.

For non-reeling applications, the outer sheath may be flexible PVC, incorporating externally laid, galvanized steel, nylon coated strainer wires.

w) Enclosures

Definitions

The generic term enclosures shall be taken to mean any housing which encloses overall any items of plant or equipment. To distinguish between the different forms of enclosure, the following definitions shall be used.

- Cabinets will be regarded as any wall or pedestal mounted thermally controlled enclosure.
- Kiosks shall mean any floor standing, thermally controlled, overall enclosure which may incorporate either an integral base or use the ground or floor slab as the base of the enclosure. The Kiosks shall be sized to permit man access for servicing the equipment within.
- Shelters shall mean overall floor standing housing providing general weather protection without sealing or thermal control.
- Housing shall mean the specific enclosure without thermal control for items of equipment, either located externally or within another enclosure.
- Compounds shall mean areas enclosed by fencing or walls but generally exposed to the weather.

General

All cabinets and kiosks shall be fully weatherproof enclosures to IP55, manufactured from maintenance- free, resin bonded, glass fibre reinforce, polyester (GRP0 inner and outer skins, encapsulating not less than 12mm plywood reinforcement and insulation to give 'u' value of at least 1.5W/m²C. The doors shall have flexible neoprene seals.

All cabinets, kiosks and shelters shall have doors incorporating steel reinforcement for rigidity and self- locking stays to maintain the doors open to at least 90°.

Door hinges shall be black epoxy coated, vandal-proof pattern with stainless steel pins. Locking door handles shall also be black epoxy coated steel with stainless steel cam action locking plates.

Where double doors are provided, shoot bolts shall be fitted to the top and bottom of the left hand door, central dead-locking of latch to right hand door to incorporate a security keyed 'Yale' type lock to suit local key or other specified standards.

The closing edges of the doors shall have an external or internal overlap for weather sealing.

Ventilation to kiosks and shelters shall be provided either as under-eaves or via high level louvred vents protected by affine mesh stainless steel/aluminum insect screen. Ventilation provided shall be equivalent to a 10mm continuous gap around the enclosure perimeter.

The interior shall be finished with white based abrasion resistant vinyl paint. The exterior finish shall be GRP coloured Dark Green to BS 4800 (14 C 30) unless otherwise specified.

Cabinets

Wall mounted equipment cabinets shall have external fixing lugs and have removable gland plates fitted to the base for cable or pipework entry.

All cabinets shall have mounting rails bonded to the rear wall to facilitate equipment fixing and have an anti-condensation heater fitted. Outdoor mounted cabinets shall have a rear sloping top and a 50mm projecting drip canopy above the access door.

Inspection windows of toughened glass secured in a rubber basket shall be provided where specified.

Kiosks

Where control panels are to be protected in outdoor locations they shall be enclosed in a cross ventilated weatherproof kiosk, sized to allow at least 1.0m clear working space in front of the panel. Battens shall be mounted to the inside walls to provide fixings for internal equipment and fittings.

The kiosk materials shall have a ½ hr fire resistance rating for retention of stability, integrity and insulation in accordance with BS 476 Pt 8.

Sectional kiosk shall be pre-assembled and fully sealed before delivery to site.

Fixing holes shall be provided in the base sections and the whole unit shall be fixed and sealed to the concrete base by means of a mastic compound applied before and after the kiosk sections are in place, to prevent ingress of moisture.

Kiosk shall be fitted with:

- A suitable corrosion proof fluorescent light fitting, not less than 60 watt, so arranged to illuminate the face of the control panel complete with MK ‘Seal’ On/Off switch inside the kiosk, wall mounted adjacent to the kiosk door, and wiring.
- A suitably rated anti-condensation heater complete with thermostat, On/Off switch and wiring.
- All electrical fittings to be connected by wiring in surface mounted PVC conduit to a 2 way metalclad consumer unit.

When space for the metering equipment and cut-outs is specified, a separate section within the main frame of the kiosk is to be provided complete with fire resistant chipboard panel. Details of size required and position in relation to the panel are to be obtained from the appropriate Electricity Supply Authority.

Where specified, a lockable hinged door shall be provided to enable the meters to be read from outside the kiosk.

Where and external generator connection is specified, a small door or ‘cat-flap’ shall be fitted opposite the panel mounted appliance inlet to provide access for a generator cable and connector. The door shall be large enough to pass the connector and it shall be horizontally hinged at the top. Outward opening and lockable with a suitable padlock.

Shelters

Protection for plant requiring limited attention shall be of maintenance free materials, single skin GRP insulated panels or hot dipped galvanized steel panels with plastic skin external coating and alkyd paint interior. The shelter shall provide a degree of protection to IP44.

Housings

Field mounted electrical components and junction boxes shall be heavy duty industrial type, accommodated in totally enclosed hoseproof housings to IP65, of die cast, cast aluminum or rigid non-ferrous/polycarbonate materials having tapped conduit entries and recessed neoprene gaskets to seal the covers, the cover and housing fixings being outside the sealed area of the box.

1104 Mechanical Works

General

Materials

Any non-metallic materials such as may be employed for bellows, packing or sleeves, coatings or linings etc. liable to contact with potable water shall be approved for the purpose by a recognized approval body.

Materials in Contact with Sewage

Materials in contact with sewage shall be suitable for the environment but particularly all bronze materials shall be true bronze (i.e. zinc free) alloys.

Indicator Gauges

All gauges shall be constructed with non-corrodible metal cases and stainless steel bezels. They shall be located to enable easy readings by the plant operator and mounted to preclude damage due to vibration. The cases shall be at least 50mm diameter, unless otherwise specified, scaled in metric units and normally ranged over a 240° arc from zero to 20% - 40% above the system designed operating value for full load conditions; except where finite limits exist, e.g. level/contents gauges which shall be ranged 0-100%, or where restricted ranges are specified.

A schedule of gauges shall be provided for approval, detailing arrangements, scale ranges, designation label inscriptions and any alarm contacts.

Labels shall be securely attached on or adjacent to each gauge and groups of any such instruments shall be of matching appearance and approved layout.

Pressure gauges shall be of the Bourdon tube or diaphragm type. Each gauge shall incorporate a surge damping device and be fitted with its own stainless steel isolating cock.

Pressure gauges incorporating transducers for remote monitoring shall be damped to provide a steady output. The pressure at the tapping point shall give a direct indication on the gauge as well as driving the transducer. Any alarm contact settings shall be independent of the transducer function and nether shall interfere with the direct gauge indication.

Temperature gauges shall be of a type suitable for the application with the sensing element mounted within a thermal well. Where specified, the maximum working temperature under full load conditions shall be marked by means of a preset red pointer.

Pumping station water pressure gauges shall have a dial diameter of not less than 100mm and be calibrated in metres head. The gauges shall be uncorrected for datum and show actual pressure at the tapping point. The label bearing the designation given in the gauge schedule shall include the Ordnance Datum level of the tapping point.

Pump delivery and station delivery pressure gauges shall be mounted at a convenient height for reading on a gauge board of varnished hardwood, 20mm marine plywood or equivalent non-corrodible material with stainless steel capillary pipework, having an isolating cock at each end connecting the pressure tapping bosses and shall be adequately supported.

Fasteners

All bolts, nuts, and studbolts, including those required for installation at terminal points to existing equipment, shall be provided by the Contractor and shall have metric threads to BS 3643.

After tightening, the minimum engagement of the thread shall equal the thickness of the nut. The projection of the head beyond the outer face of the nut shall not exceed one quarter of the outside diameter of the thread. In no circumstances shall galvanised or coated bolts be shortened by cutting.

ii) Washers shall be provided under all nut and bolt heads.

All fastenings and accessories in contact with the process water shall be of stainless steel, cadmium plated mild steel or other corrosion resistant material subject to the approval of the Engineer. All bolts, nuts, screws, washers and other fixings for anchoring the plant to walls, floors, ceilings, etc. shall be of corrosion resistant material or shall have a protective surface treatment to the approval of the Engineer.

All bolts in inaccessible positions shall be secured by either self locking nuts, spring washers and nuts, or castle nuts with split pins. Fasteners associated with items requiring removal during routine maintenance shall be of stainless steel. All other items shall be sheradised or hot dip galvanized in matched condition.

All holding-down or foundation bolts shall be supplied and shall be complete with hexagon nuts and washers. Bolts of steel round bar formed into a loop at one end are not acceptable.

iii) Fastenings to Concrete or Masonry

Anchor bolts for the fixing of small items shall be of the torque-expanded type of approved make, installed strictly in accordance with the manufacturer's instructions. The size of hole required in the Civil work shall not exceed 38mm.

Where the base material will not withstand the expansion stresses imposed by the torque-expanded type or where the highest degree of resistance to vibration is required an approved type of chemically bonded anchor bolt may be used.

The minimum distance from any concrete edge shall be 100mm for expanding type fixings and 75mm for embedded bolts.

iv) Baseplates

Separately mounted items of plant which are required to maintain an accurate alignment shall be mounted on a common baseplate, together with all associated items and guards.

The baseplate shall be of rigid construction, machined on all mating surfaces and drilled for foundation fixings. Machined datum faces shall be provided and leveling facilities incorporated in the underside.

Provision shall be made for the easy removal of any section of the drive and positive re-alignment using dowels or other approved means. Shims and packings shall be kept to a minimum and clearly identified for re-assembly.

All drain points on the assembled plant are to have easy access and drain piping shall extend beyond the baseplate.

v) Provision for Handling

Suitable provision approved by the Engineer shall be made by the Contractor to facilitate the handling of all items in excess of 36kg.

Any item weighing one tonne or over and which may be required to be lifted during operation and maintenance shall be appropriately marked with its weight.

vi) Protection of Moving Parts

All moving parts where accessible to operational personnel shall be protected and guarded to meet relevant regulations. All guards shall be designed to facilitate easy removal.

vii) Balancing

All rotating parts of the machinery shall be statically and dynamically balanced unless otherwise agreed in writing by the Engineer. The complete rotating assembly shall be designed such that any critical speeds are outside the duty running speed range of the machine.

viii) Lubrication

Any components requiring manual lubrication shall be provided with greasing nipples of an approved type mounted on a panel and identified.

A remotely mounted electrically operated lubricator of approved type shall be provided to serve components, if any, requiring continuous lubrication by external mechanical means.

The lubrication tubes, if any, shall be of approved material suitable for high pressure use. The

Contractor shall include for all grease and oil required for testing at works and site.

The first filling after tests shall be provided by the Contractor who shall submit details of his recommended lubricants, which shall be available from any of the major oil companies, for approval by the Engineer.

All bearing surfaces shall be properly charged with grease before the plant is operated.

ix) Nameplates and Labels

Instruction plates, name plates and labels shall be provided for all items of the plant giving particulars of duty, size, serial number and full information for identification and operation. Their construction and engraving shall be to the Engineer's approval.

x) Plant References

After final painting, all plant items shall be identified by a unique reference character as detailed on the specification drawings or otherwise specified. Such references to be affixed in a prominent position on the plant body with characters not less than 100mm high or as otherwise specified. Characters shall be bold capital letters and/or numerals. The abbreviation 'No' shall not be used.

Unit references shall include any associated main and auxiliary drives shall follow a logical sequence bases on layout or history. In any particular installation, a set of similar duty drives where any number of units may run shall be suffixed 1, 2, 2,3, 4 etc. whereas alternative drives for the same duty where only one unit may run (i.e. duty/standby) shall be suffixed A & B.

xi) Tools and Tackle for Maintenance

The Contractor shall supply a complete set of any special tools and other equipment necessary for the dismantling, re-erection and adjustment of the plant.

The tools provided shall be in new condition, adequately labeled as to their use and contained in stout and suitable padlocked boxes. The Engineer's instructions as to who shall be the recipient of the tools shall be sought before delivery is made.

Any special slings required shall be provided and clearly marked by embossed labels to show safe working loads. Test certificates shall be provided where applicable.

xii) Locks and Keys for Mechanical Plant

All locks of the same size shall be of the same type as manufacture but having different keys. Three keys shall be provided for each lock.

Each key shall have prominently attached to it an embossed brass label stating the following:

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- Key number;
 - Location of lock/Item of equipment.

xiii) Noise Level

All plant shall run without undue vibration and with the least practicable amount of noise. Vibration levels shall not exceed these set out in ISO 2372 for the particular type of equipment.

Any items of plant which produce a noise level exceeding 65 dB (A) at 3 metres shall be listed by the Tenderer. It shall be deemed that all items of plant not so listed have a noise level of less than 65 dB (A) at 3 metres.

To meet the environmental requirements, the Contractor shall provide all necessary equipment to meet the following conditions, based on the site layout shown on the specification drawings and with 75% of the plant running simultaneously:

- the noise level generated at the site boundary by any new plant shall not exceed that generated by the existing plant;
- the noise level at 100m from the source does not exceed 65dB (A);
- the noise level in the building (10m from the source) does not exceed 80 dB (A);
- the noise level in the plant room (5m from the source) does not exceed 80dB (A);
- warning notices shall be provided at all entrances to rooms where the noise level will exceed 75 dB (A).

xiv) Frost Protection

The plant shall be adequately protected against damage from freezing, using an approved means of insulation.

Particular attention shall be given to pipework, pump casings, etc. and any part of the plant and equipment likely to stand for periods charged with static water.

Where lagging is used, it shall be suitable for outside installation and completely impervious to all weather and atmospheric conditions on the works. Lagging materials containing asbestos shall not be used.

The lagging shall be sectional and easily removed for maintenance purposes. Joints shall be sealed together with an approved waterproof adhesive tape.

Areas where lagging may be vulnerable to damage shall be suitably protected by an approved means.

xv) Corrosion Protection

Where dissimilar metals are in contact or close proximity and corrosion may occur through electrolytic action or differences in electrical potential, protection shall be afforded by electroplating, suitable gaskets, cathodic protection or other means approved by the Engineer.

Chromium plated parts shall not be used on sewage works or in any other damp or corrosive atmosphere.

All surfaces shall be adequately protected in transit, and any damage shall be removed immediately on off-loading and on completion of erection.

After cleaning and inspection but before the plant leaves the Contractor's works, the machined surfaces of steel and ironwork shall be covered with preserving fluid of an approved type, or otherwise protected to the Engineer's satisfaction.

All external steel screw fittings shall be supplied in the galvanized condition, stainless steel, or sheradised to comply with BS 4921, Class 1 or Class 2 with passivation treatment.

xvi) Surface Preparation and Painting

The whole preparation and paint system shall be suitable for operating environment specified and a painting schedule giving details of preparatory treatment, types of paint, number of coats and method of application shall be submitted with the Tender. (See Particulars of Plant).

Proprietary items may be used in their standard finish subject to the approval of the Engineer. For specified applications, adequate supervision shall be provided for all stages of preparation, application and testing.

All steelwork shall be protected in accordance with BS 5493 and based on a 'long' time to first maintenance. The exterior environment shall be regarded as 'polluted inland' (Table 1 Pt. 2) and the interior environment shall be regarded as 'frequently damp' (Table 1 Pt. 7) unless otherwise specified. Items below water level or subject to immersion shall be treated as Table 1 Pt 8.

After all machining, forming and welding has been completed, all steelwork surfaces shall be thoroughly cleaned of rust, scale, welding slag or spatter and other contaminations prior to any painting.

The system proposed shall be abrasion resistant and conform to the following typical requirements. Preparation of steelwork at the works shall be either:

- Hot dip galvanized to BS 729 with a median thickness of 85 microns (0.0034"); or
- Grit blasted to BS 7079 Grade SA 2.5 and zinc sprayed within 4 hours to BS 2569 Part 1 to a thickness of 125 microns (0.005") followed by one coat of approved etch primer.

Typical finishes (with compatible primers) based on BS 5493 are given below: Steelwork and ferrous castings exposed above water/sewage level

Either high build micaceous iron oxide or chlorinated rubber to give a minimum total dry film thickness of 300 microns, or one coat of two pack epoxy primer and further coats of epoxy paint to give a total dry film thickness of 270 microns;

xvii) Steel work below water/sewage level;

Either epoxy system as above or coal tar epoxy paint system to give a minimum total dry film thickness of 450 microns;

Ferrous castings and fittings without substrate below water level.

Coal tar epoxy paint system to give a minimum total dry film thickness of 450 microns. These coatings shall be subject to the Holiday Test.

The surface of all non-ferrous parts usually painted shall be cleaned, rubbed down, stopped, filled and given one priming coat of paint.

Anti-corrosion coatings used for any steel or iron used in pipework, pumps, valves, etc. in contact with potable water, shall either be a compatible bitumen material to BS 3416 or a polymeric anti-corrosion coating complying with Water Industry Specification WIS 4-52-01.

Any damage occurring to any part of a painting scheme shall be made good to the same standard of protection and appearance as that originally employed. Any finish coat applied onsite shall be considered for decorative purposes only.

Manufactured articles to be galvanized shall be hot dip galvanized after complete fabrication and no bending, cutting, drilling, riveting or threading shall be permitted after galvanizing.

The care of galvanized articles when transporting, storing and erecting them shall be in accordance with the recommendations of BS 729. The renovation of small areas of damaged coating not exceeding 40mm² shall be in accordance with Appendix D of BS 729 and subject to the Engineer's approval.

xviii) Paint Colours

The colours of the primer, intermediate and finishing coats of a paint system shall be easily distinguishable from each other, and the materials used shall be suitable for the method of application and preferably be supplied by one manufacturer who shall ensure that all coatings are compatible.

x) Electromechanical items

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Pump Duty

Pumps shall be of the type specified and arranged as indicated in the Specification Drawings and shown on schedule of pumps. They shall be designed to give specified output against all losses including those relating to the pump.

The Contractor shall match his pump characteristics to the pipe system network to achieve high pump efficiency and reliability.

Each set must be capable of running satisfactorily in parallel with other sets in the system without throttling and by itself, without cavitation or overload under all operating conditions within the system characteristics given.

The pump section and arrangement shall be such as to ensure that the head available exceeds the N.P.S.H. requirements of the pump under all operating condition.

Where the system and pump characteristics are such as to give rise to the possibility of surge in the pipeline with consequential damage, a surge investigation shall be undertaken if the results of the investigation show that there is a problem. Measures shall be proposed by the Contractor to alleviate the problem. These measures shall be agreed with the Engineer.

Centrifugal pumps shall be capable of withstanding without detriment, reverse rotation to a speed that would occur if the pump were to stop when the differential head was at a maximum and the delivery and/or non-return valve failed to close.

For submersible pumps the ability to operate with the maximum reliability is of prime importance, with efficiency being a paramount consideration. The pump shall therefore operate without clogging, being designed to pass a sphere of 125 mm diameter where the size of the delivery mains permits. Whilst the pumps shall be designed to meet a specific duty they shall also be capable of operating over the duty range specified for prolonged period and for standing idle for long periods without attention as in the case of storm pumping.

Centrifugal Pump Casings

Pump casings shall be of the volute type and shall be capable of withstanding all pressures which may be produced due to operating pressure surges.

Particular attention shall be paid to the wear characteristics of the pumps. In the case of submersible pumps, due to the presence of grit in the water, could be appreciable.

The pump design shall ensure that alignment is maintained between the various assemblies by recesses, spigots and dowels and shall be such that all components liable to wear can be replaced.

Components shall be permanently marked with the manufacturer's number and where dowels are not used, permanently marked for correct assembly. The pump casing and the pump impeller should normally have detachable wear rings.

The casings of the pumps shall be of a suitable grade of close-grained grey cast iron or nickel iron and have flanges to match the specified pipework.

The waterways through the pumps shall be smooth in finish and free from recesses and obstructions.

Sewage pump casings shall be of substantial construction to give long life under abrasive conditions and suitably stiffened to withstand shock due to solids in suspension. Inspection holes shall be provided in any section bend and in the pump casing above the impeller for access to facilitate the clearance of obstructions. The inspection hole covers shall be shaped to conform to the interior profile of the waterway when in place and shall be fitted with starting screws where necessary.

Impellers

Impellers shall be securely fitted to pump shafts in such a manner to prevent them becoming loose or detached when the pump is in operation, or when rotating in the reverse direction, either by liquid flow or motor rotation.

The impellers and guide vanes (if any) shall be manufactured from a suitable material, accurately machined and smoothly finished to minimize hydraulic losses.

The rotating elements shall be statistically and dynamically balanced before final assembly. The impeller shall be readily withdrawable from the pump casing without the need to disconnect pipework.

For submersible pumps, the impeller shall be of the open type with the inlet ends of the vanes being of bulbous design and the impeller passages being as large as possible consistent with good performance.

The inlet ends and surfaces of the vanes shall be dressed to give a smooth finish to prevent fouling by rags and fibrous matter within the pumps.

Impellers for both submersible and storm water pumps shall be of the non-shrouded type, constructed normally of close-grained grey cast/nickel-iron, and designed to exclude gritty matter from the shaft and gland.

Clearance at the eye rings and wear plates shall be kept to a minimum, and where it is found necessary to cut back the impeller this it be done on the vanes only.

Pump Shaft

The pump shaft shall be of high tensile or stainless steel adequately sized, with good fatigue, shock load and corrosion resistance. The duty speed range shall be well below the first critical speed of the shaft. Where a change in diameter of the shaft occurs the shoulder shall be radiussed or undercut to the appropriate BS to reduce stress concentration.

The shaft shall be complete with easily renewable steel protecting sleeves at glands and bearings.

Shaft Seals

Pump shaft sealing arrangements shall be suitable for the water pressures and shaft speeds involved.

Pumps fitted with soft re-packable or packed gland type, seals shall have stuffing boxes designed to facilitate adjustment of the packing materials.

Pumps shall be fitted with a split type mechanical shaft seal arranged such that replacement of wearing components can be carried out without the need to dismantle the pump.

Special care in the selection of materials shall be taken in order to avoid binding and electrolytic action between the shaft sleeve and the mechanical seal components, particularly where long periods of idleness are inherent in the duty cycle as in the case of standby and storm pumping.

Bearings

All pumps shall incorporate bearing arrangements which prevent the escape of lubricant into the liquid being pumped. The bearings shall be located in dust/moist-proof housings.

All bearings shall be liberally rated to ensure cool running and meet the load factors specified.

For vertically mounted pumps, the top bearing shall be a combined thrust and journal type, designed to prevent any thrust loads being transmitted to the drive motor. The pump bottom bearing shall be lubricated by an enclosed water lubricated sleeve bearing for potable water applications by grease or other approved means for sewage use. Storm pump bearings shall also be suitable for standing idle for periods of up to 2 months without attention or movement.

Where grease points are necessary they shall be fitted with removable screwed plugs which shall be accessible without removing guards. All bearings having automatic lubrication shall also have provision for hand lubrication.

Baseplates and Stools

For vertical pump units, heavy cast iron or fabricated steel floor plates and motor stools shall be provided for direct mounting in concrete floors or supporting steelwork. Suitable journal and thrust bearings shall be provided in the baseplates to carry out the vertical drive shaft.

Where necessary the motor stools shall be designed to accommodate flywheels and bearing housings.

Floor plates shall be recessed and so arranged that the tops and fixing bolts are level with the finished floor.

The pump units shall be accurately aligned and located on baseplates by set screws and parallel dowels

Lubrication/Cooling Monitoring

A lubrication system shall be arranged for the lubrication of all grease points on the pumps and shafting from motor room level. Individual bearings within the support tunnel tubes and on the pump sets themselves shall receive separate supplies of grease fed by pressure tubes laid from each bearing to battery plates readily accessible from motor floor level for grease gun operation.

Pressure tubes shall be grouped together where possible and securely attached by brackets, straps, etc. to tunnel tubes, with connectors located near to the motor support plate for easy removal of shafting in the event of maintenance work. In exposed positions pressure tubes are protected from damage. Motor grease points will not be included in this lubrication system but shall receive individual attention.

The battery plates shall have sufficient greasing points for all bearings to be located on or adjacent to each pump motor stool.

A notice is to be supplied and fixed on the wall in a prominent position detailing the manufacturer's recommended greasing schedule. The notice shall include a warning of the dangers to bearings from 'over greasing'.

A grease gun shall be supplied for all greasing purposes.

Bearings which require a continuous supply of lubricant shall incorporate a means of monitoring such a supply, either by flow or temperature rise as appropriate for the type of bearing employed; separate monitors being fitted for each bearing feed or housing.

Such monitors shall include all necessary ancillary power of pulse counting devices to enable the operation of any monitor to initiate a volt free contact rated at 240V 0.5 A AC.

Pump Tundish

Where specified, each pump shall be equipped with a cast aluminum or fabricated steel tundish to accommodate the drain lines from mechanical seals, casing vent and other minor drainage points on the pump. A single drain pipe shall be run from the tundish to the common drainage system.

Air Release Cock

The higher point on the pump casing shall be fitted with a manual air release cock have a removable handle or an automatic air release valve with a lockable isolation valve as specified. Air release pipework on sewage pumps shall be not less than 30mm bore and shall discharge back into the wet well at high level and have facilities for rodding. The drain from each air release cock shall discharge via pipework as specified.

Couplings

All couplings shall be of an approved type and the Contractor shall arranged for the provision and fitting of both coupling halves to each respective shaft and shall include for all necessary modifications to any existing shafts to be coupled.

Where specified, the Contractor shall include any equipment required to prevent damage to any part of the drive in the event of reverse rotation of the pumps..

Lubrication

The gear unit shall be grease or oil lubricated, arranged to provide an adequate supply of lubricant for the duty.

Where oil lubrication is employed, the casing shall include an oil breather, level indicator and drain plug.

Units having a rated output greater than 500kW shall have inspection covers and include a forced lubrication system comprising an oil circulating pump, reservoir tank and full flow 'Duplex' type oil filters having re-useable elements together with associated pipework; the oil being circulated by either (a) an internal mechanically driven gear pump and an external electrically driven pump arranged to prime the gears as pre-set timings as recommended by the unit manufacturer, or (b) duplicate external electrically driven pumps, each of which may be selected to prime pre-set intervals and run when the gear unit runs.

Such a lubrication system shall include dial gauges and alarm switches to monitor high oil temperature and low oil pressure.

Reverse Rotation

Where specified, the gear unit shall be capable of withstanding reverse rotation for a limited period with no detriment to the unit. Where a forced lubrication system is used, this shall continue to operate satisfactorily under such conditions.

Diaphragm Pumps

The pump shall be of the diaphragm type utilizing a bullfrog type valve, suitable for the pumping viscous solution containing solids up to 55mm diameter as specified. It shall be driven by an electric motor through an oil bath reduction gear unit.

The main body of the pump shall be manufactured from LM6 aluminum and all wetted parts shall be supplied in 316 stainless steel.

The diaphragm shall be manufactured from neoprene, nitrile, hyperlink or viton elastomers and shall be reinforced with polyester fabric.

Submersible Pumps

Pumps impellers shall be closed or semi open type made from zinc free bronze or such other materials required for use with particular water to be pumped. Pump bodies shall be of zinc free bronze or such other material as required for the water to be pumped, treated against corrosion, and equipped with detachable wear rings. The bowls shall be joined by flanges or by tie rods.

The shaft main guide bearings located in the suction and delivery end housings of the pump shall utilize a leaded-bronze material, and shall be provided with protection guards to prevent ingress of sand and grit. Pump bowl guide bearings shall utilize either leaded bronze or other approved abrasion resistant material.

All pump bearings shall be lubricated by the water to be pumped. The pump delivery end housing shall incorporate a thrust washer of suitable material at the shaft end housing to absorb upthrusts that occurs during pump starting. The pump shall incorporate a mushroom type delivery check valve to prevent reverse rotation of the shaft from back flow of water through the pump. The pumps shall be provided

with a flanged discharge connection suitable for operating against the pump closed valve head or 16 bar whichever is greater. The shaft coupling connecting the pump and driving motor shall be of the stainless steel material accurately machined and keyed to ensure a precise shaft engagement and alignment. A strainer of suitable corrosion and abrasion resistant material, designed to guard against entry of foreign matter but permitting unrestricted flow of water into the pump, shall be provided on the pump suction housing.

Protections against the effect of sand shall be provided by renewable wear rings (made from a hard smooth flexible material such as polymethane) mounted at the seating of the impellers and the passages of the shaft.

The pump shall be designed to pump water having a sand content of up to 80g/m³.

A centralizer shall be fitted to every pump to ensure central alignment of the pumping and motor in the borehole casing.

Electro-submersible motors shall be 'wet' squirrel cage rotor induction type designed to operate continuously under submerged conditions and shall, where appropriate, comply with the requirements of IEC publication 34. They shall have operating speeds not in excess of 3000 rpm.

The motors shall be continuously rated at least 20% above the maximum power absorbed by the pump within the specified operating range. Motors shall be designed to allow three consecutive starts from cold and three starts in any one hour when hot.

The motor housing shall be constructed from close grained cast iron, cast steel or fabricated steel as appropriate, and shall be designed for easy dismantling and re-assembly to facilitate replacement of motor guide and thrust bearings.

The motor windings shall be insulated with an approved heat resistant material of high insulation resistance and impervious to water. All connections on the motor winding shall be made watertight. The temperature rise of motor windings shall be limited to 45°C above ambient temperature.

The motor shall be equipped, in factory with several PTC or Pt100 thermoprobes, 2 minimum, connected to a multifunction protection relay and a pre-selection digital thermometer which cuts off the operation current of the starter when the threshold temperature is reached. The temperature setting of this device shall depend upon the type of the probe determined by the manufacturer according to the insulation class of the motor.

The motor shaft shall be machined from high tensile stainless steel of sufficient diameter to prevent distortion from the dynamic and electro-magnetic stresses imposed on it. Critical shaft speed shall be well above the maximum running speed.

The motor shall be provided with a heavy duty multipad thrust bearing at the base of the motor to absorb the shaft down thrust developed by the pump. The bearing design shall incorporate tilting thrust pads with replaceable segments arranged to self adjust according to the thrust load. The thrust disc shall be of a suitable segment carbon based or similar approved material.

The thrust bearing design shall also be suitable for reverse rotation of the shaft in the event of backflow of water through the pump.

Motor guide bearings shall utilize either leaded bronze, copper impregnated carbon or similar approved material. Rubber, nylon, Tufnell and similar materials will not be accepted for the motor guide bearings.

Motor guide and thrust bearings shall be lubricated by the motor coolant water which shall be effectively isolated from the water to be pumped. A compensating device shall be incorporated in the motor design to allow for expansion of the coolant on rising temperature.

Underground Tank Water Pumps Rising Column

Steel borehole rising column shall be provided in section lengths not exceeding 3 metres with flanged joints or screwed couplings. The rising column shall be sufficiently flexible to allow for small deviations in tank verticality. All nuts, bolts and washers shall be of stainless steel.

Rising column flanges shall incorporate a recess to accommodate and protect the motor power and control cables, water level dip tubing, etc. Cables and tubing shall be securely fixed to the rising column by straps or bands at approximately 1.0 metre intervals.

The rising column shall be sufficient to take the stresses generated by the hanging weight of the pump, motor and rising column, the stresses produced by the water pressure together with any dynamic stresses which may occur under any circumstances including valve closure. Jointing materials shall be selected with care and shall accommodate the extension of bolts due to the expected weight and surge or closed valve pressures generated in the pipeline.

The rising column shall be protected internally and externally against corrosion by a non toxic epoxy resin coating suitable for use with potable water.

Submersible Pumps Headworks

A fabricated steel discharge head piece shall be provided at the top of the tank to support the complete rising column and electro-submersible pumpset assembly, and shall be complete with lifting eye bolts. The discharge head piece shall comprise a heavy duty sealing plate arranged for bolting to the borehole outer casing flange, and a 90° discharge bend arranged for flanged connection to both rising column and horizontal surface pipework. Lifting eyes shall be provided in the sealing plate. A flange shall be provided and welded by the Contractor to the top of the borehole outer casing. The flange shall be suitably drilled to accommodate the discharge head piece sealing plate bolts. Holes shall be provided in the sealing plate to accommodate an air vent pipe, motor and control cables, water level dip tubing, etc. and shall include adequate sealing arrangements to protect against borehole contamination. A 255mm diameter screwed removable plug shall be provided over the dip tubing for water level measurement with electrical contact tape. A stainless steel air vent pipe shall be fitted to the discharge head sealing plate, terminating in an insect proof screen and arranged to prevent entry of rain or surface water.

Tank power and signal cabling shall be brought to separate robust watertight junction boxes in the top of the well head chamber, with separate cabling from the junction boxes to the Motor Control Centre (MCC).

Surge Suppression Equipment

Surge vessels and associated equipment for suppression of surge in pumping systems shall include the following:

Surge pressure vessel designed and constructed to BS 5500, constructed

category 1, 2 or 3, post weld heat treated and with a corrosion allowance of 1mm. The vessel shall be cylindrical, carbon steel, fusion welded with domed ends and mounted either vertically or horizontally on steel supports. The vessel shall be provided complete with including the following fittings:

- McNeil type access manhole with opening not less than 450 mm x 410 mm;
- Water inlet/outlet branch flanged to BS 4504 Table 16 or 25 as necessary;
- 100 mm diameter drain branch with gunmetal valve and handwheel with drain pipework discharging to drainage channel;
- Spring loaded gunmetal safety valve;
- 150 mm diameter pressure gauge complete with isolating cock;

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- Water level sight glass with isolating and blowout prevention valves;
 - Air inlet fitting incorporating an air release valve and isolating and non-return valves;
 - Three stainless steel water level control electrodes of appropriate length, complete with electrode holders, spacers and brackets;
 - Access ladder;
 - Lifting lugs;
 - Nameplate giving vessel details.
 - One or more air compressors with standby facilities. Each compressor shall be capable of charging the pressure vessel from full water in approximately 30 minutes. The compressors shall be air cooled, electrically driven and complete with baseplates.

The compressors are required to deliver completely oil-free air but may be of the air lubricated type with two stage carbon air delivery filters providing complete removal moisture and oil vapour. Each compressor shall be provided with the following fittings:

- Outlet pressure gauge;
- Pressure relief valve;
- Suction filter and silencer;
- Automatic unloading valve for a no-load start under all conditions;
- Non-return valve;
- Protective guard between motor and compressor.

Control equipment to provide fully automatic control of the selected duty compressor from the water level electrodes in the surge vessel. A time delay shall be incorporated to prevent operation of the compressor during water level changes under surge conditions and a push button feature shall be provided for manual test of the system. The control equipment shall be housed in a wall mounted panel fabricated from mild steel to form a rigid box construction of neat appearance providing an enclosure to IP54. The enclosure door shall be hinged with a rotating handle and positive closing action. The equipment shall include:

- A three pole isolating switch, with operating handle interlocked with the enclosure door;
- A water level control module;
- A 0 to 30 minutes adjustable timer;
- A non-latching motor test push-button.

Ductile iron flanged inlet/outlet pipework between a flanged tee on the pumping station or wellhead delivery pipework and the surge vessel. The pipeworks shall include an isolating valve with gearing and handwheel and all necessary bends and fittings.

Small diameter GMS pipework between the air compressors and the surge vessel. The pipework shall be suitably coated and wrapped.

For small installations a vessel with a flexible membrane and hand air pump may be used.

y) **Valves**

Types and Operating Conditions

Valves shall be designed to meet the operational and environmental conditions specified for the types indicated in the specific valve schedule.

The closure rates of all valves shall be designed to prevent the effects of surge. Where necessary, valves with a varying closure rate shall be used.

Valve flanges or couplings shall be as specified in the valve schedule and match those specified for the pipework installation.

Identification

Each valve shall be identified by a unique reference as approved which shall identify the medium/plant controlled and be numbered in a logical sequence.

The reference shall either be engraved on a 3mm thick laminated white/black/white traffolyte disc or stamped on a 1.0mm (19g) thick brass disc. The disc shall be at least 35mm diameter with reference letters and numerals not less than 4mm and 8mm high respectively.

The discs shall be mounted on the hub of the handwheel or where this is impractical, they shall be attached to the valve stem by means of suitable brass 'S' hooks and/or jack chain through a hole at the top of the disc.

Access

All valves, spindles and handwheels shall be positioned to give good access for operational personnel. It shall be possible either to remove and replace or to recondition seats, gates or gland packings which shall be accessible without removal of the valve from the pipework or, in the case of power operated valves, without removal of the actuator from the valve.

Extension spindles shall be supplied wherever necessary to achieve the specified operating requirements.

Hand Operation

All handwheels shall be arranged to turn in a clockwise direction to close the valve or penstock, the direction of rotation for opening and closing being indicated on the handwheels.

The handwheels shall be coated with black plastic and incorporate facilities for padlocking in either the open or closed position.

The operating gear of all valves and penstocks shall be such that they can be opened and closed by one man against an unbalanced head 15% in excess of the maximum

specified service value and any gearing shall be such as to permit manual operation on a reasonable time and not exceed a required rim pull of 200kg.

Power operated valves shall include equipment for manual operation by means of a handwheel or other suitable device which shall be interlocked with, and fixed to, the power unit.

Headstocks and valves of 50mm nominal bore and above shall be fitted with mechanical position indicators to show the amount which the valve is open or closed in relation to its full travel, i.e. 0.25, 0.50, 0.75, 1 etc.

Valve Materials

Valve bodies and other components shall be of corrosion resistant materials, compatible with the medium and of robust industrial design.

For water applications and where specified, valve bodies, discs and wedges shall be of cast iron, with facing rings, wedge nut and other trim of corrosion resistant bronze or gun metal.

The valve stem, thrust washers, screws, nuts and other components exposed to the water shall be of a corrosion resistant grade of bronze or stainless steel.

For water works applications, wedge gate, metal seated valve materials shall be in accordance with BS 5163 Table 6A, fitted with a stuffing box and gland seal on the stem. Oil or grease shall not be used on any bearing or seal that may be in contact with the water being controlled.

Non-Return Valves

All non-return valves shall be of a type that will operate without stock.

Valve bodies shall be of cast iron and shall be fitted with renewable type seatings.

In the case of swing gate type valves the hinge pin shall be of stainless steel, mounted in zinc free bronze bushes and extended and fitted with external levers and counter balance weights, all protected by a screen guard.

Other types of valves will be considered. In every case the non-return valve shall be selected with full consideration of the system characteristics, and shall avoid valve slam, and have low maintenance requirements.

Where specified, limit switches shall be provided to operate from the external lever. The screen guard being slotted to allow the guard to be removed without disturbing the switch cabling.

Butterfly Valves

Butterfly valves shall conform to BS EN 593.

Butterfly valves shall have a high grade cast iron body to BS EN 1561 designed to the specified working and test pressures. The pressure rating valve shall be cast in the valve body.

The disc shall be of high grade cast iron to BS EN 1561 or nodular cast iron to BS 2789 to the defined working and test pressures. It shall have a convex shape designed to achieve low head loss characteristics. The valve shafts shall be of stainless steel operating in self lubricating bushes in the body.

The valve seat shall be of gunmetal to BS 1400. The sealing ring shall be a renewable Ethylene Propylene Diene Monomer (EPDM) rubber attached to the disc edge by a sectional bronze retaining ring to form a resilient and durable seal.

The valves shall be fitted with hand wheel actuators not exceeding 500mm diameter incorporating gearing to allow opening and closing by manual operation at the pressure stated using an effort no greater than 36kg on the hand wheel supplied.

In all cases the gearing shall be designed to close the valve, from fully open to fully closed in a period of not less than ten minutes with this effort. Actuators shall be designed so as to close the valves when the hand wheel is turned in a clockwise direction; the direction of closing shall be clearly cast on the hand wheel. Position indicators shall be fitted to all actuators.

Where required valves shall be electrically actuated with a manual override. Remote actuation shall be provided with a visual indication of valve open, valve closed and percentage opening together with fault indication.

A performance curve, relating percentage valve travel, open area and discharge coefficient shall be submitted to the Engineer. The head loss coefficient with valve fully open shall be defined.

All valves shall be tested in accordance with BS EN 593 and pressure and material test certificates shall be submitted to the Engineer for approval.

Plug Valves

Plug valves shall be of the wedge gate type, with cast bodies. The plug surface shall be coated or lubricated to endure low torque operation with bubble tight shut-off and 'non-sticking' materials.

Isolating Cocks

For isolation of small bore pipework tappings for instrumentation equipment etc. and for individual component isolation, the cocks shall be stainless steel, quarter-turn, ball or plug valves with the operating handle arranged to indicate the open and closed positions. Where specified, means shall be provided for securing the valve body to a front panel or rear surface.

Where corporation cocks are specified, these shall be similar to the above isolating cocks but shall have a detachable key handle for fitting onto a squared operating shaft, the shaft end being marked to indicate the open and closed valve positions.

Air Valves

Air valves shall be either:

- Single (small) orifice valves (SAV), for the discharge of air during the normal operation of the pipeline.
- Double orifice valves (DAV), consisting of a large orifice and a small orifice. These shall permit the bulk discharge of air from the main during filling and air inflow when emptying in addition to the discharge of small quantities of air during normal operating conditions.

Air valves shall be supplied with an independent isolating butterfly valve (DAV) or cock (SAV) which permits the complete removal of the air valve from the main, without affecting the flow of water in the main.

Each air valve assembly shall be suitable for connection to a flange on the pipeline.

At the connection between the air valve and its isolating valve a BSP tapping shall be made suitable for fitting of a pressure gauge. All tappings shall be sealed by a brass plug and copper compression ring gasket.

Air valves shall operate automatically and be constructed so that the operating mechanism will not jam in either the open or closed positions.

Systems Design

All pipe systems shall be arranged, installed, supported and provided with all necessary means of venting, draining and expansion subject to the approval to the Engineer before erection commences.

The pipework layout shall be designed so that items of equipment and sections of pipework can be removed from the pipelines without major disturbance to the adjacent pipework. Particular care shall be taken to ensure that pipework thrusts are not transmitted to machinery or associated apparatus. The Contractor shall indicate on his detailed drawings the thrust blocks required to anchor his pipework.

Dead legs shall be avoided, but where this is not possible provision shall be made for flushing the pipework. Changes in pipe bore sizes shall be by the use of proprietary fittings or fabricated sections to avoid sudden changes.

Where relevant, formed bends and offsets shall be used and be cold formed in a standard pipe bending machine. They shall have an inside radius of not less than 4 times the outside diameter of the pipe.

Hydraulic pipework. Pipework for pressurized hydraulic fluid shall be sized to maintain fluid velocities below those which specified and provide a safety factor of 4:1 on the design pressure, which shall be taken as 120% working pressure;

Compressed air pipework. Air pipework shall be seamless heavy duty Black Mild Steel class C, sized such that the air flow velocity does not exceed 8m/sec. the complete pipework will receive 2 coats of chlorinated rubber paint, with a final 3rd coat, the final finish color to match existing and as approved by the Engineer. All joints will be flanged; no threaded joint will be approved for the entire compressed air pipework assembly. To provide adequate condensate drainage, the pipework system shall be run with a horizontal fall of not less than 1 in 50 in the direction of air flow and incorporate drainage points at distances of not less than 30m. Drainage points shall be formed by the use of equal tees with a down- pointing leg fitted preferably where changes of direction of flow occur.

Any branch take-off shall be from the top of the main and the bottom of any falling pipe shall be drained.

Flanges

Unless otherwise specified flanges shall be faced and drilled to conform to the dimensions specified in BS 4504. Flanges shall be compatible with the pressure rating of the adjacent pipework but not less than 15 bar. Bolts, nuts and washers (two washers per bolt) shall be to BS BS EN 1092-3;2003. No bolt shall project more than two full threads beyond its nut after tightening. In no circumstances shall the shortening of excessively long bolts by cutting be allowed.

Gaskets shall comply with replaced by BS EN 1514 (1997) and replaced by BS EN 681-2 (200) and BS 681-1 (1996) Type W.

Flanges shall be painted with two coats of chlorinated rubber paint.

Mechanical Couplings

Unless otherwise specified or shown in the Drawings pipes and fittings shall be supplied with flexible joints.

Mechanical couplings shall be of the Dresser, Viking Johnson type without a centre register.

Joints rings used shall be of the ethylene propylene rubber (EPDM) or other material approved by the Engineer.

All mechanical couplings and flange adapters including nuts, bolts and washers shall be supplied with 'Rilsan' nylon thermoplastic polyamide applied by fluidized bed dipping.

Materials for the Assembly of Flexible Joints

Lubricant shall be of a kind not conducive to the growth of bacteria and shall have no deleterious effects on either the joint rings or pipes. Lubricants for water supply shall not impart to water, taste, colour, or any effect known to be injurious to health.

Materials

Pipework materials, sizes, pressure rating, fittings, coupling arrangements and median carried shall be as detailed in the Particular Specification, pipework being in standard metric sizes where possible.

General purpose steel pipework with screwed fitting shall be of galvanized mild steel to BS 1387 heavy grade with fittings of galvanized malleable iron to BS 143/1256, having tapered internal and external threads to BS 21.

Flange joints shall be as specified below for the application and all necessary bolts, nuts and washers shall be cadmium plated. Welded joints in carbon steel pipe shall be to Class II quality to BS 2640 or BS 2971. Welding shall only be carried out by welders who are approved in accordance with the relevant BS.

Water pressurized system shall use pipe-work of carbon steel in accordance with BS 3601 with pipe sizes to BS 3600. Sizes greater than 80mm shall be selected from the preferred sizes 100, 150, 200, 300, 450, 600 and 800mm.

Flange sizes shall be according to BS 4505 rated NP16 unless otherwise specified.

All flanged joints shall be made with 3mm thick rubber canvas reinforced insertion rings complying with BS 4865 Part 1 table 16A.

Low pressure large bore systems shall use steel pipes and fittings to BS 4622 unless ductile iron pipes and fittings to BS 4772 are specified. Screwed or cast flanges shall have a minimum NP16 rating and be fitted with 3mm thick rubber canvas-reinforced insertion rings.

Hydraulic pipework shall be of stainless steel high pressure tubing grade CFS 316 to BS 3605 or mild steel grade CDS 23/S to BS 3602 as specified.

Flexible hoses shall be of the twin wire braid reinforced type complying with BS 3832.

Pipe fittings not normally visible or accessible after installation shall be of the welded socket type with break joints at suitable positions for maintenance.

All other fittings shall be of the compression type in mild steel with an electroplated corrosion resistant finish.

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Joint and Pipe Fastenings

All nuts, bolts, washers, flanges, gaskets, flanged tied adaptors, drain valves, special connection pieces, supporting hangers, brackets or clips and temporary supports for the pipework, together with all terminal point connection material shall be supplied and installed under this Contract.

All flanged joints shall be fitted with suitable insertion ring gaskets which shall be carefully adjusted concentric to the bore of the pipe so that no undue strain is placed on any of the bolts or flanges of the pipe when bolting up.

Joints on flanges that exist or have been installed under other contracts shall be made with the same material and suitable for the flange faces.

Flushing and drain connections on pipework below 150mm shall be made using proprietary welded fittings with G series internal parallel threads to BS 2779 which shall be immediately sealed with steel hexagon headed shouldered plugs and seals. Holes thus made in the pipe shall have any burrs removed and be finally pulled through to remove loose particles.

Template Pipes

Template or closure pipes shall be provided where necessary to facilitate erection. The design and construction of the template pipes shall be to the approval of the Engineer, and the Contractor will be responsible for establishing the dimensions of the template pipes such that there will be no strain on the connected items after installation.

By-passes

Where pipeline flow meters are used, particularly electromagnetic meters, by-pass pipework and valves shall be installed to allow removal of the meter without interrupting the process flow. Draining shall either be via backflow or drain valves.

Flanged Adaptors

Flanged adaptors shall be provided as indicated in the Specification drawings. Each adaptors shall be complete with all associated fittings and shall be installed in accordance with the manufacturer's instructions.

Branch Pipe and Bosses

Whenever any small bore pipework makes a connection into the pipeline system, a boss of branch pipe shall be provided which shall be at least twice the diameter in width and one diameter in thickness of the tapped hole which it contains.

Bosses shall be located at the main pipe horizontal centre line and those provided for water sample cocks shall be tapped 38mm (1.5") BSP and have reasonable access for sampling. Bosses provided for instrumentation equipment shall be tapped 1" BSP with a reducer fitted to suit the small bore pipework and isolating cock. Unused bosses shall be fitted with blank plugs having a central squared projection for tightening or removal.

Small Bore Pipework

Small bore pipework up to 15mm OD shall be manufactured from stainless steel tubing with suitable compression type fittings. All small bore pipework and capillary tubes shall be adequately and securely clipped or clamped. Compression fittings bends shall be kept to a minimum, as pipeline bends of generous radii are preferred. Compression couplings shall be heavy series to BS 4386 Part 1.

Any gauges, transducers or switches etc. fed via small bore pipework shall have an individual isolating cock adjacent to each component with adequate space being allowed for component removal for servicing.

Duct Seals

After the pipework is installed, the Contractor shall seal the ends of all ducts, pipes or trenches leading into buildings, whether occupied or not, for pipework associated with this Contract.

The seals shall be approved water, gas and fire sealing transit units with appropriate fillers, and insert blocks shall be fitted to duct trench entries. All steelwork on such transit assemblies and frames shall be hot dip galvanised. Where shown on the Engineer's drawings, transit frames will be incorporated in the construction by the Civil works contractor.

Reference Marking

Prior to dispatch from the manufacturer's works each pipe section shall be marked with an appropriate reference number for future identification.

Protection of Pipework

Immediately after the completion of fabrication at the works or on site and during transport and storage, pipe ends shall be protected from external damage and sealed against ingress of dirt by suitable caps, plugs or other similar means. After cleaning and inspection, machined surfaces of all steel and ironwork shall be covered with preserving fluids of approved type otherwise protected and all flanges shall be fitted with blank discs bolted to each face.

Ductile Iron Pipe Work

ii) General

Ductile iron pipes and fittings for water supply shall comply with BS EN 545.

Ductile iron pipes and fittings for sewers shall comply with BS EN 598.

Ductile iron pipes and fitting for sewerage rising mains shall comply with BS EN 598

Pipes and fittings shall have spigot and socket joints unless otherwise specified or shown on the Drawings.

Spigot and socket flexible joints shall be of the push-fit type with gaskets of ethylene propylene rubber (EPDM).

The Contractor shall supply sufficient pipes suitable for cutting on site to meet his requirements during pipeline construction.

iii) Flexible Joints

Spigot and socket flexible joints shall provide the following minimum angular deflections without leakage at the works test pressure specified.

not exceeding DN 300: 5° exceeding

DN 300 : 4°

Joint deflection at installation shall not exceed 50% of the manufacturer's maximum allowable.

iv) Self Anchored Flexible Joints

Self anchored flexible joints for pipe diameters up to and including DN 300 shall be standard push-fit type joints but with modified gaskets incorporating stainless steel toothed inserts. The joints shall be suitable for a working pressure of 14 bar with allowable deflection of 5 degrees.

Self anchored flexible joints for pipe diameters exceeding DN 300 shall incorporate a weld on flange and tie bolts or similar self-restrained joint system. The joints shall be suitable for a working pressure of 14 bar with an allowable deflection of 4 degrees.

v) External Coating

Pipes and fittings shall be given an external coating of extruded polyethylene coating to BS EN 545.

Steel Pipe Work

vi) General

Steel pipes shall be manufactured to BS EN 10224 but also current or API Specification 5L and shall be suitable for the pressure ratings required by the Contract. Steel pipes shall be protected with an internal lining and an external coating.

Joints and fittings shall be provided with at least the same degree of corrosion protection as the pipe itself.

Steel pipes shall be manufactured or adapters supplied such that the outside diameters are compatible with the outside diameter of pipes and fittings to which steel pipes interconnect.

vii) Grade of Steel

Unless otherwise specified or necessary to meet the requirements of the Contract steel pipes shall be manufactured from Grad X 42 to API Spec. 5L with a minimum yield stress of 289 MPa and a minimum tensile strength of 413 MPa.

viii) Joints

The pipes and fittings shall be complete with push fit spigot and socket type joints with integral gasket of EPDM rubber or similar. After assembly the joints shall be welded around the socket mouth to seal the annulus and provide end-load resistance without damaging the internal corrosion protection system or the sealing gasket. A tapped hole shall be provided for pressure testing the completed joint. After testing the annulus shall be filled with bitumen and the hole plugged.

Where required by the Engineer the Contractor shall demonstrate his proposal, materials and methods of quality control by undertaking site trials of the jointing system.

ix) Thickness of Pipes and Fittings

The minimum permissible wall thickness of steel pipes and fittings shall be as required by API Specification 5L for the relevant pipeline locations and test pressures, in accordance with the Contract.

The minimum thickness for steel fittings shall take into account flexibility and stress intensification factors.

x) Inspection and Testing of Pipes and Fittings

All pipes and fittings shall be hydrostatically tested at the place of manufacture to the pressures stated in API Specification 5L.

External coatings shall be tested with a Holiday detector, prior to dispatch.

xi) Dimensions of Fitting and Specials

The dimensions of fittings and specials shall be in accordance with BS EN 10224 but also current.

xii) Corrosion Protection

Steel pipes and fittings shall be protected at the manufacturer's works with epoxy resin as follows:-

- Surface Preparation Blast cleaned internally and externally.
- Lining and Coating Internal and external surfaces coated with 10% solids thermosetting fusion bonded epoxy resin Scotchkote 206N or similar approved material. Minimum dry film thickness 300 microns applied by fluidized bed method.

Any damage to the coatings resulting from pipe cutting, jointing, welding, transportation, handling etc. shall be repaired with a two-part chemically cured epoxy resin primer and finish coats applied according to the manufacturer's instructions.

All coating materials shall be approved for contact with potable water.

xiii) Expansion Joints

Expansion joints shall permit expansion or contraction of the pipeline over a range of at least 50 mm either way, i.e. a total movement of 100 mm. Tie bolts shall be provided across the joint to restrict excessive movement of the joint. The expansion joint shall be coated internally and externally with the same material as the adjoining pipework. All bolts, nuts and washers shall be 316 stainless steel.

z) Platforms and Walkways

General

All necessary platforms, toe-plates, ladders, stanchions, handrails, chains and all associated fittings, support structures and curbing shall be supplied to provide a safe and efficient installation.

Steelwork

All mild steel item shall be protected to BS 5493 Section II by hot dip galvanizing after fabrication to BS 729 with a minimum thickness of 85 microns (0.0034") unless otherwise specified.

No cutting, drilling, bending, riveting, threading or similar operation will be permitted after galvanizing, and due care shall be exercised in transporting, handling and fixing galvanised metalwork to prevent damage to zinc coating. Under no circumstances shall damage to zinc coating be repaired with rust inhibiting paint.

Platforms

Platforms as indicated on the Specification drawings shall be provided. All platform panels shall be individually secured to the supporting structure and be of suitable size and weight for ease of handling. They shall be cut and fixed to maintain a continuity of pattern.

Platforms, walkways and floor covers shall be adequately supported to prevent undue flexing and have supporting rebates with a minimum landing width of 30mm. Where the supporting structure is concrete, galvanised mild steel angle curbs shall be provided and securely grouted into rebates left in the concrete such that the tops of the panels are flush with the top of the concrete.

Normal access ways shall be suitable for a minimum uniformly distributed load of 5 kN/m² (105 lbf/ft²). Where platforms and floor covers are specified for concentrated loads or machinery support, the uniformly distributed loading shall be not less than 15 kN/m² (315 lbf/ft²).

Plated flooring shall be aluminum chequer plate having a minimum base thickness of 8mm with a non-slip tread pattern, secured to the supporting steelwork with countersunk screws, which shall be cadmium plated when used with aluminum plate. For maneuvering small-wheeled items e.g. switchboards trucks, plain floor sheeting 8mm thickness shall be provided over specified areas.

Open mesh platforms shall be open type, galvanised mild steel flooring.

Hinged Covers

Hinged covers provided in platforms shall have a galvanised, fabricated steel framework, covered to match the surrounding floor strength and pattern.

Covers provided for permanent man access shall be located as indicated on the specified drawings. They shall have a minimum clear opening of 750 x 750 mm and have a locking stay fitted, arranged so that in the fully open position, the stay will hold the cover open until released. Provision for padlocking the cover in the open or closed position shall be provided.

Covers for valve keys or other small openings shall be sized to suit the application and not include either stays or padlocking facilities.

Ladders

Ladders shall be of mild steel construction except where they are subject to prolonged immersion in water where they shall be of stainless steel.

Permanently fixed ladders of the step type shall have flat section, non-slip, open type treads not less than 450mm wide between stringers, with handrails fitted to each side extended to meet the platform handrails at the upper end. Tread width shall be not less than 120mm with a pyramid pattern nosing.

Vertical or near vertical fixed ladders for emergency use shall be in accordance with BS 4211 with equally spaced rungs between 230mm and 260mm apart with a width between stringers not exceeding 400mm. Safety hoops shall be provided where ladders rise more than 2.3m from the ground or platform. The stringers shall be extended at least 1100mm above the upper platform, and suitably opened out for access, or where ladders are below manhole covers, a separate hand hold shall be fixed to the upper platform.

Railings

Guardrails shall be provided for all platforms elevated greater than 500mm and the upper rail shall form the handrail. A knee rail shall be included and located approximately at mid-height.

Stanchions and rails shall be of mild steel or aluminum alloy tubing as specified, not less than 31mm overall diameter and tube thickness 10 SWG set in a twin-rail arrangement with the upper rail not less than 1.1m above the platform level or 900mm above the stringer pitch line for stair flight. Ball type tubular standards are to support the rails at not more than 1.5m centres and arranged so that there is a standard not more than 300mm away from any bend and 150mm from any rail joint. Rails are to be secured to prevent movement within the standards. Standards and rails shall be attached to the platform/walkway and not to any non-structural floor or toe plates.

Any roughness on the external surfaces shall be removed in an approved manner to produce a safe surface to the satisfaction of the Engineer.

A plastic coated finish shall be applied where specified and care should be taken to preserve from damage the plastic coating which may, if desired, be applied at a later date. The Contractor is to include all cleaning and derusting operations necessary.

Whenever possible, runs of guardrail shall be continuous and sharp vertical changes of direction shall be avoided. Handrails shall terminate in swept ends either to the wall or return to the knee rail by means of a U bend which shall not extend greater than 350mm beyond the centre line of the last standard.

Safety Chains

Access openings in guardrailing to ladders and platforms having a direct drop of more than 300mm shall be protected by a double row of safety chains of galvanised or electro-plated zinc mild steel 3 SWG x 3 links per 100mm complete with 'S' hook attachments at one end and permanently fixed at the other.

Toe Plates

All platform and walkway frames shall have toe plates attached to the sides where guardrails are fitted. Only around cut-outs provided in floor plates shall the toe plate be secured to the floor plate by welding.

Toe plates shall be at least 100mm high and 6mm thick, any gaps between the toe plate and the floor should not exceed 15mm.

Trench Covers

Trench covers shall be of minimum or galvanised mild steel chequer plate (min 3mm thick) supported to prevent undue flexing and having suitable holes to allow removal by standard lifting keys. Support shall be by means of steel curbing rebates cast into the trench top edges, such that the top of the covers are flush with the top of the finished floor level and providing a landing width of at least 30mm.

Additional or alternative support for switchboards etc. shall be from at least 75 x 35 mm channel section cross bearers and transverse trimmers, fixed or cast into the floor and located to suit equipment fixings, access requirements and floor cover spans.

To prevent differential deflection, butt straps shall be fitted to the underside of floor plates which have no other support.

Edging curbs suitable for mild steel chequer plate shall be painted in red oxide primer, the curbing may be tapped to accept cover securing screws. Where aluminum plates are used in contact with any mild steel supports, a bitumen coating on the points of contact shall be used.

aa) Cranes and Hoists

General

Cranes and hoists shall be of standard proven design in accordance with BS 466, rated for lifting the specified working loads, utilization and service conditions and shall be suitable for operation from the runway beams provided. Motions shall be motorized as specified with dual speed hoisting facility and controlled from a pendant push button unit via a crane control panel mounted on the gantry.

All operations, whether manual or electric, shall be controlled or performed from motor room floor level unless otherwise specified.

The lifting assembly shall be rated for the highest lift that could occur during installation and maintenance operations, including allowance for stiction.

The crane shall consist of a gantry or jib, crab and hoist assembly, ropes, block and hook together with the necessary running rails and all electrical supply requirements.

Chains used for lifting or travel shall be alloy steel and corrosion protected by an electro-deposited, zinc coated finish after manufacture. They shall not be hot dip galvanised.

Jibs or gantries shall be of plate or box girder design and securely attached to end mountings or carriages.

Hoist

The hoist unit on travelling beams shall be mounted to provide the highest possible lifting facility whilst maintaining adequate clearance between the crab/hoist assembly and the building structure and fittings.

Hoist units fitted to single runway beams, fixed or jib mounted, shall be of the self-suspension type mounted on a single rigid trolley suitable for manual geared travel along the runway beam. Two end stops shall be provided on the beam suitable for the trolley provided. The trolley shall have ball or roller bearings grease packed for life.

The hook shall be fitted with a swivel and a safety catch and be capable of touching the floor and providing a minimum lifting height as specified.

In the case of electrically operated hoist the normal hoist speed shall be approximately 4 metres/min and the creep speed shall be approximately 600mm/min or nearest standards. An overload device and overwind limit shall be included to prevent dangerous overloads. Raise and lower limit switches shall be provided at the maximum and minimum lift positions. Instantaneous fail safe braking in the event of power failure shall be provided.

Where operation is by electric motor a power supply shall be provided under the contract. Power shall be taken from a feed in the main distribution panel forming a part of the works and a wall mounted fused isolator shall be provided at a suitable location approximately 1.5 m above floor level alongside the lifting installation.

Power transmission to the moving installation shall be by pick up shoe running along the underside of shrouded rails, suspended concertina cable running on slides or a rail or a cable from a self winding cable reeling drum. In the latter case the tension in the cable shall be controlled and supported provided to prevent the cable dropping more than one metre below the crane rails(s).

Testing

All lifting equipment shall be tested at the manufacturer's works and on site. Tests on site shall comprise a full load test, including, where applicable, deflection checks on beams. Where the contractor wishes to use lifting equipment forming part of the permanent works for installation purposes he shall have the equipment tested and be in possession of a valid test certificate before using the equipment. All equipment must be tested or retested within one month of handing over to the Employer. Test

certificates shall be provided in triplicate. The Contractor shall be responsible at his own cost for the provision of all weights, slings and other equipment required for testing.

Rating Plates

The SWL shall be clearly marked on the rating plate and shall be legible from the plant working level.

Paint Finish

The finish colour shall be full gloss Yellow Colour No. 356 to BS 381C or equivalent reference 08 E 52 to BS 4800.

Crane Access

Where clearance permit, provision for safe maintenance shall be provided in accordance with BS 466 and shall include a walkway across the span having a height clearance of 2m and be fitted with double- tiered handrails and toe boards.

bb) Air Compressors and Blowers

Air Compressor/Blower

The compressor shall be an air cooled type capable of oil and dust free air delivery at the volume and pressures specified when directly or indirectly driven by an electric motor or diesel engine.

The compressor performance shall be in accordance with BS 1571 for the site condition and duty cycle specified and shall include the following components:

- Suction air filter/silencer;
- Solenoid operated unloader valve;
- Pressure relief valve;
- Non-return valve;
- Isolating valve;
- Low oil pressure switch (or pressure lubricated).

Where necessary, depending on load factor, the compressor shall include cylinder jacket and after cooler facilities for cooling the delivered air, the aftercooler having a suitable pressure relief valve and automatic drain valve.

Air Receiver

The compressor shall deliver air into an air receiver manufactured in accordance with BS 5169 Class III Grade E or F, to accommodate the specified design pressure and internal volume.

The receiver shall incorporate the following items:-

- One safety relief valve;
- One automatic drain valve;
- One pressure gauge (o – bar);
- Pressure and temperature switched to suit the control;
- Inspection access to permit internal examination of the receiver;
- Lifting facilities as determined by the receiver weight.

The receivers shall preferably be located in low ambient temperature areas to minimize condensation and the inlet outlet pipe connections shall be arranged to promote air circulation.

Separators

The air distribution main shall include a separator to remove suspended moisture in the air main.

Compressed Air Filters

The air supply shall incorporate filters of the disposable element type as near as possible to the point of use.

Filtration shall be carried out using two filters in series, the first filter graded for course filtration and the second for fine filtration as defined in the Specific Requirements.

Drain Traps/Strainers

Automatic drain traps shall be provided for air receivers, filters and separators. Strainers shall be provided for protection of the drain traps. Ball traps shall have cast iron bodies with stainless steel internal parts (Spirax Sarco or equal).

Air Pressure Control

The compressor shall be arranged to maintain the air pressure in the system within the specified limits by means of pressure switches in conjunction with unloader valves and timers to prevent prolonged off- load running.

The frequency of starting and stopping shall be within the limitations of the drive arrangement.

Where two compressors are operated on a duty/standby basis, the duty compressor shall operate whenever the low pressure switch closes and shall cease operation when the high pressure switch opens. Should the pressure fall to the standby low pressure, the standby compressor shall operate in conjunction with the duty compressor and shall similarly cease operation when the high pressure switch opens.

The circuits for the compressor motor starters shall be completely separate. Either unit shall be capable of duty or standby operation and periodically their modes will be reversed.

The blower shall discharge continuously the specified free air delivery at specified suction and delivery pressures.

The blower shall be of the centrifugal or positive displacement rotary type with cast iron casings capable of delivering oil-free air. The blower shall be fitted with mechanical seals and incorporate a mechanical oil lubrication system, including an oil flow indicator, level indicator, pressure gauge, filling and drain plugs.

The design of the blowers is to be such that the noise level is kept to a minimum. The impellers shall each be equipped with heavy duty spherical roller bearing at each end. Gear end bearings shall be axially located on the inner and outer races to control thrust and maintain factory set clearances at all times.

The two timing gears shall be accurately machined to position the impellers in the impeller case and shall be secured to the shafts by locking kits. Gears shall be enclosed in an oil-tight housing.

The shaft sealing arrangement shall comprise a garter spring viton lip seal and a piston ring seal with an intermediate space vented to atmosphere.

Gears and gear end bearings shall be lubricated by a splash oiling system from oil maintained in the gear housing. Drive end bearings shall be grease lubricated or lubricated by a splash oiling system from oil maintained in the drive cover, depending upon gear size.

Each blower is to be direct driven through a flexible coupling, or indirectly via 'V' belts, by means of an electric motor, the complete assembly being mounted on a cast iron combination base plate. Both driver and driven units are to be dowelled or otherwise positively located to the base plate and substantial guards provided over all moving parts.

All covers and flanges associated with spigotted joints should be provided with easing screws if possible.

Blower Accessories

Each blower shall include a tachometer, an adjustable weight operated lever type air relief valve, delivery pressure and suction gauges each with isolating cocks mounted on a panel secured to a blower. An automatic unloader vented to outside atmosphere or an approved by-pass system is also to be included if this will assist starting.

The air relief valve is to be of double flanged cast iron construction with gunmetal trim. The adjustable weight shall have provision for locking to prevent any unauthorized interference.

Bosses shall be provided on each blower discharge pipe, upstream of the non-return valves, suitably tapped for connection by capillary tubing to pressure switches.

Blower Filters

The filters shall be capable of handling the designed throughput of air with the minimum of pressure drop whilst excluding 99.7% of all particles down to 2 microns.

The filters shall be of the two stage type comprising a hand operated roller mounted first stage roll type element and a disposable cartridge type second stage having access from one side only. The first stage unit is to be mounted in a galvanized sheet steel case with easily removable covers, the roller handle being conveniently positioned for easy adjustment of the roll.

The second stage unit is to be mounted in a galvanized sheet steel case and the units connected by a transition piece, a further transition piece being arranged between the second stage and the silencer. Connections with isolation taps are to be provided on both sides of each stage and suitable manometers fitted to allow for measurement of the differential pressure.

Each unit shall be supported from the floor on substantial steel frames with welded plate feet.

Air Silencers

Single inlet and outlet silencers shall be included for the blowers and manufactured of sheet steel, comprising a perforated inner tube and an outer galvanized casing, the space between being filled with a sound absorbing material. A flange is to be provided at each end, and all necessary supports extending to floor level are to be included. The silencers are to be designed for the minimum pressure drop..

Noise Attenuating Enclosure

The enclosure shall be removable pre-fabricated type designed to reduce the noise level by approximately 20 dB (A).

The enclosure shall incorporate access doors or panels such that routine maintenance can be carried out without removing the entire enclosure. It shall be possible to remove the enclosure without disconnection of the silencer mounted outside the enclosure. The operating sound pressure level of the set, measured in accordance with BS 4196 at a distance of 3 metres, with the exhaust silencer and the noise attenuating enclosure in position, shall be a maximum of 80 dB (A).

cc) Miscellaneous Equipment

Submersible Mixers

The mixer shall be of the propeller type where the motor, gear unit, shaft, and propeller comprise a compact unit which is completely submerged.

The complete unit shall be of materials suitable for the particular application.

The junction box shall be completely sealed from the surrounding liquid and from the motor unit to prevent ingress of liquids.

The gear unit shall be fitted with spur gears with helical teeth to provide the desired speed reduction to suit the particular application.

The motor shall be of submersible type in accordance with Section 6 – Electrical Specification. The mechanical shaft seal shall have working faces of material to suit the particular application.

Bearings shall be of the deep groove ball or roller type designed for an L10 life in excess of 25,000 hours of continuous operation.

The whole mixer unit shall be mounted on guide rails and shall be complete with all necessary chains and shackles for safe and effective removal.

A lifting davit suitable for removal of the mixer unit shall be provided which shall be tested in accordance with the relevant British Standards. Test certificates shall be provided and the safe working load shall be clearly marked. The lifting capacity of the davit shall exceed the maximum weight of the unit by 100% minimum to overcome binding of the mixer unit on the guide rail.

Tank Covers

Tanks shall conform to the following:

- Tank covers are to be provided where specified in order to retain odours. They shall be purpose designed and manufactured for the particular application from ultraviolet resistant Glass Reinforced Plastic (GRP) or glass-coated steel, and shall be provided with all necessary ribs and stiffeners on the underside to provide a rigid and robust structure;
- They shall rise from the tank walls to the centre of the tank, shall be self-draining and shall not sag or form hollows;
- They shall be suitable for use with sewage sludge and sludge gases, including those dissolved in water;

GRP covers shall comply with the relevant provision of BS 4994 as appropriate. Glass coated steel covers shall comply with the specification requirements for glass coated steel tanks, as appropriate;

Loading shall be in accordance with the provisions of BS 6399 (Roofs with no access) except where permanent access is specifically provided, in which case loadings shall be to BS 6399 (Roofs with access). In the case of GRP roofs, the maximum strain shall be limited to 0.3%. Calculations shall be provided for all roofs and covers;

The corners and edges of cover panel shall be smooth and uniform. All joints (viz. panels to wall, panels to bridge or panel to panel) shall be sealed with a flexible strip and pliant sealant to produce a close seal. The joints around openings, such as hatch covers, shall be sealed with a flexible strip firmly attached to the fixed portion of the covers;

Each cover shall incorporate 2 No. hinged, locking manholes at positions to be agreed, not less than 0.8m square. The lids shall be strengthened to prevent twisting on opening and shall be designed to fold back flat on opening with securely fixed handles;

The manhole and tank covers shall be provided a separate 200mm diameter stiffened opening with a sealing plate for instrumentation use. ~~Where the covers are to be fitted to a tank at a roof height of more than 2m above ground level, suitable safety harness fixing points shall be provided adjacent to each manhole opening;~~

Each cover shall be provided with 2 No. 500mm square openings, one near the centre, one at the edge, in positions to be agreed, with stiffened edges, for fitting of ventilation equipment, and shall be sealed with removable plates;

In case where the covers are to be supplied together with new tanks or new scraper bridges, then they shall be designed in co-operation with the relevant manufacturers to ensure compatibility;

Where specified and where necessary for machinery access, special sealed access openings shall be provided shaped to suit the machinery concerned;

The method of fixing and sealing to the tank walls shall be for the supplier to decide, and shall be stated in the Tender. All supports, fixings etc. shall be manufactured from corrosion resistant material. Galvanized or plated mild steel is not acceptable.

1.26 Inspection and Testing during Manufacture

The performance of each item of Plant or Pipe shall be tested in accordance with the Specification to the requirements of the Project Manager.

Test certificates in triplicate shall be submitted by the Contractor to the Project Manager within 2 weeks of the date of the tests. Type tests are not acceptable. Test certificates shall be supplied for tests carried out on the actual Plant being supplied.

Plant shall not be dispatched from the manufacturer's works until it has passed the specified tests and approval been given by the Project Manager.

The Project Manager shall at his discretion witness tests of individual items of Plant at the manufacturer's works. The Project Manager shall be given three weeks' notice in writing before such tests are to take place.

The acceptance by the Project Manager of any item of Plant or equipment after testing at the manufacturer's works shall in no way relieve the Contractor of his responsibility for the correct performance.

2. Conformity Visit for Drilling Rigs and Contractor's Equipment

Before erection of the drilling rig at the first borehole location, the Project Manager will verify that the Contractor's has mobilized the equipment listed in the Contract. No authorization to start the drilling works will be given if equipment is not mobilized as listed.

At any moment during drilling operations, the Project Manager may interrupt works operations if the equipment mobilized by the Contractor differs from those listed in the Contract.

3. Method for Boreholes Construction

3.1. Location of boreholes

The final locations of boreholes will be given by the Project Manager, with a minimum 5 days' notice before erection of rig at site.

a) Depth and boreholes design

The boreholes to be drilled will be required to penetrate thickness up to 10 m to 20 m soil or poorly consolidated sediments. The contractor should indicate clearly in his proposal the drilling technique he will operate for drilling the first poorly consolidated levels.

The required drilling technique down to a depth of about 400m is rotary drilling with bentonite accepted in the drilling fluid (see § 5.4 for characteristics of the drilling fluid).

b) Centralisers and end plug

In order to achieve the required borehole linearity, all casing permanently installed in wells should be fitted with centralisers at 6 meter intervals or as otherwise directed by the Project Manager. The centralisers should be factory manufactured from spring steel straps welded to hinged steel collars to the approval and direction of the Project Manager.

A factory manufactured stainless steel end plug will be installed at the bottom of the screen and tubes.

c) Gravel pack installation

A special attention will be paid to quality of gravel pack installation. The mud circulation should be maintained during gravel pack installation.

No gravel pack could be installed in the well without use of a cross-over tool. With this tool, the fluid and filter pack pumped down through the drill pipe will discharge below the packed associated to the cross-over tool while the return flow will be conducted up through the packer into the annular space around the drill pipe. The stinger pipe below cross-over tool will extend to some 1 m of the bottom of the screen.

In order to prevent undesirable separation of coarse and fine fraction of the gravel pack, the uniformity coefficient of the mixture will be lower than 2.5 (see § 5.6. Characteristics of the gravel pack). In order to check the perfect installation of the gravel pack, a 3m piece of telltale screen will be installed above the production screen, inside the telescoped section.

d) Partial backfilling of wells

The Contractor may be required to backfill an existing well to a depth specified by the Project Manager. The backfill material will consist of sand and ten millimeters by twenty millimeters crushed or graded gravel or other sized gravel. All such backfill material must be approved by the Project Manager before being used in the well.

e) Cementation under pressure

The Cementation under pressure should be done from the bottom through a cementing shoe: the annular space shall be filled in by cement up to cement appears at the surface. If cement fail to reach the surface, the Contractor, should at his own cost and to the satisfaction of the Project Manager, demonstrate that the cement is continuously sealing the casing from the bottom to half of the cemented depth. It should then continue the cementation from the surface and finally demonstrate at his own cost and to the satisfaction of the Project Manager, that cement is continuously sealing the whole casing.

~~Should the Contractor fail to conduct these operations to the satisfaction of the Project Manager, the borehole may be declared lost.~~

f) Failure of casing strings to enter well

In the event that any string of casing will not enter the well, the casing will be removed and the well will be reamed or re-drilled. If the string of casing still does not enter the well, the well will be declared lost.

3.3. Drilling Sequence

- Drilling of the poorly unconsolidated levels, up to 10 to 20 m
- Installing of a surface casing from the bottom of the hole to the surface
- The surface casing will be fixed in position by cement being placed in the bottom half meter of the hole by tremmie pipe installed inside the casing, to ensure that the surface pipe remains plumb, and that there is an annular seal for the cement. The annular space between the well and the surface casing will then be filled with cement up to 1 m below ground surface. Once in place the cement will be allowed to set for a period of 12 hours
- Drilling of the borehole down to a depth of about 230 m (diam. 20 or 22”) below the ground.
- An electrical well logging shall be performed and decision can be taken to continue drilling (come back to previous indented line)
- The extrados of the casing is cemented under pressure from the bottom up to the surface. The Contractor will provide all necessary equipment to ensure the correct and successful displacement of the cement. Before proceeding with the cementing of the casing, circulation should be established around the casing without any loss and on completion of the cementing some cement should return to the surface.
- The cement is allowed to set for 24 hours minimum
- Gravel pack shall be installed beneath the screens and tubes using a cross-over tool.
- The borehole is then developed
- A full pumping test is completed
- The well head is constructed

3.4. Sampling and logging

a) Formation Sampling

Representative samples of the strata penetrated will be collected every meter (or as otherwise directed and approved by the Project Manager), by whatever method is standard for the drilling technique in use. A sample of the formation cuttings will be removed from the drilling medium by collecting the sample in a screen, or by collecting a large sample of the drilling fluid and allowing the

~~cuttings to settle out. Care will be taken to ensure that the sample is representative of the material being drilled and not contaminated by hole erosion or cavings.~~

The samples will be placed in approved and appropriately marked heavy plastic sample bags and handed over in a sturdy box to the Project Manager. The sample box will be a container fitted with individual compartments for the samples. A card will be inserted into each compartment along with the sample, indicating, in water-proof ink, the depth from which the sample was recovered.

When requested by the Project Manager, the samples will be displayed in a neat and organized manner so that the entire geologic section is clearly represented.

b) Well head logging

Penetration rates, measured as minutes per meter drilled, must be recorded for every meter in the drillers log in regard with the pressure on the tool. The Contractor must report immediately to the Project Manager's representative on site any changes in the penetration rate. The penetration rate report must include the method of drilling used and if any changes in the drilling method must be recorded its depth and time of change. Drilling interruption for flushing without drilling, stoppage during installation of additional drill pipes; breakdowns, etc must be properly recorded so that the drilling rates can be properly interpreted purely based on time taken for drilling.

The contractor shall endeavour to operation in such a way as to detect water strikes by noting increases in flow rates. For this purpose marsh funnel and stopwatch must be available. In order to measure yield rates during drilling and so to obtain an indication of water strikes, the return water must be directed through a gauging weir consisting of a 90o weir plate (V – Notch) installed at a suitable point in the return water circulation system. The dimension of the V-Notch should be at least 800mm wide across the top and the V and 400 mm vertical depth.

3.5. Borehole development and cleanup

Well development will be conducted with successively both airlift pump system and interrupted over-pumping. All well development methods and chemicals must be approved by the Project Manager.

For airlift pump system, it is a requirement that the double-tube airlift method to be used by the drilling contractor for the development of boreholes. Development must begin from the bottom of the borehole, the apparatus being placed about 1 m above the base of the borehole. The air is turned on and off repeatedly to agitate the fine material within the gravel pack and the surrounding formation. This process continued every two meters upward within the borehole until the static water level is reached. Once this is completed the apparatus is lowered to the bottom of the borehole to remove sand and gravel and the borehole is then further airlifted until the water is totally clean to the satisfaction of the Project Manager.

For interrupted pumping, the pumping shall be done at rates up to 2 times the design capacity. The pumping should be carried out in at least 5 steps, which should include pumping rates of 0.25, 0.5, 1, 1.5 and 2 times the design capacity, with no check valve nor foot valve present. Pumping shall be conducted in 5 minute cycles.

Development shall continue for a minimum of 6 hours air-lift development plus 3 hours interrupted pumping development and until the discharge water is clean and free of sand (i.e. no more than 1 cm diam. sand stain test) or until such time as the Project Manager finds

~~acceptable. No payment shall be made for the extra hours necessary after 15 hours of development.~~

3.6. Borehole Disinfection

The Contractor shall at all times take every precaution to ensure that the borehole is kept free of contamination. The Contractor will ensure that formation stabilizer material is disinfected prior to installation.

Disinfection of the borehole shall be undertaken immediately after the borehole development process has been completed. The Contractor will devise a method for the disinfection procedure that meets the approval of the Project Manager. The Contractor will include the cost of the disinfection process in his unit process for borehole construction.

The Contractor shall ensure that the disinfecting agent is uniformly applied throughout the entire water depth of the borehole. The disinfecting agent may be placed by a tremie pipe of sufficient length to extend to the bottom of the borehole. The disinfecting agent shall be applied through the hose that shall be raised and lowered to achieve uniform distribution of the solution throughout the borehole.

3.7. Concrete slab, well heads and capping of boreholes

a) Sanitary seal

The annular space between the borehole and wall of the surface casing shall be grouted for sanitary seal for a depth not less than 2 m below ground surface with mixture of cement and water slurry by a pour-in method from the top.

Cement grouting shall be carried out in one continuous operation before initial setting of the cement occurs. Regardless of the method used, the grout shall be introduced at the bottom of the space to be grouted. In no circumstance will this be less than 2 m below the wellhead. The method proposed by the Contractor will be changed or modified if and required to suit the local conditions.

b) Construction of concrete slab

After the completion of the borehole to the satisfaction of the Project Manager, the Contractor if must excavate around the sanitary seal until reasonably firm formation is reached.

The ends of the surface casing shall be cut off 0.5 m below the surface level.

The Contractor shall construct a reinforced concrete block (with 12 mm steel reinforcing rods at equal spacing) with the surface dimension of 1 m width, 1 m length and 1.5 m high (1 m below the surface level, 0.5 m above the surface level). Surface of the concrete block will have a divergent slope.

The well casing must protrude 0.2 m above the concrete block unless otherwise specified by the Project Manager.

The wellhead block shall be cast around the surface casing in accordance with the Contract drawings, with 0.5 m inside the concrete slab.

c) Wellhead block and capping

The wellhead block without artesian pressure is detailed in the drawings section. The Contractor shall supply all materials and carry out the construction of the wellhead according to the following instructions:

- on the top of this casing, a welded flange (stainless steel, 10 mm tick);
- over the flange, a capping plate (stainless steel, 10 mm tick) bolted together with the coupling in 8 points and welded in 10 points.

The wellhead block with artesian pressure will be equivalent to the above, but should stand up to 3 bars pressure.

The well head shall be marked with the well number, in a manner approved by the Project Manager.

3.8. Lost boreholes and abandonment

a) Failure to complete wells

Should any accident to the plant, jamming of the tools or casing, collapse of the borehole, or any other causes due to the Contractor's negligence, prevent the satisfactory completion of the works, the borehole shall be deemed to be lost and no payment shall be made for that borehole or for any material not recovered there from, nor for any time spent during operations or while attempting to overcome the problems. The option of declaring such lost well shall rest with the Contractor.

In the event of a well potentially being deemed lost, the Project Manager may where possible redesign the well so that it is of use to the Employer and payment will be made in accordance with quantities and rates written in the Contract document. Should it not be possible to do this, the well shall be declared 'lost'.

A well may also be declared lost by the Project Manager if it is not completed as required due to uncontrolled caving, lost tools down-hole which cannot be recovered, lost circulation zones, unsuccessful cementing or any other reason which leads to failure of completion and which renders the well useless or of little value to the Employer.

A lost hole should be neutralised by a full cementation at the satisfaction of the Project Manager.

No payment shall be made for a lost well and its neutralisation.

In the event of lost well the Contractor shall drill a new well at a site indicated by the Project Manager.

b) Fishing

Under no circumstances will the Employer pay any charge for time spent on fishing operations due to the Contractor's negligence, broken drill string components, stuck pipe, junk in the hole or any other reason. Contractors are advised to assure themselves of the good condition of all drill string components and maintain adequate wellhead security at all times.

c) Abandonment

The Project Manager shall have the right at any time during the progress of the work to order the abandonment of a borehole.

~~The Contractor thereupon shall withdraw the casing from the borehole, if applicable, and salvage or attempt to salvage all such materials as the Project Manager shall direct and/or up until the Project Manager revokes such direction and shall fill in or leave the borehole to the satisfaction of the Project Manager. Aquifers may be sealed by cement.~~

Payment shall be made for such abandoned boreholes at the rates and tariffs shown in the Bill of Quantities.

4. AQUIFER TESTING AND WATER QUALITY

4.1. Introduction

The aquifer pumping test is a thorough and precise test of the characteristics of the water bearing formation in the vicinity of the well. It is of prime importance that the Contractor correctly monitors test pumping operations to ensure that accurate data is obtained. Testing work will be carried out with the intent of maximising the chances of success in completing tests within the allocated period of time.

For testing operations, the pump test will be installed at the bottom of the pump house, i.e. the bottom of the casing.

6.2. Calibration test

Before beginning the actual tests on each well, a calibration test must be undertaken. This involves checking that all equipment including the pump, generator, manometer and pipes are working satisfactorily. The discharge pipeline shall be checked for leaks. The gate valve shall be graduated and relative discharge positions marked in preparation for the step test. Once the calibration test has been completed the well must be allowed to recover to the satisfaction of the Project Manager, before the actual test pumping operations can begin.

The cost of the calibration test shall be uniformly spread over the pump test items of the Bill of Quantities.

4.3. Tests sequence and duration

If calibration test shows that a well has sufficient capacity to be interest, pump testing shall be carried out. The following two types of test may be conducted according to the instruction of the Project Manager.

- Continuous Step Draw-Down test: The Step Draw-Down test shall have six (6) steps of one (1) hour each, without rest period. The test shall begin with the lowest discharge rate (about 1/5 of the pump capacity) and increase consecutively until the maximum discharge rate is reached. (about 150% of the planned well yield). Upon completion of the step drawdown test, a step recovery test shall be undertaken, which should normally last for at least two (2) hours or as otherwise directed by the Project Manager.
- Constant discharge test. Constant discharge tests will be hundred twenty (120) hours in length followed by a twenty four (24) hours recovery period, at a pumping rate close to the planned well yield (70 l/s or 115 l/s). The Project Manager or his representative during the test on the basis of the measurements made and his analysis may increase or reduce both periods thereof.

~~The pump test shall be terminated only upon the written notice of the Project Manager or his representative.~~

The test pump cannot be removed from the well during the recovery periods.

The pumped water during pumping test should not be allowed to form pools to avoid re-infiltration in the vicinity of the wells. If the Project Manager feels that infiltration would take place around the well he can order the Contractor to dispose the water by means of discharge pipes toward a nearby natural drain over a distance where infiltration into the aquifer during testing is negligible.

4.4. Water level measurements

During the period of the tests, the Contractor shall measure and record water levels in the pumped well. For measurement of water levels in wells, pressure meter or electric water level indicators shall be used.

If water level indicator is used, the Contractor shall have at least two water level indicators on each site. In the tested well, the measurement will be done through a temporary measurement pipe which shall be deep enough to reach the top of the pump.

The water level measurement will also be done in up to 2 neighbour wells designated by the Project Manager.

For the tested borehole, the following time intervals are recommended:

Every	1	minutes from	0	to	10	minutes of pumping
Every	2	minutes from	10	to	30	minutes of pumping
Every	5	minutes from	30	to	60	minutes of pumping
Every	10	minutes from	60	to	360	minutes of pumping
Every	15	minutes from	360	to	600	minutes of pumping
Every	30	minutes from	10	to	24	Hours of pumping
Every	60	minutes from	24	to	72	hours of pumping

4.5. Flow measurements

Flow measurements shall be made by means of a gauging weir consisting of a 90° weir plate (V – Notch) as described in the drawing section.

Flow measurements will be made for any water level measurement.

The contractor is responsible with mobilising testing pump with sufficient capacity to meet the planned well yield.

4.6. Interruption of the test pumping

The discharge rate during the pumping shall be maintained within five per cent of the rate established by the Project Manager and the Contractor shall maintain uninterrupted pumping during the period of all tests. If not so, the Project Manager may declare the test interrupted. Shall the Contractor fail to provide accurate water level and flow measurement with the recommended frequency, the Project Manager may also declare the test interrupted.

No payment will be made for the elapsed time of the test prior to the interruption.

Unless otherwise directed by the Project Manager, interrupted tests shall not be restarted until sufficient time has elapsed for complete recovery of the water levels in the pump or observation well and shall not be considered to be a part of the pumping test for purposes of

~~payment even though water level measurements shall be made during that period by the Contractor if so directed by the Project Manager.~~

4.7. Reporting

The contractor shall record test-pumping data on prepared sheets after the approval of the Project Manager. The data sheet shall be filled in the English language. The data sheets prepared in triplicate shall include the following information:

- 1) The location of the well being tested.
- 2) The physical characteristic of the well including depth, diameter, size length of casing screen setting and length of screen.
- 3) Characteristics of the test pump
- 4) Depth of setting of the test pump in meters.
- 5) Date and time of start and finish of pumping test.
- 6) Static water level at commencement of test, dynamic water levels and discharge rates at prescribed time intervals.
- 7) Draw -down recovery after pumping is completed.
- 8) Date and time of start of removal of test pump from the borehole.

4.8. Water samples and analysis

Water samples for water quality analysis must be collected during the pumping test as directed by the Project Manager. Each sample consists of 4 containers as in a glass or suitable plastic container of 1-liter capacity each.

Water samples should be clearly marked showing name and number of well, date of sampling, hour of sampling, temperature and conductivity of water during sampling and signature of person taking the sample.

2 sets of samples are dedicated for future ICP-MS analyses and will be stored. 1 set will be stored for cross-check analysis if required.

One sample shall be sent to a Laboratory approved by the Project Manager within 12 hours after sampling. During transportation, the sample shall be kept in an isotherm box.

The contractor shall carry out water analysis for at least the following:-:

- Temperature
- Electrical conductivity at 25°C
- pH at 20°C
- Cations: Ca⁺⁺ Mg⁺⁺ Na⁺ K⁺ and total Fe
- Anions: Cl⁻, NO₃⁻, SO₄⁻⁻ and HCO₃⁻

Note

- :
- a) The Project Manager may order additional analyses if deemed necessary to achieve project objectives

-
- b) Contractor is responsible in ensuring that the samples are stored in correct temperature condition throughout the contract, if deemed necessary the contractor shall provide air-conditioned room exclusively for storing the samples.
- c) Time of storing: till the demobilization.

5. QUALITY OF MATERIALS AND WORKS

5.1. Erection of drilling machine at borehole site

The drilling machine must be erected at the borehole site in such a way that the hole will be drilled within 1 m of the marks which is shown to the contractor by the Project Manager.

No payment will be made for a well not located at the designed site.

5.2. Verticality and alignment of boreholes

The wells will be drilled and cased straight and vertical, and all casing, screen or liners will be set plumb and true to line.

Upon completion of drilling or at any other time, the borehole shall be tested for verticality and straightness using deviation-measuring instruments like Inclinator, Draft Indicator...etc provided and operated by the Contractor at the Contractor's own expenses. Readings of deviation and direction will be taken at three meters depth intervals. Deviation shall be no more than 10%.

After pump house casing installation, verticality will be tested by the plumb-bob method. The dummy will consist of an axially suspended cylinder (or cage-ring) at least 7 m long with an external diameter as specified in the Conventional Code of Testing Boreholes. The suspending wire should be less than 5 millimetres diameter of uniform cross section with no kinks. Dummy should freely be passed down the borehole without force. Dummy is provided and operated by the Contractor at the Contractor's own expenses. Should the plumb or dummy fail to move freely throughout the length of the casing or hole to the bottom of the housing line or should the borehole vary from the vertical in excess of above specified value, or beyond limitations of this test, the plumbness and alignment of the borehole shall be corrected by the contractor at his own expense. Should the contractor fail to correct such faulty alignment or verticality, the well may be deemed lost. The Project Manager may waive the requirements of this paragraph for verticality if in his judgment he establish that:-

- The Contractor has exercised all possible care in constructing the borehole and the defect is due to circumstances beyond his control.
- The usefulness of the completed borehole will not be materially affected.
- The cost of necessary remedial measures will be excessive.

In no event will the provisions of this paragraph with respect to alignment be waived.

5.3. Assembling of casing, tubes and screens

The assembling methodology for casing, tubes and screen will be submitted to and approved by the Project Manager before operation. A particular attention will be paid to the external

~~diameter of tubes and screens, and his compatibility with cementing or gravel pack installation.~~

The 18"5/8 casing may be coupled to each other either with welds. In order to secure mechanical and corrosion resistances, the Contractor should submit the certificates and qualifications of the

welding operator as well as the welding procedures to the Project Manager and get his approval before starting operations. All welding electrodes must comply with the Standard Specifications DIN 1913 or AWS (American Welding Society) standards.

The 13"3/8 tubes and screens may be coupled to each other either with tight sleeve connection (ZSM connection 2 rods version).

The 8"5/8 and 10"3/4 (type 2) tubes and screens may be coupled to each other either with tight sleeve connection (ZSM connection 2 rods version) or with API round threaded connection.

The 10"3/4 (type 1) tubes and screens may be coupled to each other either with API round threaded connection.

In case of threaded connections, the lubricating compound shall not contain any heavy metal or hydrocarbon.

5.4. Characteristics of the drilling fluid and additives

In order to limit the environmental impact and to improve the mud quality, the contractor should use mud tanks. Hand dug pits for mud are forbidden.

Drilling mud should be of biodegradable type and non-toxic and amenable to degradation by an appropriate chemical agent. The use of bentonite mud is only authorized for drilling of the sealed terrain, i.e. less than about 230 m.

The Contractor must ensure that if the Employer or Project Manager specifies mud drilling, he has the necessary equipment including mud pumps, viscosity-measuring apparatus, water tanks etc., to enable him successfully complete the works.

The Contractor shall specify the brand name and manufacturer of any mud or chemicals or additives proposed to be used and include technical specifications or any other relevant data. Readings of the mud condition (pH, viscosity, density and sand content) will be collected and recorded as directed by the Project Manager. Steps will be taken immediately to correct any variations of the preferred values.

A special and permanent attention should be paid to the density of the drilling mud, in regard to the expected high artesianism of the aquifer. Balanced mud weights will be used for control of the artesian conditions. Barite may be used for mud weight control.

Where applicable and required, mud dispersing agents (such as glassy phosphate), acids for washing limestone, and other chemicals applicable to standard procedures may be used as. If polyphosphates are used, it must be followed by well disinfection. It is recommended, however, to provide a polyphosphate product that already contains disinfecting agents (i.e.

‘_Weltone’ or equivalent).

5.5. Characteristics of the casings and screens

Surface casing can be standard black steel casing. All other casing, plain tubes and screens will be made of 304L stainless steel or equivalent.

~~The 10 3/4" tubes and screens characteristics should be:~~

- Tubes: Internal and external longitudinally welded pipe AISI 304L according to ASTM A312 or DIN 4922 with ferrite content <5% and OD 273 mm
- Tubes and screens: the minimum collapse resistance will be 65 bars for the type 1 (the standard pipe 273 x 9.27 mm should meet this requirement) and 50 bars for the type 2.
- Before shipment material will be picked and passivated according to ASTM A380

The 8 5/8" tubes and screens characteristics should be:

- Tubes: Internal and external longitudinally welded pipe AISI 304L according to ASTM A312 or DIN 4922 with ferrite content <5% and OD 219 mm
- Tubes and screens: the minimum collapse Strength will be 70 bars (the standard pipe 219 x 8,18 mm (Sch 40) should meet this requirement).
- Before shipment material will be picked and passivated according to ASTM A380

All screens to be installed into the boreholes would be with 0.75 mm slot (tolerance 0.2 mm). This slot might be modified to 1 mm (tolerance 0.2 mm) slot after the first series of tests. The authorized open area will range from 6.5% to 9.5%, in order to maintain an entry velocity from 2 to 3 cm/s. In case of use of pipe base wire wound screens, the pipe has to offer an open area significantly higher than the continuous wire open area, and 13% minimum.

All casing and tubes supplied by the Contractor and which will be installed permanently in the boreholes must be with no circular welding; only longitudinally welding is allowed except to connect the fittings. None of the pipes will made of short pieces welded together.

All casing and tubes supplied by the Contractor and which will be installed permanently in the boreholes must be new and must comply with the ASTM standards. The appropriate manufacturer's product information pamphlets with full details of the offered casing, tubes and screens, including method of joining must be provided to the Project Manager and accepted before installation in the hole. The following information should be engraved on equipments:

- Customer project name
- Supplier name
- Material
- OD and slot for screens, OD and nominal thickness for tubes

The Contractor will organise at his own costs a qualitative inspection, carried out by a recognized international certification company (third part inspection – choice of the third party to be given to Project Manager). It must be held for the release of the equipment at supplier site to check conformity of:

- Origin of stainless steel, traceability during manufacturing process to avoid mix of different stainless steel.
- Quality plan, quality certificate and qualification of manufacturer, welding operators qualifications, welding procedures

Material manufacturer certificates according to EN 10204 / 3.1

- ~~Dimensional results (slot measurements, tally list)~~

- X-Ray control of the longitudinal welded joint (for 2% of length over 10% of the pipes number randomly selected)
- Before shipment material will be pickled and passivated according to ASTM A380
- Destructive tensile test (on a partial length of 13”3/8, 10 3/4 and 85/8”screen). The Contractor should demonstrate that these figures are compatible with the weight of columns of screen and tubes.
- Full length destructive collapse test (on pipes and screens 13”3/8 , 10 3/4 and 85/8”)
- Internal pickling report and internal acceptance report of the production, as well as environmental report on passivation plan

The Contractor will organise at his own costs (covering travel, accommodation for a minimum of 3 days, subsistence) the participation of two (2) representatives of the Client to the qualitative inspection.

5.6. Characteristics of the gravel pack

The gravel pack will consist of quartz sand and gravel will not contain any carbonate calcium. The material must be clean well-rounded 90 % composed of quartz. The use angular crushed material is not acceptable. Considering the nature of the aquifer material and the specified screen aperture, the required grain size for 95% of the gravel pack material should be 1.0 mm to 2,5 mm.

5 kg sample of the gravel pack material must be submitted to the Project Manager for approval before use. Such approval shall be issued in writing and under no circumstances is the contractor to produce gravel for the work until such approval has been received.

5.7. Characteristics of the cement

a) Cement

All cement, which is used, must comply with the Standard Specification DIN 1164, EN 197, DIN 18555 and must not be older than three months. Unless otherwise instructed by the Project Manager or the Employer, a hardening agent such as calcium chloride should not be used to accelerate the cement setting process. The normal aggregate size for use with the cement may not exceed 19 mm unless otherwise stated.

b) Cement slurry

The cement used for cement slurry will be PORTLAND artificial CPA325 type.

The water used shall be potable water. No less than 800 kg of cement will be used per cubic meter of water.

~~**d) Cement mortar**~~

The cement used for cement slurry will be PORTLAND artificial CPA325 type.

The water used shall be potable water. No less than 50 kg of cement will be used for 100 l of water. A minimum of 600 kg of cement shall be used per cubic meter of sand.

5.7. Tools and accessories

For accessories listed below, the contractor should provide and get approved drawings including all technical details, quality plan, reference and origin:

Production well head with and without artesian pressure

- Bottom plug;
- Centralizers;
- Handling tools and clamps for pipes and screens (according to EEC safety rules), and;
- Cross-over tool.

3.AWWDA GENERAL SPECIFICATIONS

~~IMPLEMENTATION OF COVID-19 PREVENTIVE MEASURES~~

GUIDELINES FOR CONCRETE WORKS FOR THE FOUNDATION OF ELEVATED STEEL WATER TANKS

1. DEFINITION

Structural concrete is any class of concrete which is used in reinforced, prestressed or unreinforced concrete construction, which is subject to stress.

2. DESIGN OF CLASS C30 CONCRETE MIX

Below please find the mix design for class 30 structural concrete.

Class of Concrete	Nominal Strength (N/mm ²)	Maximum Nominal Aggregate Size	Maximum Water / Cement Ratio	Target Mean Strength N/mm ²	Strength test results	
					Strength at 7 days N/mm ²	Strength at 28 days N/mm ²
30/20	30	20	0.48	41.5	25.5	37.5

Note: Premix concrete from identified suitable suppliers will be utilised for the foundation works to ensure uniform quality in the various sites.

3. QUALITY CONTROL OF CONCRETE PRODUCTION

3.1 Sampling

Samples of concrete shall be taken at the point of deposition. Six number 150mm concrete cubes shall be made from each batch and shall be cured and tested all in accordance with BS 1881, three at seven days and the other three at 28 days. Each sample shall be taken from one batch selected at random and at intervals such that each sample represents not more than 20m³ of concrete.

Minimum three specimens should be tested at each selected age. If strength of any specimen varies by more than 15 percent of average strength, results of such specimen should be rejected.

3.2 Testing

3.2.1 Slump Test

Concrete slump test or slump cone test is to determine the workability or consistency of concrete mix during the progress of the work. Concrete slump test is carried out from batch to batch to check the uniform quality of concrete during construction. This test should be carried out for every pour of concrete in accordance with BS 8110.

3.2.2 Cube Test:

Compressive strength of concrete cube test provides an idea about all the characteristics of concrete. By this single test one judge that whether Concreting has been done properly or not.

Compressive strength of concrete depends on many factors such as water-cement ratio, cement strength, quality of concrete material, quality control during production of concrete etc. Concrete cube test should be carried out in accordance with BS 8110.

4. PLACING OF CONCRETE

- a) **Consent for Placing:** Concrete shall not be placed in any part of the Works until the Engineer's consent has been given in writing.
- b) **Preparation of Surface to Receive Concrete:** Before deposition of concrete, receiving surface shall be clean, hard and sound and shall be wet but without any free-standing water. Unless otherwise instructed by the Engineer surfaces against which concrete is to be placed shall receive class 15 blinding.

The amount of mortar placed at any one time shall be limited so that it does not dry out or set before being covered with concrete.

- e) **Placing Procedures:** The concrete shall be deposited as nearly as possible in its final position. It shall be placed so as to avoid segregation of the concrete and displacement of the reinforcement, other embedded items, or formwork. It shall not exceed 500mm in compacted thickness unless otherwise permitted or directed by the Engineer, but the layers shall not be thinner than four times the maximum nominal size of aggregate.

All work shall be completed on each batch of concrete before its initial set commences and thereafter the concrete shall not be disturbed before it has set hard. No concrete that has partially hardened during transit shall be used in the Works and the transport of concrete from the mixer to the point of placing shall be such that this requirement can be complied with.

Concrete shall not be placed during rain which is sufficiently heavy or prolonged as to wash mortar from coarse aggregate on the exposed faces of fresh concrete.

In drying weather, covers shall be provided for all fresh concrete surfaces which are not being worked on. Water shall not be added to concrete for any reason.

When concrete is discharged above its place of final deposition, segregation shall be prevented by the use of chutes, downpipes, trunking, baffles or other appropriate devices, as approved by the Engineer. Special care shall be taken to avoid segregation.

5. COMPACTION OF CONCRETE

The concrete shall be fully compacted throughout the full extent of the placed layer. It shall be thoroughly worked against the formwork and around any reinforcement and other embedded items, without displacing them. Particular care shall be taken at arises and other confined spaces. Successive layers of the same pour shall be thoroughly worked together.

Concrete shall be compacted with the assistance of mechanical immersion vibrators. The vibrators shall be inserted vertically into the concrete to penetrate the layer underneath at regular spacing. The spacing shall not exceed the distance from the vibrator over which vibration is visibly effective

A sufficient number of vibrators shall be operated to enable the entire quantity of concrete being placed to be vibrated for the necessary period and, in addition, standby vibrators shall be available for instant use at each place where concrete is being placed.

Vibration shall be continued at each point until the concrete ceases to contract, a thin layer of mortar has appeared on the surface and air bubbles have ceased to appear. Vibrators shall be withdrawn slowly to prevent the formation of voids.

6. CURING OF CONCRETE

Concrete shall be protected during the first stage of hardening from loss of moisture and from the development of temperature differentials within the concrete sufficient to cause cracking. The methods used for curing shall not cause damage of any kind to the concrete. Curing shall be continued for at least seven days. The Contractor shall keep the exposed surfaces continuously wet by means of a water spray or by covering with a water absorbent material which is kept wet. Water used for curing shall be of the same quality as that used for concrete mixing.

7. PROTECTION OF FRESH CONCRETE

Freshly placed concrete shall be protected from rainfall and from water running over the surface until it is sufficiently hard to resist damage from these causes. No traffic shall be allowed on any concrete surface until such time as it is hard enough to resist damage by such traffic.

Concrete placed in the Works shall not be subjected to any loading until it has attained at least its nominal strength.

8. RECORDS OF CONCRETE PLACING

Records, in a form agreed by the Engineer, shall be kept by the Contractor of the details of every pour of concrete placed in the Works. These records shall include class of concrete, location of pour, date of pour, ambient temperature and weather conditions during mixing and placing and concrete temperature at time of placing, moisture contents of aggregates, details of mixes, batch numbers, cement batch number, results of all tests undertaken, location of test cube sample points and details of any cores taken.

The Contractor shall supply to the Engineer histograms of all 28-day cube strengths together with accumulative and monthly standard deviations and any other information which the Engineer may require concerning the concrete placed in the works.

9. BENDING REINFORCEMENT

The Contractor shall satisfy himself as to the accuracy of any bar bending schedules supplied and shall be responsible for cutting, bending, and fixing the reinforcement in accordance with the drawings.

Reinforcement shall be thoroughly cleaned and all dirt, scale, loose rust, oil and other contaminants removed before it is placed in the Works.

10. FIXING REINFORCEMENT

Before concrete is placed in any section of the Works which includes reinforcement, the reinforcement shall be completely clean and free from all contamination including concrete which may have been deposited on it from previous operations.

Unless otherwise agreed by the Engineer, all intersecting bars shall either be tied together with 1.6mm diameter soft annealed iron wire and the ends of the wire turned into the body of the concrete, or shall be secured with a wire clip of a type agreed by the Engineer.

Spacer blocks shall be used for ensuring that the correct cover is maintained on the reinforcement. Blocks shall be as small as practicable and of a shape agreed by the Engineer. They shall be made of mortar mixed in the proportions of one part of cement to two parts of sand. Wires cast into the block for tying in to the reinforcement shall be 1.6mm diameter soft annealed iron.

Reinforcement shall be rigidly fixed so that no movement can occur during concrete placing. Any fixings made to the formwork shall not be within the space to be occupied by the concrete currently being placed. The Contractor shall ensure that reinforcement left exposed in the Works shall not suffer distortion, displacement or other damage.

The Engineer's approval for concrete placing is to be sought in writing for each pour, leaving adequate time to inspect and rectify any defects noted in the formwork, falsework, reinforcement, scaffolding, concreting arrangements, etc.

11. FORMWORK

Formwork means the surface against which concrete is placed to form a face, together with all the immediate supports to retain it in position while concrete is placed.

a) Construction of formwork and falsework

Formwork and falsework shall be so constructed that they will support the loads imposed on them by the fresh concrete together with additional stresses imposed by vibrating equipment and by construction traffic, so that after the concrete has hardened the formed faces shall be in the positions shown on the drawings within the tolerances.

All joints in formwork including formwork for construction joints shall be tight against the escape of cement, water and fines. Where reinforcement projects through formwork, the form shall fit closely round the bars.

Formwork shall not be re-used after it has suffered damage which in the opinion of the Engineer is sufficient to impair the finished surfaces of the concrete.

Where circumstances prevent easy access within the form for cleaning and inspection, temporary openings for this purpose shall be provided through the formwork.

b) Preparation of formwork

Before any reinforcement is placed into position within formwork, the latter shall be thoroughly cleaned and then dressed with a release agent. The agent shall be either a suitable oil incorporating a wetting agent, an emulsion of water suspended in oil or a low viscosity oil containing chemical agents. The Contractor shall not use an emulsion of oil suspended in water nor any release agent which causes staining or discoloration of the concrete, air holes on the concrete surface, or retards the set of the concrete.

In cases where it is necessary to fix reinforcement before placing formwork, all surface preparation of formwork shall be carried out before it is placed into position. The Contractor shall not allow reinforcement or prestressing tendons to be contaminated with formwork release agent.

Before placing concrete all dirt, construction debris and other foreign matter shall be removed completely from within the placing area.

c) Removal of formwork

Formwork shall be carefully removed without shock or disturbance to the concrete. No formwork shall be removed until the concrete has gained sufficient strength to withstand safely any stresses to which it may thereby be subjected.

The minimum periods which shall elapse between completion of placing concrete and removal of forms are given in Table 1 below.

Compliance with these requirements shall not relieve the Contractor of his obligation to delay removal of formwork until the removal can be completed without damage to the concrete.

Table 1: MINIMUM PERIODS FOR FORMWORK REMOVAL

Position of Formwork	Minimum Period
Vertical or near vertical faces of reinforced walls, beams and columns	48 hours
Underside of arches, beams and slabs (formwork only)	4 days
Supports to underside of arches, beams and slabs	14 days

WATER TIGHTNESS TESTING PROCEDURE FOR ELEVATED STEEL WATER TANKS
TESTING PROCEDURE

Service reservoirs should be tested for water tightness before being put into service.

The interior of the reservoir, especially any joints, should be closely inspected before filling with water.

The tank should be filled with treated water, to a test level about 75 mm below the overflow sill, **at a uniform rate not exceeding 2m** vertical rise in water level per 24 hours.

The water should be allowed to stand under test for 7 days.

While Pumping, check pipe fittings for movements and leakages.

While filling the tank, check for:

- Any movements within the concrete foundations;
- Any movements on the tower and tank panels;
- Any leakages.

For elevated tanks the acceptance criteria shall **be no visible leaks**.

During the 7-day test period, the effects of evaporation from the water surface can be reduced by closing all air vents and access openings (except for one vent left open for pressure balance).

The delivery pipe connected to the reservoir should be inspected during the test to ensure that all isolating valves are shut tight. Any significant leakage through them should be measured.

The test may be deemed successful if the drop of water level over the 7-day test period does not exceed the lesser of $1/500 \times \text{average water depth}$ **i.e 4mm**, after deducting any measured leakage through valves and making allowance for any evaporation.

If the test fails, the test compartment should then be emptied and closely inspected for faults likely to cause the leakage.

Below please find checklist

WATER TIGHTNESS TEST CHECK-LIST

NAME OF SITE..... INSPECTED BY:

DATE.....

S/No	Inspection Aspect	Response				Remarks
1	Joints inspected	YES		NO		
2	1st Filling - 0.5m (up to 6hrs)	YES		NO		
2.1	Movement vibration of rising main	YES		NO		
2.2	Leakages in rising main	YES		NO		
2.3	Movement in concrete foundations	YES		NO		
2.4	Vibration movement in tower and tanks	YES		NO		
2.5	Observed Leakages through tank	YES		NO		
3	2nd Filling, up to 1m (up to 12 hrs)	YES		NO		
3.1	Movement vibration of rising main	YES		NO		
3.2	Leakages in rising main	YES		NO		
3.3	Movement in concrete foundations	YES		NO		
3.4	Vibration movement in tower and tanks	YES		NO		
3.5	Observed Leakages through tank	YES		NO		
4	3rd Filling, up to 1.5m (Up to 18 hrs)					
4.1	Movement vibration of rising main	YES		NO		
4.2	Leakages in rising main	YES		NO		
4.3	Movement in concrete foundations	YES		NO		
4.4	Vibration movement in tower and tanks	YES		NO		
4.5	Observed Leakages through tank	YES		NO		
5	4th Filling, up to 2.0m (Up to 24 hrs)					
5.1	Movement vibration of rising main	YES		NO		
5.2	Leakages in rising main	YES		NO		
5.3	Movement in concrete foundations	YES		NO		
5.4	Vibration movement in tower and tanks	YES		NO		
5.5	Observed Leakages through tank	YES		NO		
6	Daily Observation for 7 days test period					
6.1	Movement in concrete foundations	YES		NO		
6.2	Vibration movement in tower and tanks	YES		NO		
6.3	Observed Leakages through tank	YES		NO		
7	Total Leakage in (mm)					
8	Test Status	PASS		FAIL		

Name & Signature:

Contractor..... Supervising Engineer.....

Date:.....Date:.....
.....

Location

The works will be located in Machakos County.

Scope of Works

The Electrical sub-contractor shall supply and install the complete Electrical Services installation systems comprising but not limited to the following:

4.2.1 High Pressure protection

It shall be possible to program a “high-pressure” safety cut-out, set 1.5 bar above the duty pressure. The pumps set shall automatically shut down in the event of the above pressure being identified. Following a shut-down the controller shall (a) re-start the pump set automatically once the high condition has disappeared, or (b) will remain shut down until manually re-started by an authorised person. (The preferred option shall be agreed with the end user prior to hand over and the controller programmed accordingly).

4.2.2 Low Pressure/pipe burst protection

It shall be possible to program a “Low-pressure” safety cut-out, set 1 bar below the duty pressure. The pumps set shall automatically shut down in the event of the above pressure being identified. Following a shut-down the controller shall (a) re-start the pump set automatically once the high condition has disappeared, or (b) will remain shut down until manually re-started by an authorised person. (The preferred option shall be agreed with the end user prior to hand over and the controller programmed accordingly).

4.2.3 Soft pressure build up.

The panel shall incorporate a slow-speed/one-pump-only start up, following a power outage or maintenance shutdown to gradually fill up the pipeline and reduce risk of airlocks and water hammer.

4.2.4 Redundant sensor

The controller shall have a feature that gives an alarm if there is incoherency between the two discharge sensor signals.

4.2.5 Testing and Commissioning:

Once installed on site, with all necessary permanent water services, power supplies, control and alarm systems completed and tested. The panel manufacturer shall be invited to site to commission, test and demonstrate the operation of the panel to the full satisfaction of the Engineer and End User.

Working Drawings /Fabrication Drawings

Upon award of the subcontract the subcontractor shall produce three sets of the working drawings to Engineer prior to commencement of the work. The Engineer has to approve the drawings for the subcontractor to proceed with the works. The drawings shall be in A2 hard copies.

Fabrication drawings of the pumps control panel shall be submitted to the engineers for approval before fabrication commences.

As Built Drawings

The subcontractor shall prepare the As-Built drawings at the completion for the subcontract. The drawings shall be in AUTOCAD and 3No. Sets of A3 hard copies.

Abbreviations

The following abbreviations are used in these documents:

FIDIC	Federation International des Ingenieurs – Conseils
BS	British Standards
CP	Code of Practice
GRP	Glass Reinforced Plastic
AC	Asbestos Cement
DI	Ductile Iron
Ch	Chainage
PVC	Polyvinyl Chloride
kPa	kilo Pascal
g	acceleration due to gravity - (9.807m/s ²)
gpm	gallons per minute
mgd	million gallons per day
mm	millimeters
m	metres
mhd	metres head
m ³	cubic metres
m ³ /day	cubic metres per day
m/s ²	metres per second head
l/head/day	litres per head per day
kW	kilowatts
kVa	kilovolt-ampere
kWh	kilowatt hour
ISO	International Standards Organisation
CFM	cubic feet per minute
AOD	Above ordnance datum
SWL	Static water level
PWL	Pumping water level
GL	Ground level
EOH	End of hole

PART 3 – Conditions of Contract and Contract Forms

Section VII. General Conditions (GC)

Section VII. General Conditions (GC)

[Name of Employer]

[Name of Contract]

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Section VII. General Conditions (GC)

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General Conditions (GC)

1. General Provisions

1.1 Definitions

In the Conditions of Contract (“these Conditions”), which include Particular Conditions, Parts A and B, and these General Conditions, the following words and expressions shall have the meanings stated. Words indicating persons or parties include corporations and other legal entities, except where the context requires otherwise.

1.1.1 The Contract

- 1.1.1.1 “Contract” means the Contract Agreement, the Letter of Acceptance, the Letter of Bid, these Conditions, the Specification, the Drawings, the Schedules, and the further documents (if any) which are listed in the Contract Agreement or in the Letter of Acceptance.
- 1.1.1.2 “Contract Agreement” means the contract agreement referred to in GC Clause 1.6 [Contract Agreement].
- 1.1.1.3 “Letter of Acceptance” means the letter of formal acceptance, signed by the Employer, of the Letter of Bid, including any annexed memoranda comprising agreements between and signed by both Parties. If there is no such letter of acceptance, the expression “Letter of Acceptance” means the Contract Agreement and the date of issuing or receiving the Letter of Acceptance means the date of signing the Contract Agreement.
- 1.1.1.4 “Letter of Bid” means the document entitled letter of bid, which was completed by the Contractor and includes the signed offer to the Employer for the Works.
- 1.1.1.5 “Specification” means the document entitled specification, as included in the Contract, and any additions and modifications to the specification in accordance with the Contract. Such document specifies the Works.
- 1.1.1.6 “Drawings” means the drawings of the Works, as included in the Contract, and any additional and modified drawings issued by (or on behalf of) the Employer in accordance with the Contract.
- 1.1.1.7 “Schedules” means the document(s) entitled schedules, completed by the Contractor and submitted with the Letter of Bid, as included in the Contract. Such document may include the Bill of Quantities, data, lists, and schedules of rates and/or prices.
- 1.1.1.8 “Bid” means the Letter of Bid and all other documents which the Contractor submitted with the Letter of Bid, as included in the Contract.
- 1.1.1.9 “Bill of Quantities”, “Day work Schedule” and “Schedule of Payment Currencies” mean the documents so named (if

any) which are comprised in the Schedules.

- 1.1.1.10 “Contract Data” means the pages completed by the Employer entitled contract data which constitute Part A of the Particular Conditions.

1.1.2 Parties and Persons

- 1.1.2.1 “Party” means the Employer or the Contractor, as the context requires.
- 1.1.2.2 “Employer” means the person named as employer in the Particular Conditions and the legal successors in title to this person.
- 1.1.2.3 “Contractor” means the person(s) named as contractor in the Letter of Bid accepted by the Employer and the legal successors in title to this person(s).
- 1.1.2.4 “Engineer” means the person appointed by the Employer to act as the Engineer for the purposes of the Contract and named in the Particular Conditions, or other person appointed from time to time by the Employer and notified to the Contractor under **GC** Clause 3.4 [Replacement of the Engineer].
- 1.1.2.5 “Contractor’s Representative” means the person named by the Contractor in the Contract or appointed from time to time by the Contractor under **GC** Clause 4.3 [Contractor’s Representative], who acts on behalf of the Contractor.
- 1.1.2.6 “Employer’s Personnel” means the Engineer, the assistants referred to in **GC** Clause 3.2 [Delegation by the Engineer] and all other staff, labour and other employees of the Engineer and of the Employer; and any other personnel notified to the Contractor, by the Employer or the Engineer, as Employer’s Personnel.
- 1.1.2.7 “Contractor’s Personnel” means the Contractor’s Representative and all personnel whom the Contractor utilises on Site, who may include the staff, labour and other employees of the Contractor and of each Subcontractor; and any other personnel assisting the Contractor in the execution of the Works.
- 1.1.2.8 “Subcontractor” means any person named in the Contract as a subcontractor, or any person appointed as a subcontractor, for a part of the Works; and the legal successors in title to each of these persons.
- 1.1.2.9 “DB” means the person or three persons appointed under **GC** Clause 20.2 [Appointment of the Dispute Board] or **GC** Clause 20.3 [Failure to Agree on the Composition of the Dispute Board]
- 1.1.2.10 “FIDIC” means the Fédération Internationale des Ingénieurs-Conseils, the international federation of consulting engineers.
- 1.1.2.11 “Bank” means the financing institution (if any) named in the Particular Conditions.

- 1.1.2.12 “Borrower” means the person (if any) named as the borrower in the Particular Conditions.

1.1.3 Dates, Tests, Periods and Completion

- 1.1.3.1 “Base Date” means the date 28 days prior to the latest date for submission of the Bid.
- 1.1.3.2 “Commencement Date” means the date notified under **GC** Clause 8.1 [Commencement of Works].
- 1.1.3.3 “Time for Completion” means the time for completing the Works or a Section (as the case may be) under **GC** Clause 8.2 [Time for Completion], as stated in the Particular Conditions (with any extension under **GC** Clause 8.4 [Extension of Time for Completion]), calculated from the Commencement Date.
- 1.1.3.4 “Tests on Completion” means the tests which are specified in the Contract or agreed by both Parties or instructed as a Variation, and which are carried out under **GC** Clause 9 [Tests on Completion] before the Works or a Section (as the case may be) are taken over by the Employer.
- 1.1.3.5 “Taking-Over Certificate” means a certificate issued under **GC** Clause 10 [Employer’s Taking Over].
- 1.1.3.6 “Tests after Completion” means the tests (if any) which are specified in the Contract and which are carried out in accordance with the Specification after the Works or a Section (as the case may be) are taken over by the Employer.
- 1.1.3.7 “Defects Notification Period” means the period for notifying defects in the Works or a Section (as the case may be) under **GC** Clause 11.1 [Completion of Outstanding Work and Remedying Defects], which extends over twelve months except if otherwise stated in the Particular Conditions (with any extension under **GC** Clause 11.3 [Extension of Defects Notification Period]), calculated from the date on which the Works or Section is completed as certified under **GC** Clause 10.1 [Taking Over of the Works and Sections].
- 1.1.3.8 “Performance Certificate” means the certificate issued under **GC** Clause 11.9 [Performance Certificate].
- 1.1.3.9 “day” means a calendar day and “year” means 365 days.

1.1.4 Money and Payments

- 1.1.4.1 “Accepted Contract Amount” means the amount accepted in the Letter of Acceptance for the execution and completion of the Works and the remedying of any defects.
- 1.1.4.2 “Contract Price” means the price defined in **GC** Clause 14.1 [The Contract Price], and includes adjustments in accordance with the Contract.
- 1.1.4.3 “Cost” means all expenditure reasonably incurred (or to be incurred) by the Contractor, whether on or off the Site, including overhead and similar charges, but does not include profit.

- 1.1.4.4 “Final Payment Certificate” means the payment certificate issued under **GC** Clause 14.13 [Issue of Final Payment Certificate].
- 1.1.4.5 “Final Statement” means the statement defined in **GC** Clause 14.11 [Application for Final Payment Certificate].
- 1.1.4.6 “Foreign Currency” means a currency in which part (or all) of the Contract Price is payable, but not the Local Currency.
- 1.1.4.7 “Interim Payment Certificate” means a payment certificate issued under **GC** Clause 14 [Contract Price and Payment], other than the Final Payment Certificate.
- 1.1.4.8 “Local Currency” means the currency of the Country.
- 1.1.4.9 “Payment Certificate” means a payment certificate issued under **GC** Clause 14 [Contract Price and Payment].
- 1.1.4.10 “Provisional Sum” means a sum (if any) which is specified in the Contract as a provisional sum, for the execution of any part of the Works or for the supply of Plant, Materials or services under **GC** Clause 13.5 [Provisional Sums].
- 1.1.4.11 “Retention Money” means the accumulated retention moneys which the Employer retains under **GC** Clause 14.3 [Application for Interim Payment Certificates] and pays under **GC** Clause 14.9 [Payment of Retention Money].
- 1.1.4.12 “Statement” means a statement submitted by the Contractor as part of an application, under **GC** Clause 14 [Contract Price and Payment], for a payment certificate.

1.1.5 Works and Goods

- 1.1.5.1 “Contractor’s Equipment” means all apparatus, machinery, vehicles and other things required for the execution and completion of the Works and the remedying of any defects. However, Contractor’s Equipment excludes Temporary Works, Employer’s Equipment (if any), Plant, Materials and any other things intended to form or forming part of the Permanent Works.
- 1.1.5.2 “Goods” means Contractor’s Equipment, Materials, Plant and Temporary Works, or any of them as appropriate.
- 1.1.5.3 “Materials” means things of all kinds (other than Plant) intended to form or forming part of the Permanent Works, including the supply-only materials (if any) to be supplied by the Contractor under the Contract.
- 1.1.5.4 “Permanent Works” means the permanent works to be executed by the Contractor under the Contract.
- 1.1.5.5 “Plant” means the apparatus, machinery and other equipment intended to form or forming part of the Permanent Works, including vehicles purchased for the Employer and relating to the construction or operation of the Works.
- 1.1.5.6 “Section” means a part of the Works specified in the Particular Conditions as a Section (if any).

1.1.5.7 “Temporary Works” means all temporary works of every kind (other than Contractor’s Equipment) required on Site for the execution and completion of the Permanent Works and the remedying of any defects.

1.1.5.8 “Works” mean the Permanent Works and the Temporary Works, or either of them as appropriate.

1.1.6 Other Definitions

1.1.6.1 “Contractor’s Documents” means the calculations, computer programs and other software, drawings, manuals, models and other documents of a technical nature (if any) supplied by the Contractor under the Contract.

1.1.6.2 “Country” means the country in which the Site (or most of it) is located.

1.1.6.3 “Employer’s Equipment” means the apparatus, machinery and vehicles (if any) made available by the Employer for the use of the Contractor in the execution of the Works, as stated in the Specification; but does not include Plant which has not been taken over by the Employer.

1.1.6.4 “Force Majeure” is defined in **GC** Clause 19 [Force Majeure].

1.1.6.5 “Laws” means all national (or state) legislation, statutes, ordinances and other laws, and regulations and by-laws of any legally constituted public authority.

1.1.6.6 “Performance Security” means the security (or securities, if any) under **GC** Clause 4.2 [Performance Security].

1.1.6.7 “Site” means the places where the Permanent Works are to be executed including storage and working areas and to which Plant and Materials are to be delivered, and any other places as may be specified in the Contract as forming part of the Site.

1.1.6.8 “Unforeseeable” means not reasonably foreseeable by an experienced contractor by the Base Date.

1.1.6.9 “Variation” means any change to the Works, which is instructed or approved as a variation under **GC** Clause 13 [Variations and Adjustments].

1.1.6.10 “Notice of Dissatisfaction” means the notice given by either Party to the other under **GC** Clause 20.4 [Obtaining Dispute Board’s Decision] indicating its dissatisfaction and intention to commence arbitration.

1.2 Interpretation

1.2.1 In the Contract, except where the context requires otherwise

- (a) words indicating one gender include all genders;
- (b) words indicating the singular also include the plural and words indicating the plural also include the singular;
- (c) provisions including the word “agree”, “agreed” or “agreement” require

the agreement to be recorded in writing;

- (d) “written” or “in writing” means hand-written, type-written, printed or electronically made, and resulting in a permanent record;
- (e) the word “tender” is synonymous with “bid” and “tenderer” with “bidder” and the words “tender documents” with “bidding documents”.

1.2.2 The marginal words and other headings shall not be taken into consideration in the interpretation of these Conditions.

1.2.3 In these Conditions, provisions including the expression "Cost plus profit" require this profit to be one-twentieth (5%) of this Cost unless otherwise indicated in the Particular Conditions.

1.3 Communications

1.3.1 Wherever these Conditions provide for the giving or issuing of approvals, certificates, consents, determinations, notices, requests and discharges, these communications shall be:

- (a) in writing and delivered by hand (against receipt), sent by mail or courier, or transmitted using any of the agreed systems of electronic transmission as stated in the Particular Conditions; and
- (b) delivered, sent or transmitted to the address for the recipient’s communications as stated in the Particular Conditions. However:
 - (i) if the recipient gives notice of another address, communications shall thereafter be delivered accordingly; and
 - (ii) if the recipient has not stated otherwise when requesting an approval or consent, it may be sent to the address from which the request was issued.

Approvals, certificates, consents and determinations shall not be unreasonably withheld or delayed. When a certificate is issued to a Party, the certifier shall send a copy to the other Party.

1.3.2 When a notice is issued to a Party, by the other Party or the Engineer, a copy shall be sent to the Engineer or the other Party, as the case may be.

1.4 Law and Language

1.4.1 The Contract shall be governed by the law of the country or other jurisdiction stated in the Particular Conditions.

The ruling language of the Contract shall be that stated in the Particular Conditions.

The language for communications shall be that stated in the Particular Conditions. If no language is stated there, the language for communications shall be the ruling language of the Contract.

1.5 Priority of Documents

1.5.1 The documents forming the Contract are to be taken as mutually explanatory of one another. For the purposes of interpretation, the priority of the

documents shall be in accordance with the following sequence:

- (a) the Contract Agreement (if any),
- (b) the Letter of Acceptance,
- (c) the Tender,
- (d) the Particular Conditions – Part A,
- (e) the Particular Conditions – Part B
- (f) these General Conditions,
- (g) the Specification,
- (h) the Drawings, and
- (i) the Schedules and any other documents forming part of the Contract.

If an ambiguity or discrepancy is found in the documents, the Engineer shall issue any necessary clarification or instruction.

1.6 Contract Agreement

- 1.6.1 The Parties shall enter into a Contract Agreement within 28 days after the Contractor receives the Letter of Acceptance, unless the Particular Conditions establish otherwise. The Contract Agreement shall be based upon the form provided in Section IX, Contract Forms. The costs of stamp duties and similar charges (if any) imposed by law in connection with entry into the Contract Agreement shall be borne by the Employer.

1.7 Assignment

- 1.7.1 Neither Party shall assign the whole or any part of the Contract or any benefit or interest in or under the Contract. However, either Party:
- (a) may assign the whole or any part with the prior agreement of the other Party, at the sole discretion of such other Party, and
 - (b) may, as security in favour of a bank or financial institution, assign its right to any moneys due, or to become due, under the Contract.

1.8 Care and Supply of Documents

- 1.8.1 The Specification and Drawings shall be in the custody and care of the Employer. Unless otherwise stated in the Contract, two copies of the Contract and of each subsequent Drawing shall be supplied to the Contractor, who may make or request further copies at the cost of the Contractor

Each of the Contractor's Documents shall be in the custody and care of the Contractor, unless and until taken over by the Employer. Unless otherwise stated in the Contract, the Contractor shall supply to the Engineer six copies of each of the Contractor's Documents.

The Contractor shall keep, on the Site, a copy of the Contract, publications named in the Specification, the Contractor's Documents (if any), the Drawings and Variations and other communications given under the Contract. The Employer's Personnel shall have the right of access to all these

documents at all reasonable times.

If a Party becomes aware of an error or defect in a document which was prepared for use in executing the Works, the Party shall promptly give notice to the other Party of such error or defect.

1.9 Delayed Drawings or Instructions

- 1.9.1 The Contractor shall give notice to the Engineer whenever the Works are likely to be delayed or disrupted if any necessary drawing or instruction is not issued to the Contractor within a particular time, which shall be reasonable. The notice shall include details of the necessary drawing or instruction, details of why and by when it should be issued, and the nature and amount of the delay or disruption likely to be suffered if it is late.

If the Contractor suffers delay and/or incurs Cost as a result of a failure of the Engineer to issue the notified drawing or instruction within a time which is reasonable and is specified in the notice with supporting details, the Contractor shall give a further notice to the Engineer and shall be entitled subject to **GC** Clause 20.1 [Contractor's Claims] to:

- (a) an extension of time for any such delay, if completion is or will be delayed, under **GC** Clause 8.4 [Extension of Time for Completion], and
- (b) payment of any such Cost plus profit, which shall be included in the Contract Price.

- 1.9.2 After receiving this further notice, the Engineer shall proceed in accordance with **GC** Clause 3.5 [Determinations] to agree or determine these matters.

However, if and to the extent that the Engineer's failure was caused by any error or delay by the Contractor, including an error in, or delay in the submission of, any of the Contractor's Documents, the Contractor shall not be entitled to such extension of time, Cost or profit.

1.10 Employer's Use of Contractor's Documents

- 1.10.1 As between the Parties, the Contractor shall retain the copyright and other intellectual property rights in the Contractor's Documents and other design documents made by (or on behalf of) the Contractor.

- 1.10.2 The Contractor shall be deemed (by signing the Contract) to give to the Employer a non-terminable transferable non-exclusive royalty-free licence to copy, use and communicate the Contractor's Documents, including making and using modifications of them. This licence shall:

- (a) apply throughout the actual or intended working life (whichever is longer) of the relevant parts of the Works,
- (b) entitle any person in proper possession of the relevant part of the Works to copy, use and communicate the Contractor's Documents for the purposes of completing, operating, maintaining, altering, adjusting, repairing and demolishing the Works, and
- (c) in the case of Contractor's Documents which are in the form of computer programs and other software, permit their use on any computer on the Site and other places as envisaged by the Contract, including replacements of any computers supplied by the Contractor.

- 1.10.3 The Contractor's Documents and other design documents made by (or on

behalf of) the Contractor shall not, without the Contractor's consent, be used, copied or communicated to a third party by (or on behalf of) the Employer for purposes other than those permitted under this GC Clause.

1.11 Contractor's Use of Employer's Documents

- 1.11.1 As between the Parties, the Employer shall retain the copyright and other intellectual property rights in the Specification, the Drawings and other documents made by (or on behalf of) the Employer. The Contractor may, at his cost, copy, use, and obtain communication of these documents for the purposes of the Contract. They shall not, without the Employer's consent, be copied, used or communicated to a third party by the Contractor, except as necessary for the purposes of the Contract.

1.12 Confidential Details

- 1.12.1 The Contractor's and the Employer's Personnel shall disclose all such confidential and other information as may be reasonably required in order to verify the Contractor's compliance with the Contract and allow its proper implementation.

Each of them shall treat the details of the Contract as private and confidential, except to the extent necessary to carry out their respective obligations under the Contract or to comply with applicable Laws. Each of them shall not publish or disclose any particulars of the Works prepared by the other Party without the previous agreement of the other Party. However, the Contractor shall be permitted to disclose any publicly available information, or information otherwise required to establish his qualifications to compete for other projects.

1.13 Compliance with Laws

- 1.13.1 The Contractor shall, in performing the Contract, comply with applicable Laws.

- 1.13.2 Unless otherwise stated in the Particular Conditions:

- (a) the Employer shall have obtained (or shall obtain) the planning, zoning, building permit or similar permission for the Permanent Works, and any other permissions described in the Specification as having been (or to be) obtained by the Employer; and the Employer shall indemnify and hold the Contractor harmless against and from the consequences of any failure to do so; and
- (b) the Contractor shall give all notices, pay all taxes, duties and fees, and obtain all permits, licences and approvals, as required by the Laws in relation to the execution and completion of the Works and the remedying of any defects; and the Contractor shall indemnify and hold the Employer harmless against and from the consequences of any failure to do so, unless the Contractor is impeded to accomplish these actions and shows evidence of its diligence.

1.14 Joint and Several Liability

- 1.14.1 If the Contractor constitutes (under applicable Laws) a joint venture, consortium or other unincorporated grouping of two or more persons:

- (a) these persons shall be deemed to be jointly and severally liable to the Employer for the performance of the Contract;

- (b) these persons shall notify the Employer of their leader who shall have authority to bind the Contractor and each of these persons; and
- (c) the Contractor shall not alter its composition or legal status without the prior consent of the Employer.

1.15 Inspections and Audit by the Bank

- 1.15.1 The Contractor shall permit the Bank and/or persons appointed by the Bank to inspect the Site and/or the Contractor's accounts and records relating to the performance of the Contract and to have such accounts and records audited by auditors appointed by the Bank if required by the Bank.

2 The Employer

2.1 Right of Access to the Site

- 2.11 The Employer shall give the Contractor right of access to, and possession of, all parts of the Site within the time (or times) stated in the Particular Conditions. The right and possession may not be exclusive to the Contractor. If, under the Contract, the Employer is required to give (to the Contractor) possession of any foundation, structure, plant or means of access, the Employer shall do so in the time and manner stated in the Specification. However, the Employer may withhold any such right or possession until the Performance Security has been received.

- 2.12 If no such time is stated in the Particular Conditions, the Employer shall give the Contractor right of access to, and possession of, the Site within such times as required to enable the Contractor to proceed without disruption in accordance with the programme submitted under **GC** Clause 8.3 [Programme].

- 2.13 If the Contractor suffers delay and/or incurs Cost as a result of a failure by the Employer to give any such right or possession within such time, the Contractor shall give notice to the Engineer and shall be entitled subject to **GC** Clause 20.1 [Contractor's Claims] to:

- (a) an extension of time for any such delay, if completion is or will be delayed, under **GC** Clause 8.4 [Extension of Time for Completion], and
- (b) payment of any such Cost plus profit, which shall be included in the Contract Price.

- 2.14 After receiving this notice, the Engineer shall proceed in accordance with **GC** Clause 3.5 [Determinations] to agree or determine these matters.

- 2.15 However, if and to the extent that the Employer's failure was caused by any error or delay by the Contractor, including an error in, or delay in the submission of, any of the Contractor's Documents, the Contractor shall not be entitled to such extension of time, Cost or profit.

2.2 Permits, Licences or Approvals

- 2.21 The Employer shall provide, at the request of the Contractor, such reasonable assistance as to allow the Contractor to obtain properly:

- (a) copies of the Laws of the Country which are relevant to the Contract but are not readily available, and

- (b) any permits, licences or approvals required by the Laws of the Country:
 - (i) which the Contractor is required to obtain under **GC** Clause 1.13 [Compliance with Laws],
 - (ii) for the delivery of Goods, including clearance through customs, and
 - (iii) for the export of Contractor's Equipment when it is removed from the Site.

2.3 Employer's Personnel

- 2.3.1 The Employer shall be responsible for ensuring that the Employer's Personnel and the Employer's other contractors on the Site:
- (a) co-operate with the Contractor's efforts under **GC** Clause 4.6 [Co-operation], and
 - (b) take actions similar to those which the Contractor is required to take under **GC** Clauses 4.8.1(a), 4.8.1(b), and 4.8.1(c) [Safety Procedures] and under **GC** Clause 4.18 [Protection of the Environment].

2.4 Employer's Financial Arrangements

- 2.4.1 The Employer shall submit, before the Commencement Date and thereafter within 28 days after receiving any request from the Contractor, reasonable evidence that financial arrangements have been made and are being maintained which will enable the Employer to pay the Contract Price punctually (as estimated at that time) in accordance with **GC** Clause 14 [Contract Price and Payment]. Before the Employer makes any material change to his financial arrangements, the Employer shall give notice to the Contractor with detailed particulars.
- 2.4.2 In addition, if the Bank has notified to the Borrower that the Bank has suspended disbursements under its loan, which finances in whole or in part the execution of the Works, the Employer shall give notice of such suspension to the Contractor with detailed particulars, including the date of such notification, with a copy to the Engineer, within 7 days of the Borrower having received the suspension notification from the Bank. If alternative funds will be available in appropriate currencies to the Employer to continue making payments to the Contractor beyond a date 60 days after the date of Bank notification of the suspension, the Employer shall provide reasonable evidence in such notice of the extent to which such funds will be available.

2.5 Employer's Claims

- 2.5.1 If the Employer considers himself to be entitled to any payment under any Clause of these Conditions or otherwise in connection with the Contract, and/or to any extension of the Defects Notification Period, the Employer or the Engineer shall give notice and particulars to the Contractor. However, notice is not required for payments due under **GC** Clause 4.19 [Electricity, Water and Gas], under **GC** Clause 4.20 [Employer's Equipment and Free-Issue Material], or for other services requested by the Contractor.
- 2.5.2 The notice shall be given as soon as practicable and no longer than 28 days after the Employer became aware, or should have become aware, of the event or circumstances giving rise to the claim. A notice relating to any extension of the Defects Notification Period shall be given before the expiry of such

period.

- 2.5.3 The particulars shall specify the **GC** Clause or other basis of the claim, and shall include substantiation of the amount and/or extension to which the Employer considers himself to be entitled in connection with the Contract. The Engineer shall then proceed in accordance with **GC** Clause 3.5 [Determinations] to agree or determine (i) the amount (if any) which the Employer is entitled to be paid by the Contractor, and/or (ii) the extension (if any) of the Defects Notification Period in accordance with **GC** Clause 11.3 [Extension of Defects Notification Period].
- 2.5.4 This amount may be included as a deduction in the Contract Price and Payment Certificates. The Employer shall only be entitled to set off against or make any deduction from an amount certified in a Payment Certificate, or to otherwise claim against the Contractor, in accordance with this **GC** Clause.

3 The Engineer

3.1 Engineer's Duties and Authority

- 3.1.1 The Employer shall appoint the Engineer who shall carry out the duties assigned to him in the Contract. The Engineer's staff shall include suitably qualified engineers and other professionals who are competent to carry out these duties.
- 3.1.2 The Engineer shall have no authority to amend the Contract.
- 3.1.3 The Engineer may exercise the authority attributable to the Engineer as specified in or necessarily to be implied from the Contract. If the Engineer is required to obtain the approval of the Employer before exercising a specified authority, the requirements shall be as stated in the Particular Conditions. The Employer shall promptly inform the Contractor of any change to the authority attributed to the Engineer.
- 3.1.4 However, whenever the Engineer exercises a specified authority for which the Employer's approval is required, then (for the purposes of the Contract) the Employer shall be deemed to have given approval.
- 3.1.5 Except as otherwise stated in these Conditions:
- (a) whenever carrying out duties or exercising authority, specified in or implied by the Contract, the Engineer shall be deemed to act for the Employer;
 - (b) the Engineer has no authority to relieve either Party of any duties, obligations or responsibilities under the Contract;
 - (c) any approval, check, certificate, consent, examination, inspection, instruction, notice, proposal, request, test, or similar act by the Engineer (including absence of disapproval) shall not relieve the Contractor from any responsibility he has under the Contract, including responsibility for errors, omissions, discrepancies and non-compliances; and
 - (d) any act by the Engineer in response to a Contractor's request except otherwise expressly specified shall be notified in writing to the Contractor within 28 days of receipt.
- 3.1.6 The following provisions shall apply:

The Engineer shall obtain the specific approval of the Employer before taking action under the following Clauses of these Conditions:

- (a) **GC Clause 4.12:** Agreeing or determining an extension of time and/or additional cost.
- (b) **GC Clause 13.1:** Instructing a Variation, except;
 - (i) in an emergency situation as determined by the Engineer, or
 - (ii) if such a Variation would increase the Accepted Contract Amount by less than the percentage specified in the Particular Conditions.
- (c) **GC Clause 13.3:** Approving a proposal for Variation submitted by the Contractor in accordance with **GC Clause 13.1** or **13.2**.
- (d) **GC Clause 13.4:** Specifying the amount payable in each of the applicable currencies

3.1.7

Notwithstanding the obligation, as set out above, to obtain approval, if, in the opinion of the Engineer, an emergency occurs affecting the safety of life or of the Works or of adjoining property, he may, without relieving the Contractor of any of his duties and responsibility under the Contract, instruct the Contractor to execute all such work or to do all such things as may, in the opinion of the Engineer, be necessary to abate or reduce the risk. The Contractor shall forthwith comply, despite the absence of approval of the Employer, with any such instruction of the Engineer. The Engineer shall determine an addition to the Contract Price, in respect of such instruction, in accordance with **GC Clause 13** and shall notify the Contractor accordingly, with a copy to the Employer.

3.2 Delegation by the Engineer

3.2.1

The Engineer may from time to time assign duties and delegate authority to assistants, and may also revoke such assignment or delegation. These assistants may include a resident engineer, and/or independent inspectors appointed to inspect and/or test items of Plant and/or Materials. The assignment, delegation or revocation shall be in writing and shall not take effect until copies have been received by both Parties. However, unless otherwise agreed by both Parties, the Engineer shall not delegate the authority to determine any matter in accordance with **GC Clause 3.5** [Determinations].

3.2.2

Assistants shall be suitably qualified persons, who are competent to carry out these duties and exercise this authority, and who are fluent in the language for communications defined in **GC Clause 1.4** [Law and Language].

3.2.3

Each assistant, to whom duties have been assigned or authority has been delegated, shall only be authorised to issue instructions to the Contractor to the extent defined by the delegation. Any approval, check, certificate, consent, examination, inspection, instruction, notice, proposal, request, test, or similar act by an assistant, in accordance with the delegation, shall have the same effect as though the act had been an act of the Engineer. However:

- (a) any failure to disapprove any work, Plant or Materials shall not constitute approval, and shall therefore not prejudice the right of the Engineer to reject the work, Plant or Materials;

- (b) if the Contractor questions any determination or instruction of an assistant, the Contractor may refer the matter to the Engineer, who shall promptly confirm, reverse or vary the determination or instruction.

3.3 Instructions of the Engineer

3.3.1 The Engineer may issue to the Contractor (at any time) instructions and additional or modified Drawings which may be necessary for the execution of the Works and the remedying of any defects, all in accordance with the Contract. The Contractor shall only take instructions from the Engineer, or from an assistant to whom the appropriate authority has been delegated under this **GC** Clause. If an instruction constitutes a Variation, **GC** Clause 13 [Variations and Adjustments] shall apply.

3.3.2 The Contractor shall comply with the instructions given by the Engineer or delegated assistant, on any matter related to the Contract. Whenever practicable, their instructions shall be given in writing. If the Engineer or a delegated assistant:

- (a) gives an oral instruction,
- (b) receives a written confirmation of the instruction, from (or on behalf of) the Contractor, within two working days after giving the instruction, and
- (c) does not reply by issuing a written rejection and/or instruction within two working days after receiving the confirmation,

then the confirmation shall constitute the written instruction of the Engineer or delegated assistant (as the case may be).

3.4 Replacement of the Engineer

3.4.1 If the Employer intends to replace the Engineer, the Employer shall, not less than 21 days before the intended date of replacement, give notice to the Contractor of the name, address and relevant experience of the intended replacement Engineer. If the Contractor considers the intended replacement Engineer to be unsuitable, he has the right to raise objection against him by notice to the Employer, with supporting particulars, and the Employer shall give full and fair consideration to this objection.

3.5 Determinations

3.5.1 Whenever these Conditions provide that the Engineer shall proceed in accordance with this **GC** Clause 3.5 to agree or determine any matter, the Engineer shall consult with each Party in an endeavour to reach agreement. If agreement is not achieved, the Engineer shall make a fair determination in accordance with the Contract, taking due regard of all relevant circumstances.

3.5.2 The Engineer shall give notice to both Parties of each agreement or determination, with supporting particulars within 28 days from the receipt of the corresponding claim or request except when otherwise specified. Each Party shall give effect to each agreement or determination unless and until revised under **GC** Clause 20 [Claims, Disputes and Arbitration].

4 The Contractor

4.1 Contractor's General Obligations

- 4.1.1 The Contractor shall design (to the extent specified in the Contract), execute and complete the Works in accordance with the Contract and with the Engineer's instructions, and shall remedy any defects in the Works.
- 4.1.2 The Contractor shall provide the Plant and Contractor's Documents specified in the Contract, and all Contractor's Personnel, Goods, consumables and other things and services, whether of a temporary or permanent nature, required in and for this design, execution, completion and remedying of defects.
- 4.1.3 All equipment, material, and services to be incorporated in or required for the Works shall have their origin in any eligible source country as defined by the Bank, in the Rules and Procedures for Procurement of Goods and Works.
- 4.1.4 The Contractor shall be responsible for the adequacy, stability and safety of all Site operations and of all methods of construction. Except to the extent specified in the Contract, the Contractor (i) shall be responsible for all Contractors' Documents, Temporary Works, and such design of each item of Plant and Materials as is required for the item to be in accordance with the Contract, and (ii) shall not otherwise be responsible for the design or specification of the Permanent Works.
- 4.1.5 The Contractor shall, whenever required by the Engineer, submit details of the arrangements and methods which the Contractor proposes to adopt for the execution of the Works. No significant alteration to these arrangements and methods shall be made without this having previously been notified to the Engineer.
- 4.1.6 If the Contract specifies that the Contractor shall design any part of the Permanent Works, then unless otherwise stated in the Particular Conditions:
- (a) the Contractor shall submit to the Engineer the Contractor's Documents for this part in accordance with the procedures specified in the Contract;
 - (b) these Contractor's Documents shall be in accordance with the Specification and Drawings, shall be written in the language for communications defined in GC Clause 1.4 [Law and Language], and shall include additional information required by the Engineer to add to the Drawings for co-ordination of each Party's designs;
 - (c) the Contractor shall be responsible for this part and it shall, when the Works are completed, be fit for such purposes for which the part is intended as are specified in the Contract; and
 - (d) prior to the commencement of the Tests on Completion, the Contractor shall submit to the Engineer the "as-built" documents and, if applicable, operation and maintenance manuals in accordance with the Specification and in sufficient detail for the Employer to operate, maintain, dismantle, reassemble, adjust and repair this part of the Works. Such part shall not be considered to be completed for the purposes of taking-over under GC Clause 10.1 [Taking Over of the Works and Sections] until these documents and manuals have been submitted to the Engineer.

4.2 Performance Security

- 4.2.1 The Contractor shall obtain (at his cost) a Performance Security for proper performance, in the amount stated in the Particular Conditions and denominated in the currency(ies) of the Contract or in a freely convertible currency acceptable to the Employer. If an amount is not stated in the Particular Conditions, this GC Clause shall not apply.

- 4.2.2 The Contractor shall deliver the Performance Security to the Employer within 28 days after receiving the Letter of Acceptance, and shall send a copy to the Engineer. The Performance Security shall be issued by a reputable bank or financial institution selected by the Contractor, and shall be in the form stipulated in Section IX, Contract Forms or in another form approved by the Employer.
- 4.2.3 The Contractor shall ensure that the Performance Security is valid and enforceable until the Contractor has executed and completed the Works and remedied any defects. If the terms of the Performance Security specify its expiry date, and the Contractor has not become entitled to receive the Performance Certificate by the date 28 days prior to the expiry date, the Contractor shall extend the validity of the Performance Security until the Works have been completed and any defects have been remedied.
- 4.2.4 The Employer shall not make a claim under the Performance Security, except for amounts to which the Employer is entitled under the Contract.
- 4.2.5 The Employer shall indemnify and hold the Contractor harmless against and from all damages, losses and expenses (including legal fees and expenses) resulting from a claim under the Performance Security to the extent to which the Employer was not entitled to make the claim.
- 4.2.6 The Employer shall return the Performance Security to the Contractor within 21 days after receiving a copy of the Performance Certificate.
- 4.2.7 Without limitation to the provisions of the rest of this **GC** Clause, whenever the Engineer determines an addition or a reduction to the Contract Price as a result of a change in cost and/or legislation or as a result of a Variation, amounting to more than 25 percent of the portion of the Contract Price payable in a specific currency, the Contractor shall at the Engineer's request promptly increase, or may decrease, as the case may be, the value of the Performance Security in that currency by an equal percentage.

4.3 Contractor's Representative

- 4.3.1 The Contractor shall appoint the Contractor's Representative and shall give him all authority necessary to act on the Contractor's behalf under the Contract.
- 4.3.2 Unless the Contractor's Representative is named in the Contract, the Contractor shall, prior to the Commencement Date, submit to the Engineer for consent the name and particulars of the person the Contractor proposes to appoint as Contractor's Representative. If consent is withheld or subsequently revoked in terms of **GC** Clause 6.9 [Contractor's Personnel], or if the appointed person fails to act as Contractor's Representative, the Contractor shall similarly submit the name and particulars of another suitable person for such appointment.
- 4.3.3 The Contractor shall not, without the prior consent of the Engineer, revoke the appointment of the Contractor's Representative or appoint a replacement.
- 4.3.4 The whole time of the Contractor's Representative shall be given to directing the Contractor's performance of the Contract. If the Contractor's Representative is to be temporarily absent from the Site during the execution of the Works, a suitable replacement person shall be appointed, subject to the Engineer's prior consent, and the Engineer shall be notified accordingly.
- 4.3.5 The Contractor's Representative shall, on behalf of the Contractor, receive instructions under **GC** Clause 3.3 [Instructions of the Engineer].

4.3.6 The Contractor's Representative may delegate any powers, functions and authority to any competent person, and may at any time revoke the delegation. Any delegation or revocation shall not take effect until the Engineer has received prior notice signed by the Contractor's Representative, naming the person and specifying the powers, functions and authority being delegated or revoked.

4.3.7 The Contractor's Representative shall be fluent in the language for communications defined in **GC** Clause 1.4 [Law and Language]. If the Contractor's Representative's delegates are not fluent in the said language, the Contractor shall make competent interpreters available during all working hours in a number deemed sufficient by the Engineer.

4.4 Subcontractors

4.4.1 The Contractor shall not subcontract the whole of the Works.

4.4.2 The Contractor shall be responsible for the acts or defaults of any Subcontractor, his agents or employees, as if they were the acts or defaults of the Contractor. Unless otherwise stated in the Particular Conditions:

- (a) the Contractor shall not be required to obtain consent to suppliers solely of Materials, or to a subcontract for which the Subcontractor is named in the Contract;
- (b) the prior consent of the Engineer shall be obtained to other proposed Subcontractors;
- (c) the Contractor shall give the Engineer not less than 28 days' notice of the intended date of the commencement of each Subcontractor's work, and of the commencement of such work on the Site; and
- (d) each subcontract shall include provisions which would entitle the Employer to require the subcontract to be assigned to the Employer under **GC** Clause 4.5 [Assignment of Benefit of Subcontract] (if or when applicable) or in the event of termination under **GC** Clause 15.2 [Termination by Employer].

4.4.3 The Contractor shall ensure that the requirements imposed on the Contractor by **GC** Clause 1.12 [Confidential Details] apply equally to each Subcontractor.

4.4.4 Where practicable, the Contractor shall give fair and reasonable opportunity for contractors from the Country to be appointed as Subcontractors.

4.5 Assignment of Benefit of Subcontract

4.5.1 If a Subcontractor's obligations extend beyond the expiry date of the relevant Defects Notification Period and the Engineer, prior to this date, instructs the Contractor to assign the benefit of such obligations to the Employer, then the Contractor shall do so. Unless otherwise stated in the assignment, the Contractor shall have no liability to the Employer for the work carried out by the Subcontractor after the assignment takes effect.

4.6 Co-operation

4.6.1 The Contractor shall, as specified in the Contract or as instructed by the Engineer, allow appropriate opportunities for carrying out work to:

- (a) the Employer's Personnel,
- (b) any other contractors employed by the Employer, and
- (c) the personnel of any legally constituted public authorities,

who may be employed in the execution on or near the Site of any work not included in the Contract.

4.6.2 Any such instruction shall constitute a Variation if and to the extent that it causes the Contractor to suffer delays and/or to incur Unforeseeable Cost. Services for these personnel and other contractors may include the use of Contractor's Equipment, Temporary Works or access arrangements which are the responsibility of the Contractor.

4.6.3 If, under the Contract, the Employer is required to give to the Contractor possession of any foundation, structure, plant or means of access in accordance with Contractor's Documents, the Contractor shall submit such documents to the Engineer in the time and manner stated in the Specification.

4.7 Setting Out

4.7.1 The Contractor shall set out the Works in relation to original points, lines and levels of reference specified in the Contract or notified by the Engineer. The Contractor shall be responsible for the correct positioning of all parts of the Works, and shall rectify any error in the positions, levels, dimensions or alignment of the Works.

4.7.2 The Employer shall be responsible for any errors in these specified or notified items of reference, but the Contractor shall use reasonable efforts to verify their accuracy before they are used.

4.7.3 If the Contractor suffers delay and/or incurs Cost from executing work which was necessitated by an error in these items of reference, and an experienced contractor could not reasonably have discovered such error and avoided this delay and/or Cost, the Contractor shall give notice to the Engineer and shall be entitled subject to **GC** Clause 20.1 [Contractor's Claims] to:

- (a) an extension of time for any such delay, if completion is or will be delayed, under **GC** Clause 8.4 [Extension of Time for Completion], and
- (b) payment of any such Cost plus profit, which shall be included in the Contract Price.

4.7.4 After receiving this notice, the Engineer shall proceed in accordance with **GC** Clause 3.5 [Determinations] to agree or determine (i) whether and (if so) to what extent the error could not reasonably have been discovered, and (ii) the matters described in **GC** Clause 4.7.3(a) and (b) above related to this extent.

4.8 Safety Procedures

4.8.1 The Contractor shall:

- (a) comply with all applicable safety regulations,
- (b) take care for the safety of all persons entitled to be on the Site,
- (c) use reasonable efforts to keep the Site and Works clear of unnecessary obstruction so as to avoid danger to these persons,

- (d) provide fencing, lighting, guarding and watching of the Works until completion and taking over under **GC Clause 10** [Employer's Taking Over], and
- (e) provide any Temporary Works (including roadways, footways, guards and fences) which may be necessary, because of the execution of the Works, for the use and protection of the public and of owners and occupiers of adjacent land.

4.9 Quality Assurance

- 4.9.1 The Contractor shall institute a quality assurance system to demonstrate compliance with the requirements of the Contract. The system shall be in accordance with the details stated in the Contract. The Engineer shall be entitled to audit any aspect of the system.
- 4.9.2 Details of all procedures and compliance documents shall be submitted to the Engineer for information before each design and execution stage is commenced. When any document of a technical nature is issued to the Engineer, evidence of the prior approval by the Contractor himself shall be apparent on the document itself.
- 4.9.3 Compliance with the quality assurance system shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

4.10 Site Data

- 4.10.1 The Employer shall have made available to the Contractor for his information, prior to the Base Date, all relevant data in the Employer's possession on sub-surface and hydrological conditions at the Site, including environmental aspects. The Employer shall similarly make available to the Contractor all such data which come into the Employer's possession after the Base Date. The Contractor shall be responsible for interpreting all such data.
- 4.10.2 To the extent which was practicable (taking account of cost and time), the Contractor shall be deemed to have obtained all necessary information as to risks, contingencies and other circumstances which may influence or affect the Tender or Works. To the same extent, the Contractor shall be deemed to have inspected and examined the Site, its surroundings, the above data and other available information, and to have been satisfied before submitting the Tender as to all relevant matters, including (without limitation):
 - (a) the form and nature of the Site, including sub-surface conditions,
 - (b) the hydrological and climatic conditions,
 - (c) the extent and nature of the work and Goods necessary for the execution and completion of the Works and the remedying of any defects,
 - (d) the Laws, procedures and labour practices of the Country, and
 - (e) the Contractor's requirements for access, accommodation, facilities, personnel, power, transport, water and other services.

4.11 Sufficiency of the Accepted Contract Amount

- 4.11.1 The Contractor shall be deemed to:
 - (a) have satisfied himself as to the correctness and sufficiency of the Accepted Contract Amount, and

- (b) have based the Accepted Contract Amount on the data, interpretations, necessary information, inspections, examinations and satisfaction as to all relevant matters referred to in **GC** Clause 4.10 [Site Data].

4.11.2 Unless otherwise stated in the Contract, the Accepted Contract Amount covers all the Contractor's obligations under the Contract (including those under Provisional Sums, if any) and all things necessary for the proper execution and completion of the Works and the remedying of any defects.

4.12 Unforeseeable Physical Conditions

4.12.1 In this **GC** Clause, "physical conditions" means natural physical conditions and man-made and other physical obstructions and pollutants, which the Contractor encounters at the Site when executing the Works, including sub-surface and hydrological conditions but excluding climatic conditions.

4.12.2 If the Contractor encounters adverse physical conditions which he considers to have been Unforeseeable, the Contractor shall give notice to the Engineer as soon as practicable.

4.12.3 This notice shall describe the physical conditions, so that they can be inspected by the Engineer, and shall set out the reasons why the Contractor considers them to be Unforeseeable. The Contractor shall continue executing the Works, using such proper and reasonable measures as are appropriate for the physical conditions, and shall comply with any instructions which the Engineer may give. If an instruction constitutes a Variation, **GC** Clause 13 [Variations and Adjustments] shall apply.

4.12.4 If and to the extent that the Contractor encounters physical conditions which are Unforeseeable, gives such a notice, and suffers delay and/or incurs Cost due to these conditions, the Contractor shall be entitled subject to notice under **GC** Clause 20.1 [Contractor's Claims] to:

- (a) an extension of time for any such delay, if completion is or will be delayed, under **GC** Clause 8.4 [Extension of Time for Completion], and
- (b) payment of any such Cost, which shall be included in the Contract Price.

4.12.5 Upon receiving such notice and inspecting and/or investigating these physical conditions, the Engineer shall proceed in accordance with **GC** Clause 3.5 [Determinations] to agree or determine (i) whether and (if so) to what extent these physical conditions were Unforeseeable, and (ii) the matters described in **GC** 4.12.4(a) and (b) above related to this extent.

4.12.6 However, before additional Cost is finally agreed or determined for item (ii) under **GC** Clause 4.12.5, the Engineer may also review whether other physical conditions in similar parts of the Works (if any) were more favourable than could reasonably have been foreseen when the Contractor submitted the Bid. If and to the extent that these more favourable conditions were encountered, the Engineer may proceed in accordance with **GC** Clause 3.5 [Determinations] to agree or determine the reductions in Cost which were due to these conditions, which may be included (as deductions) in the Contract Price and Payment Certificates. However, the net effect of all adjustments under **GC** 4.12.4(b) and all these reductions, for all the physical conditions encountered in similar parts of the Works, shall not result in a net reduction in the Contract Price.

4.12.7 The Engineer shall take account of any evidence of the physical conditions foreseen by the Contractor when submitting the Tender, which shall be made available by the Contractor, but shall not be bound by the Contractor's interpretation of any such evidence.

4.13 Rights of Way and Facilities

- 4.13.1 Unless otherwise specified in the Contract the Employer shall provide effective access to and possession of the Site including special and/or temporary rights-of-way which are necessary for the Works. The Contractor shall obtain, at his risk and cost, any additional rights of way or facilities outside the Site which he may require for the purposes of the Works.

4.14 Avoidance of Interference

- 4.14.2 The Contractor shall not interfere unnecessarily or improperly with:
- (a) the convenience of the public, or
 - (b) the access to and use and occupation of all roads and footpaths, irrespective of whether they are public or in the possession of the Employer or of others.
- 4.14.2 The Contractor shall indemnify and hold the Employer harmless against and from all damages, losses and expenses (including legal fees and expenses) resulting from any such unnecessary or improper interference.

4.15 Access Route

- 4.15.1 The Contractor shall be deemed to have been satisfied as to the suitability and availability of access routes to the Site at Base Date. The Contractor shall use reasonable efforts to prevent any road or bridge from being damaged by the Contractor's traffic or by the Contractor's Personnel. These efforts shall include the proper use of appropriate vehicles and routes.
- 4.15.2 Except as otherwise stated in these Conditions:
- (a) the Contractor shall (as between the Parties) be responsible for any maintenance which may be required for his use of access routes;
 - (b) the Contractor shall provide all necessary signs or directions along access routes, and shall obtain any permission which may be required from the relevant authorities for his use of routes, signs and directions;
 - (c) the Employer shall not be responsible for any claims which may arise from the use or otherwise of any access route;
 - (d) the Employer does not guarantee the suitability or availability of particular access routes; and
 - (e) Costs due to non-suitability or non-availability, for the use required by the Contractor, of access routes shall be borne by the Contractor.

4.16 Transport of Goods

- 4.16.1 Unless otherwise stated in the Particular Conditions:
- (a) the Contractor shall give the Engineer not less than 21 days' notice of the date on which any Plant or a major item of other Goods will be delivered to the Site;
 - (b) the Contractor shall be responsible for packing, loading, transporting, receiving, unloading, storing and protecting all Goods and other things required for the Works; and

- (c) the Contractor shall indemnify and hold the Employer harmless against and from all damages, losses and expenses (including legal fees and expenses) resulting from the transport of Goods, and shall negotiate and pay all claims arising from their transport.

4.17 Contractor's Equipment

- 4.17.1 The Contractor shall be responsible for all Contractor's Equipment. When brought on to the Site, Contractor's Equipment shall be deemed to be exclusively intended for the execution of the Works. The Contractor shall not remove from the Site any major items of Contractor's Equipment without the consent of the Engineer. However, consent shall not be required for vehicles transporting Goods or Contractor's Personnel off Site.

4.18 Protection of the Environment

- 4.18.1 The Contractor shall take all reasonable steps to protect the environment (both on and off the Site) and to limit damage and nuisance to people and property resulting from pollution, noise and other results of his operations.
- 4.18.2 The Contractor shall ensure that emissions, surface discharges and effluent from the Contractor's activities shall not exceed the values stated in the Specification or prescribed by applicable Laws.

4.19 Electricity, Water and Gas

- 4.19.1 The Contractor shall, except as stated below, be responsible for the provision of all power, water and other services he may require for his construction activities and to the extent defined in the Specifications, for the tests.
- 4.19.2 The Contractor shall be entitled to use for the purposes of the Works such supplies of electricity, water, gas and other services as may be available on the Site and of which details and prices are given in the Specification. The Contractor shall, at his risk and cost, provide any apparatus necessary for his use of these services and for measuring the quantities consumed.
- 4.19.3 The quantities consumed and the amounts due (at these prices) for such services shall be agreed or determined by the Engineer in accordance with **GC** Clause 2.5 [Employer's Claims] and **GC** Clause 3.5 [Determinations]. The Contractor shall pay these amounts to the Employer.

4.20 Employer's Equipment and Free-Issue Materials

- 4.20.1 The Employer shall make the Employer's Equipment (if any) available for the use of the Contractor in the execution of the Works in accordance with the details, arrangements and prices stated in the Specification. Unless otherwise stated in the Specification:
 - (a) the Employer shall be responsible for the Employer's Equipment, except that
 - (b) the Contractor shall be responsible for each item of Employer's Equipment whilst any of the Contractor's Personnel is operating it, driving it, directing it or in possession or control of it.
- 4.20.2 The appropriate quantities and the amounts due (at such stated prices) for the use of Employer's Equipment shall be agreed or determined by the Engineer in accordance with **GC** Clause 2.5 [Employer's Claims] and **GC** Clause 3.5

[Determinations]. The Contractor shall pay these amounts to the Employer.

4.20.3 The Employer shall supply, free of charge, the “free-issue materials” (if any) in accordance with the details stated in the Specification. The Employer shall, at his risk and cost, provide these materials at the time and place specified in the Contract. The Contractor shall then visually inspect them, and shall promptly give notice to the Engineer of any shortage, defect or default in these materials. Unless otherwise agreed by both Parties, the Employer shall immediately rectify the notified shortage, defect or default.

4.20.4 After this visual inspection, the free-issue materials shall come under the care, custody and control of the Contractor. The Contractor’s obligations of inspection, care, custody and control shall not relieve the Employer of liability for any shortage, defect or default not apparent from a visual inspection.

4.21 Progress Reports

4.21.1 Unless otherwise stated in the Particular Conditions, monthly progress reports shall be prepared by the Contractor and submitted to the Engineer in six copies. The first report shall cover the period up to the end of the first calendar month following the Commencement Date. Reports shall be submitted monthly thereafter, each within 7 days after the last day of the period to which it relates.

4.21.2 Reporting shall continue until the Contractor has completed all work which is known to be outstanding at the completion date stated in the Taking-Over Certificate for the Works.

4.21.3 Each report shall include:

- (a) charts and detailed descriptions of progress, including each stage of design (if any), Contractor’s Documents, procurement, manufacture, delivery to Site, construction, erection and testing; and including these stages for work by each nominated Subcontractor (as defined in GC Clause 5 [Nominated Subcontractors]),
- (b) photographs showing the status of manufacture and of progress on the Site;
- (c) for the manufacture of each main item of Plant and Materials, the name of the manufacturer, manufacture location, percentage progress, and the actual or expected dates of:
 - (i) commencement of manufacture,
 - (ii) Contractor’s inspections,
 - (iii) tests, and
 - (iv) shipment and arrival at the Site;
- (d) the details described in GC Clause 6.10 [Records of Contractor’s Personnel and Equipment];
- (e) copies of quality assurance documents, test results and certificates of Materials;
- (f) list of notices given under GC Clause 2.5 [Employer’s Claims] and notices given under GC Clause 20.1 [Contractor’s Claims];
- (g) safety statistics, including details of any hazardous incidents and

activities relating to environmental aspects and public relations; and

- (h) comparisons of actual and planned progress, with details of any events or circumstances which may jeopardise the completion in accordance with the Contract, and the measures being (or to be) adopted to overcome delays.

4.22 Security of the Site

4.22.1 Unless otherwise stated in the Particular Conditions:

- (a) the Contractor shall be responsible for keeping unauthorised persons off the Site, and
- (b) authorised persons shall be limited to the Contractor's Personnel and the Employer's Personnel; and to any other personnel notified to the Contractor, by the Employer or the Engineer, as authorised personnel of the Employer's other contractors on the Site.

4.23 Contractor's Operations on Site

4.23.1 The Contractor shall confine his operations to the Site, and to any additional areas which may be obtained by the Contractor and agreed by the Engineer as additional working areas. The Contractor shall take all necessary precautions to keep Contractor's Equipment and Contractor's Personnel within the Site and these additional areas, and to keep them off adjacent land.

4.23.2 During the execution of the Works, the Contractor shall keep the Site free from all unnecessary obstruction, and shall store or dispose of any Contractor's Equipment or surplus materials. The Contractor shall clear away and remove from the Site any wreckage, rubbish and Temporary Works which are no longer required.

4.23.3 Upon the issue of a Taking-Over Certificate, the Contractor shall clear away and remove, from that part of the Site and Works to which the Taking-Over Certificate refers, all Contractor's Equipment, surplus material, wreckage, rubbish and Temporary Works. The Contractor shall leave that part of the Site and the Works in a clean and safe condition. However, the Contractor may retain on Site, during the Defects Notification Period, such Goods as are required for the Contractor to fulfil obligations under the Contract.

4.24 Fossils

4.24.1 All fossils, coins, articles of value or antiquity, and structures and other remains or items of geological or archaeological interest found on the Site shall be placed under the care and authority of the Employer. The Contractor shall take reasonable precautions to prevent Contractor's Personnel or other persons from removing or damaging any of these findings.

4.24.2 The Contractor shall, upon discovery of any such finding, promptly give notice to the Engineer, who shall issue instructions for dealing with it. If the Contractor suffers delay and/or incurs Cost from complying with the instructions, the Contractor shall give a further notice to the Engineer and shall be entitled subject to GC Clause 20.1 [Contractor's Claims] to:

- (a) an extension of time for any such delay, if completion is or will be delayed, under GC Clause 8.4 [Extension of Time for Completion], and
- (b) payment of any such Cost, which shall be included in the Contract Price.

- 4.24.3 After receiving this further notice, the Engineer shall proceed in accordance with **GC** Clause 3.5 [Determinations] to agree or determine these matters.

5 Nominated Subcontractors

5.1 Definition of “nominated Subcontractor”

- 5.1.1 In the Contract, “nominated Subcontractor” means a Subcontractor:

- (a) who is stated in the Contract as being a nominated Subcontractor, or
- (b) whom the Engineer, under **GC** Clause 13 [Variations and Adjustments], instructs the Contractor to employ as a Subcontractor subject to **GC** Clause 5.2 [Objection to Notification].

5.2 Objection to Nomination

- 5.2.1 The Contractor shall not be under any obligation to employ a nominated Subcontractor against whom the Contractor raises reasonable objection by notice to the Engineer as soon as practicable, with supporting particulars. An objection shall be deemed reasonable if it arises from (among other things) any of the following matters, unless the Employer agrees in writing to indemnify the Contractor against and from the consequences of the matter:

- (a) there are reasons to believe that the Subcontractor does not have sufficient competence, resources or financial strength;
- (b) the nominated Subcontractor does not accept to indemnify the Contractor against and from any negligence or misuse of Goods by the nominated Subcontractor, his agents and employees; or
- (c) the nominated Subcontractor does not accept to enter into a subcontract which specifies that, for the subcontracted work (including design, if any), the nominated Subcontractor shall:
 - (i) undertake to the Contractor such obligations and liabilities as will enable the Contractor to discharge his obligations and liabilities under the Contract;
 - (ii) indemnify the Contractor against and from all obligations and liabilities arising under or in connection with the Contract and from the consequences of any failure by the Subcontractor to perform these obligations or to fulfil these liabilities; and
 - (iii) be paid only if and when the Contractor has received from the Employer payments for sums due under the Subcontract referred to under **GC** Clause 5.3 [Payment to nominated Subcontractors].

5.3 Payments to nominated Subcontractors

- 5.3.1 The Contractor shall pay to the nominated Subcontractor the amounts shown on the nominated Subcontractor’s invoices approved by the Contractor which the Engineer certifies to be due in accordance with the subcontract. These amounts plus other charges shall be included in the Contract Price in accordance with **GC** Clause 13.5.1(b) [Provisional Sums], except as stated in

GC Clause 5.4 [Evidence of Payments].**5.4 Evidence of Payments**

5.4.1 Before issuing a Payment Certificate which includes an amount payable to a nominated Subcontractor, the Engineer may request the Contractor to supply reasonable evidence that the nominated Subcontractor has received all amounts due in accordance with previous Payment Certificates, less applicable deductions for retention or otherwise. Unless the Contractor:

- (a) submits this reasonable evidence to the Engineer, or
- (b)
 - (i) satisfies the Engineer in writing that the Contractor is reasonably entitled to withhold or refuse to pay these amounts, and
 - (ii) submits to the Engineer reasonable evidence that the nominated Subcontractor has been notified of the Contractor's entitlement,

then the Employer may (at his sole discretion) pay, direct to the nominated Subcontractor, part or all of such amounts previously certified (less applicable deductions) as are due to the nominated Subcontractor and for which the Contractor has failed to submit the evidence described in this GC Clause 5.4.1(a) or (b) above. The Contractor shall then repay, to the Employer, the amount which the nominated Subcontractor was directly paid by the Employer.

6 Staff and Labour**6.1 Engagement of Staff and Labour**

6.1.1 Except as otherwise stated in the Specification, the Contractor shall make arrangements for the engagement of all staff and labour, local or otherwise, and for their payment, feeding, transport, and, when appropriate, housing.

6.1.2 The Contractor is encouraged, to the extent practicable and reasonable, to employ staff and labour with appropriate qualifications and experience from sources within the Country

6.2 Rates of Wages and Conditions of Labour

6.2.1 The Contractor shall pay rates of wages, and observe conditions of labour, which are not lower than those established for the trade or industry where the work is carried out. If no established rates or conditions are applicable, the Contractor shall pay rates of wages and observe conditions which are not lower than the general level of wages and conditions observed locally by employers whose trade or industry is similar to that of the Contractor.

6.2.2 The Contractor shall inform the Contractor's Personnel about their liability to pay personal income taxes in the Country in respect of such of their salaries, wages, allowances and any benefits as are subject to tax under the Laws of the Country for the time being in force, and the Contractor shall perform such duties in regard to such deductions thereof as may be imposed on him by such Laws.

6.3 Persons in the Service of Employer

- 6.3.1 The Contractor shall not recruit, or attempt to recruit, staff and labour from amongst the Employer's Personnel.

6.4 Labour Laws

- 6.4.1 The Contractor shall comply with all the relevant labour Laws applicable to the Contractor's Personnel, including Laws relating to their employment, health, safety, welfare, immigration and emigration, and shall allow them all their legal rights.
- 6.4.2 The Contractor shall require his employees to obey all applicable Laws, including those concerning safety at work.

6.5 Working Hours

- 6.5.1 No work shall be carried out on the Site on locally recognised days of rest, or outside the normal working hours stated in the Particular Conditions, unless:
- (a) otherwise stated in the Contract,
 - (b) the Engineer gives consent, or
 - (c) the work is unavoidable, or necessary for the protection of life or property or for the safety of the Works, in which case the Contractor shall immediately advise the Engineer.

6.6 Facilities for Staff and Labour

- 6.6.1 Except as otherwise stated in the Specification, the Contractor shall provide and maintain all necessary accommodation and welfare facilities for the Contractor's Personnel. The Contractor shall also provide facilities for the Employer's Personnel as stated in the Specification.
- 6.6.2 The Contractor shall not permit any of the Contractor's Personnel to maintain any temporary or permanent living quarters within the structures forming part of the Permanent Works.

6.7 Health and Safety

- 6.7.1 The Contractor shall at all times take all reasonable precautions to maintain the health and safety of the Contractor's Personnel. In collaboration with local health authorities, the Contractor shall ensure that medical staff, first aid facilities, sick bay and ambulance service are available at all times at the Site and at any accommodation for Contractor's and Employer's Personnel, and that suitable arrangements are made for all necessary welfare and hygiene requirements and for the prevention of epidemics.
- 6.7.2 The Contractor shall appoint an accident prevention officer at the Site, responsible for maintaining safety and protection against accidents. This person shall be qualified for this responsibility, and shall have the authority to issue instructions and take protective measures to prevent accidents. Throughout the execution of the Works, the Contractor shall provide whatever is required by this person to exercise this responsibility and authority.
- 6.7.3 The Contractor shall send, to the Engineer, details of any accident as soon as practicable after its occurrence. The Contractor shall maintain records and make reports concerning health, safety and welfare of persons, and damage to

property, as the Engineer may reasonably require.

- 6.7.4 HIV-AIDS Prevention. The Contractor shall conduct an HIV-AIDS awareness programme via an approved service provider, and shall undertake such other measures as are specified in this Contract to reduce the risk of the transfer of the HIV virus between and among the Contractor's Personnel and the local community, to promote early diagnosis and to assist affected individuals.
- 6.7.5 The Contractor shall throughout the contract (including the Defects Notification Period): (i) conduct Information, Education and Consultation Communication (IEC) campaigns, at least every other month, addressed to all the Site staff and labour (including all the Contractor's employees, all Sub-Contractors and Consultants' employees, and all truck drivers and crew making deliveries to Site for construction activities) and to the immediate local communities, concerning the risks, dangers and impact, and appropriate avoidance behaviour with respect to, of Sexually Transmitted Diseases (STD) - or Sexually Transmitted Infections (STI) in general and HIV/AIDS in particular; (ii) provide male or female condoms for all Site staff and labour as appropriate; and (iii) provide for STI and HIV/AIDS screening, diagnosis, counselling and referral to a dedicated national STI and HIV/AIDS programme, (unless otherwise agreed) of all Site staff and labour.
- 6.7.6 The Contractor shall include in the program to be submitted for the execution of the Works under GC Clause 8.3 an alleviation program for Site staff and labour and their families in respect of Sexually Transmitted Infections (STI) and Sexually Transmitted Diseases (STD) including HIV/AIDS. The STI, STD and HIV/AIDS alleviation programme shall indicate when, how and at what cost the Contractor plans to satisfy the requirements of this GC Clause and the related specification. For each component, the programme shall detail the resources to be provided or utilised and any related sub-contracting proposed. The programme shall also include provision of a detailed cost estimate with supporting documentation. Payment to the Contractor for preparation and implementation this programme shall not exceed the Provisional Sum dedicated for this purpose.

6.8 Contractor's Superintendence

- 6.8.1 Throughout the execution of the Works, and as long thereafter as is necessary to fulfil the Contractor's obligations, the Contractor shall provide all necessary superintendence to plan, arrange, direct, manage, inspect and test the work.
- 6.8.2 Superintendence shall be given by a sufficient number of persons having adequate knowledge of the language for communications (defined in GC Clause 1.4 [Law and Language]) and of the operations to be carried out (including the methods and techniques required, the hazards likely to be encountered and methods of preventing accidents), for the satisfactory and safe execution of the Works.

6.9 Contractor's Personnel

- 6.9.1 The Contractor's Personnel shall be appropriately qualified, skilled and experienced in their respective trades or occupations. The Engineer may require the Contractor to remove (or cause to be removed) any person employed on the Site or Works, including the Contractor's Representative if applicable, who:
- (a) persists in any misconduct or lack of care,

- (b) carries out duties incompetently or negligently,
- (c) fails to conform with any provisions of the Contract, or
- (d) persists in any conduct which is prejudicial to safety, health, or the protection of the environment.

6.9.2 If appropriate, the Contractor shall then appoint (or cause to be appointed) a suitable replacement person.

6.10 Records of Contractor's Personnel and Equipment

6.10.1 The Contractor shall submit, to the Engineer, details showing the number of each class of Contractor's Personnel and of each type of Contractor's Equipment on the Site. Details shall be submitted each calendar month, in a form approved by the Engineer, until the Contractor has completed all work which is known to be outstanding at the completion date stated in the Taking-Over Certificate for the Works.

6.11 Disorderly Conduct

6.11.1 The Contractor shall at all times take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or amongst the Contractor's Personnel, and to preserve peace and protection of persons and property on and near the Site.

6.12 Foreign Personnel

6.12.1 The Contractor may bring in to the Country any foreign personnel who are necessary for the execution of the Works to the extent allowed by the applicable Laws. The Contractor shall ensure that these personnel are provided with the required residence visas and work permits. The Employer will, if requested by the Contractor, use his best endeavours in a timely and expeditious manner to assist the Contractor in obtaining any local, state, national or government permission required for bringing in the Contractor's personnel.

6.12.2 The Contractor shall be responsible for the return of these personnel to the place where they were recruited or to their domicile. In the event of the death in the Country of any of these personnel or members of their families, the Contractor shall similarly be responsible for making the appropriate arrangements for their return or burial.

6.13 Supply of Foodstuffs

6.13.1 The Contractor shall arrange for the provision of a sufficient supply of suitable food as may be stated in the Specification at reasonable prices for the Contractor's Personnel for the purposes of or in connection with the Contract.

6.14 Supply of Water

6.14.1 The Contractor shall, having regard to local conditions, provide on the Site an adequate supply of drinking and other water for the use of the Contractor's Personnel.

6.15 Measures against Insect and Pest Nuisance

- 6.15.1 The Contractor shall at all times take the necessary precautions to protect the Contractor's Personnel employed on the Site from insect and pest nuisance, and to reduce their danger to health. The Contractor shall comply with all the regulations of the local health authorities, including use of appropriate insecticide.

6.16 Alcoholic Liquor or Drugs

- 6.16.1 The Contractor shall not, otherwise than in accordance with the Laws of the Country, import, sell, give, barter or otherwise dispose of any alcoholic liquor or drugs, or permit or allow importation, sale, gift, barter or disposal thereof by Contractor's Personnel.

6.17 Arms and Ammunition

- 6.17.1 The Contractor shall not give, barter, or otherwise dispose of, to any person, any arms or ammunition of any kind, or allow Contractor's Personnel to do so.

6.18 Festivals and Religious Customs

- 6.18.1 The Contractor shall respect the Country's recognised festivals, days of rest and religious or other customs.

6.19 Funeral Arrangements

- 6.19.1 The Contractor shall be responsible, to the extent required by local regulations, for making any funeral arrangements for any of his local employees who may die while engaged upon the Works.

6.20 Forced labour

- 6.20.1 The Contractor shall not employ forced labour, which consists of any work or service, not voluntarily performed, that is exacted from an individual under threat of force or penalty, and includes any kind of involuntary or compulsory labour, such as indentured labour, bonded labour or similar labour - contracting arrangements.

6.21 Child labour

- 6.21.1 The Contractor shall not employ children in a manner that is economically exploitative, or is likely to be hazardous, or to interfere with the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development. Where the relevant labour laws have provisions for employment of minors, the Contractor shall follow those laws applicable to the Contractor. Children below the age of 18 years shall not be employed in dangerous work.

6.22 Employment Records of Workers

- 6.22.1 The Contractor shall keep complete and accurate records of the employment of labour at the Site. The records shall include the names, ages, genders, hours worked and wages paid to all workers. These records shall be summarised on a monthly basis and submitted to the Engineer, and these records shall be available for inspection by Auditors during normal working hours. These records shall be included in the details to be submitted by the Contractor under GC Clause 6.10 [Records of Contractor's Personnel and Equipment].

6.23 Workers' Organisations

- 6.23.1 In countries where the relevant labour laws recognise workers' rights to form and to join workers' organisations of their choosing without interference and to bargain collectively, the Contractor shall comply with such laws. Where the relevant labour laws substantially restrict workers' organisations, the Contractor shall enable alternative means for Contractor's Personnel to express their grievances and protect their rights regarding working conditions and terms of employment. In either case described above, and where the relevant labour laws are silent, the Contractor shall not discourage Contractor's Personnel from forming or joining workers' organisations of their choosing or from bargaining collectively, and shall not discriminate or retaliate against the Contractor's Personnel who participate, or seek to participate, in such organisations and bargain collectively. The Contractor shall engage with such workers representatives. Worker organisations are expected to fairly represent the workers in the workforce.

6.24 Non-Discrimination and Equal Opportunity

- 6.24.1 The Contractor shall not make employment decisions on the basis of personal characteristics unrelated to inherent job requirements. The Contractor shall base the employment relationship on the principle of equal opportunity and fair treatment, and shall not discriminate with respect to aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, promotion, termination of employment or retirement, and discipline. In countries where the relevant labour laws provide for non-discrimination in employment, the Contractor shall comply with such laws. When the relevant labour laws are silent on non-discrimination in employment, the Contractor shall meet this Clause's requirements. Special measures of protection or assistance to remedy past discrimination or selection for a particular job based on inherent requirements of the job shall not be deemed discrimination.

7 Plant, Materials and Workmanship

7.1 Manner of Execution

- 7.1.1 The Contractor shall carry out the manufacture of Plant, the production and manufacture of Materials, and all other execution of the Works:
- (a) in the manner (if any) specified in the Contract,
 - (b) in a proper workmanlike and careful manner, in accordance with recognised good practice, and
 - (c) with properly equipped facilities and non-hazardous Materials, except as otherwise specified in the Contract.

7.2 Samples

- 7.2.1 The Contractor shall submit the following samples of Materials, and relevant information, to the Engineer for consent prior to using the Materials in or for the Works:
- (a) manufacturer's standard samples of Materials and samples specified in the Contract, all at the Contractor's cost, and

- (b) additional samples instructed by the Engineer as a Variation.

7.2.2 Each sample shall be labelled as to origin and intended use in the Works.

7.3 Inspection

7.3.1 The Employer's Personnel shall at all reasonable times:

- (a) have full access to all parts of the Site and to all places from which natural Materials are being obtained, and
- (b) during production, manufacture and construction (at the Site and elsewhere), be entitled to examine, inspect, measure and test the materials and workmanship, and to check the progress of manufacture of Plant and production and manufacture of Materials.

7.3.2 The Contractor shall give the Employer's Personnel full opportunity to carry out these activities, including providing access, facilities, permissions and safety equipment. No such activity shall relieve the Contractor from any obligation or responsibility.

7.3.3 The Contractor shall give notice to the Engineer whenever any work is ready and before it is covered up, put out of sight, or packaged for storage or transport. The Engineer shall then either carry out the examination, inspection, measurement or testing without unreasonable delay, or promptly give notice to the Contractor that the Engineer does not require to do so. If the Contractor fails to give the notice, he shall, if and when required by the Engineer, uncover the work and thereafter reinstate and make good, all at the Contractor's cost.

7.4 Testing

7.4.1 This GC Clause shall apply to all tests specified in the Contract, other than the Tests after Completion (if any).

7.4.2 Except as otherwise specified in the Contract, the Contractor shall provide all apparatus, assistance, documents and other information, electricity, equipment, fuel, consumables, instruments, labour, materials, and suitably qualified and experienced staff, as are necessary to carry out the specified tests efficiently. The Contractor shall agree, with the Engineer, the time and place for the specified testing of any Plant, Materials and other parts of the Works.

7.4.3 The Engineer may, under GC Clause 13 [Variations and Adjustments], vary the location or details of specified tests, or instruct the Contractor to carry out additional tests. If these varied or additional tests show that the tested Plant, Materials or workmanship is not in accordance with the Contract, the cost of carrying out this Variation shall be borne by the Contractor, notwithstanding other provisions of the Contract.

7.4.4 The Engineer shall give the Contractor not less than 24 hours' notice of the Engineer's intention to attend the tests. If the Engineer does not attend at the time and place agreed, the Contractor may proceed with the tests, unless otherwise instructed by the Engineer, and the tests shall then be deemed to have been made in the Engineer's presence.

7.4.5 If the Contractor suffers delay and/or incurs Cost from complying with these instructions or as a result of a delay for which the Employer is responsible, the Contractor shall give notice to the Engineer and shall be entitled subject to GC Clause 20.1 [Contractor's Claims] to:

- (a) an extension of time for any such delay, if completion is or will be delayed, under **GC** Clause 8.4 [Extension of Time for Completion], and
- (b) payment of any such Cost plus profit, which shall be included in the Contract Price.

7.4.6 After receiving this notice, the Engineer shall proceed in accordance with **GC** Clause 3.5 [Determinations] to agree or determine these matters.

7.4.7 The Contractor shall promptly forward to the Engineer duly certified reports of the tests. When the specified tests have been passed, the Engineer shall endorse the Contractor's test certificate, or issue a certificate to him, to that effect. If the Engineer has not attended the tests, he shall be deemed to have accepted the readings as accurate.

7.5 Rejection

7.5.1 If, as a result of an examination, inspection, measurement or testing, any Plant, Materials or workmanship is found to be defective or otherwise not in accordance with the Contract, the Engineer may reject the Plant, Materials or workmanship by giving notice to the Contractor, with reasons. The Contractor shall then promptly make good the defect and ensure that the rejected item complies with the Contract.

7.5.2 If the Engineer requires this Plant, Materials or workmanship to be retested, the tests shall be repeated under the same terms and conditions. If the rejection and retesting cause the Employer to incur additional costs, the Contractor shall subject to **GC** Clause 2.5 [Employer's Claims] pay these costs to the Employer.

7.6 Remedial Work

7.6.1 Notwithstanding any previous test or certification, the Engineer may instruct the Contractor to:

- (a) remove from the Site and replace any Plant or Materials which is not in accordance with the Contract,
- (b) remove and re-execute any other work which is not in accordance with the Contract, and
- (c) execute any work which is urgently required for the safety of the Works, whether because of an accident, unforeseeable event or otherwise.

7.6.2 The Contractor shall comply with the instruction within a reasonable time, which shall be the time (if any) specified in the instruction, or immediately if urgency is specified under **GC** Clause 7.6.1(c).

7.6.3 If the Contractor fails to comply with the instruction, the Employer shall be entitled to employ and pay other persons to carry out the work. Except to the extent that the Contractor would have been entitled to payment for the work, the Contractor shall subject to **GC** Clause 2.5 [Employer's Claims] pay to the Employer all costs arising from this failure.

7.7 Ownership of Plant and Materials

7.7.1 Except otherwise specified in the Contract, each item of Plant and Materials shall, to the extent consistent with the Laws of the Country, become the property of the Employer at whichever is the earlier of the following times, free from liens and other encumbrances:

- (a) when it is incorporated in the Works;
- (b) when the Contractor is paid the corresponding value of the Plant and Materials under **GC** Clause 8.10 [Payment for Plant and Materials in Event of Suspension].

7.8 Royalties

7.8.1 Unless otherwise stated in the Specification, the Contractor shall pay all royalties, rents and other payments for:

- (a) natural Materials obtained from outside the Site, and
- (b) the disposal of material from demolitions and excavations and of other surplus material (whether natural or man-made), except to the extent that disposal areas within the Site are specified in the Contract.

8 Commencement, Delays and Suspension

8.1 Commencement of Works

8.1.1 Except as otherwise specified in the Particular Conditions, the Commencement Date shall be the date at which the following precedent conditions have all been fulfilled and the Engineer's instruction recording the agreement of both Parties on such fulfilment and instructing to commence the Works is received by the Contractor:

- (a) signature of the Contract Agreement by both Parties, and if required, approval of the Contract by relevant authorities in the Country;
- (b) delivery to the Contractor of reasonable evidence of the Employer's Financial arrangements (under **GC** Clause 2.4 [Employer's Financial Arrangements]);
- (c) except if otherwise specified in the Particular Conditions, effective access to and possession of the Site given to the Contractor together with such permission(s) under **GC** Clause 1.13.2(a) [Compliance with Laws] as required for the commencement of the Works; and
- (d) receipt by the Contractor of the Advance Payment under **GC** Clause 14.2 [Advance Payment] provided that the corresponding bank guarantee has been delivered by the Contractor.

8.1.2 If the above said Engineer's instruction is not received by the Contractor within 180 days from his receipt of the Letter of Acceptance, the Contractor shall be entitled to terminate the Contract under **GC** Clause 16.2 [Termination by Contractor].

8.1.3 The Contractor shall commence the execution of the Works as soon as is reasonably practicable after the Commencement Date, and shall then proceed with the Works with due expedition and without delay.

8.2 Time for Completion

8.2.1 The Contractor shall complete the whole of the Works, and each Section (if any), within the Time for Completion for the Works or Section (as the case may be), including:

- (a) achieving the passing of the Tests on Completion, and
- (b) completing all work which is stated in the Contract as being required for the Works or Section to be considered to be completed for the purposes of taking-over under **GC** Clause 10.1 [Taking Over of the Works and Sections].

8.3 Programme

8.3.1 The Contractor shall submit a detailed time programme to the Engineer within 28 days after receiving the notice under **GC** Clause 8.1 [Commencement of Works]. The Contractor shall also submit a revised programme whenever the previous programme is inconsistent with actual progress or with the Contractor's obligations. Each programme shall include:

- (a) the order in which the Contractor intends to carry out the Works, including the anticipated timing of each stage of design (if any), Contractor's Documents, procurement, manufacture of Plant, delivery to Site, construction, erection and testing,
- (b) each of these stages for work by each nominated Subcontractor (as defined in **GC** Clause 5 [Nominated Subcontractors]),
- (c) the sequence and timing of inspections and tests specified in the Contract, and
- (d) a supporting report which includes:
 - (i) a general description of the methods which the Contractor intends to adopt, and of the major stages, in the execution of the Works, and
 - (ii) details showing the Contractor's reasonable estimate of the number of each class of Contractor's Personnel and of each type of Contractor's Equipment, required on the Site for each major stage.

8.3.2 Unless the Engineer, within 21 days after receiving a programme, gives notice to the Contractor stating the extent to which it does not comply with the Contract, the Contractor shall proceed in accordance with the programme, subject to his other obligations under the Contract. The Employer's Personnel shall be entitled to rely upon the programme when planning their activities.

8.3.3 The Contractor shall promptly give notice to the Engineer of specific probable future events or circumstances which may adversely affect the work, increase the Contract Price or delay the execution of the Works. The Engineer may require the Contractor to submit an estimate of the anticipated effect of the future event or circumstances, and/or a proposal under **GC** Clause 13.3 [Variation Procedure].

8.3.4 If, at any time, the Engineer gives notice to the Contractor that a programme fails (to the extent stated) to comply with the Contract or to be consistent with actual progress and the Contractor's stated intentions, the Contractor shall submit a revised programme to the Engineer in accordance with this **GC** Clause.

8.4 Extension of Time for Completion

8.4.1 The Contractor shall be entitled subject to **GC** Clause 20.1 [Contractor's Claims] to an extension of the Time for Completion if and to the extent that

completion for the purposes of **GC** Clause 10.1 [Taking Over of the Works and Sections] is or will be delayed by any of the following causes:

- (a) a Variation (unless an adjustment to the Time for Completion has been agreed under **GC** Clause 13.3 [Variation Procedure]) or other substantial change in the quantity of an item of work included in the Contract,
- (b) a cause of delay giving an entitlement to extension of time under a Clause of these Conditions,
- (c) exceptionally adverse climatic conditions,
- (d) Unforeseeable shortages in the availability of personnel or Goods caused by epidemic or governmental actions, or
- (e) any delay, impediment or prevention caused by or attributable to the Employer, the Employer's Personnel, or the Employer's other contractors.

8.4.2 If the Contractor considers himself to be entitled to an extension of the Time for Completion, the Contractor shall give notice to the Engineer in accordance with **GC** Clause 20.1 [Contractor's Claims]. When determining each extension of time under **GC** Clause 20.1, the Engineer shall review previous determinations and may increase, but shall not decrease, the total extension of time.

8.5 Delays Caused by Authorities

8.5.1 If the following conditions apply, namely:

- (a) the Contractor has diligently followed the procedures laid down by the relevant legally constituted public authorities in the Country,
- (b) these authorities delay or disrupt the Contractor's work, and
- (c) the delay or disruption was Unforeseeable

then this delay or disruption will be considered as a cause of delay under **GC** Clause 8.4.1(b) [Extension of Time for Completion].

8.6 Rate of Progress

8.6.1 If, at any time:

- (a) actual progress is too slow to complete within the Time for Completion, and/or
- (b) progress has fallen (or will fall) behind the current programme under **GC** Clause 8.3 [Programme],

other than as a result of a cause listed in **GC** Clause 8.4 [Extension of Time for Completion], then the Engineer may instruct the Contractor to submit, under **GC** Clause 8.3 [Programme], a revised programme and supporting report describing the revised methods which the Contractor proposes to adopt in order to expedite progress and complete within the Time for Completion.

8.6.2 Unless the Engineer notifies otherwise, the Contractor shall adopt these revised methods, which may require increases in the working hours and/or in the numbers of Contractor's Personnel and/or Goods, at the risk and cost of the Contractor. If these revised methods cause the Employer to incur

additional costs, the Contractor shall subject to notice under **GC** Clause 2.5 [Employer's Claims] pay these costs to the Employer, in addition to delay damages (if any) under **GC** Clause 8.7 below.

- 8.6.3 Additional costs of revised methods, including acceleration measures, instructed by the Engineer to reduce delays resulting from causes listed under **GC** Clause 8.4 [Extension of Time for Completion] shall be paid by the Employer, without generating, however, any other additional payment benefit to the Contractor.

8.7 Delay Damages

- 8.7.1 If the Contractor fails to comply with **GC** Clause 8.2 [Time for Completion], the Contractor shall subject to notice under **GC** Clause 2.5 [Employer's Claims] pay delay damages to the Employer for this default. These delay damages shall be the sum stated in the Particular Conditions, which shall be paid for every day which shall elapse between the relevant Time for Completion and the date stated in the Taking-Over Certificate. However, the total amount due under this **GC** Clause shall not exceed the maximum amount of delay damages (if any) stated in the Particular Conditions.

- 8.7.2 These delay damages shall be the only damages due from the Contractor for such default, other than in the event of termination under **GC** Clause 15.2 [Termination by Employer] prior to completion of the Works. These damages shall not relieve the Contractor from his obligation to complete the Works, or from any other duties, obligations or responsibilities which he may have under the Contract.

8.8 Suspension of Work

- 8.8.1 The Engineer may at any time instruct the Contractor to suspend progress of part or all of the Works. During such suspension, the Contractor shall protect, store and secure such part or the Works against any deterioration, loss or damage.

- 8.8.2 The Engineer may also notify the cause for the suspension. If and to the extent that the cause is notified and is the responsibility of the Contractor, the following **GC** Clauses 8.9, 8.10 and 8.11 shall not apply.

8.9 Consequences of Suspension

- 8.9.1 If the Contractor suffers delay and/or incurs Cost from complying with the Engineer's instructions under **GC** Clause 8.8 [Suspension of Work] and/or from resuming the work, the Contractor shall give notice to the Engineer and shall be entitled subject to **GC** Clause 20.1 [Contractor's Claims] to:

- (a) an extension of time for any such delay, if completion is or will be delayed, under **GC** Clause 8.4 [Extension of Time for Completion], and
- (b) payment of any such Cost, which shall be included in the Contract Price.

- 8.9.2 After receiving this notice, the Engineer shall proceed in accordance with **GC** Clause 3.5 [Determinations] to agree or determine these matters.

- 8.9.3 The Contractor shall not be entitled to an extension of time for, or to payment of the Cost incurred in, making good the consequences of the Contractor's faulty design, workmanship or materials, or of the Contractor's failure to protect, store or secure in accordance with **GC** Clause 8.8 [Suspension of Work].

8.10 Payment for Plant and Materials in Event of Suspension

- 8.10.1 The Contractor shall be entitled to payment of the value (as at the date of suspension) of Plant and/or Materials which have not been delivered to Site, if:
- (a) the work on Plant or delivery of Plant and/or Materials has been suspended for more than 28 days, and
 - (b) the Contractor has marked the Plant and/or Materials as the Employer's property in accordance with the Engineer's instructions.

8.11 Prolonged Suspension

- 8.11.1 If the suspension under **GC** Clause 8.8 [Suspension of Work] has continued for more than 84 days, the Contractor may request the Engineer's permission to proceed. If the Engineer does not give permission within 28 days after being requested to do so, the Contractor may, by giving notice to the Engineer, treat the suspension as an omission under **GC** Clause 13 [Variations and Adjustments] of the affected part of the Works. If the suspension affects the whole of the Works, the Contractor may give notice of termination under **GC** Clause 16.2 [Termination by Contractor].

8.12 Resumption of Work

- 8.12.1 After the permission or instruction to proceed is given, the Contractor and the Engineer shall jointly examine the Works and the Plant and Materials affected by the suspension. The Contractor shall make good any deterioration or defect in or loss of the Works or Plant or Materials, which has occurred during the suspension after receiving from the Engineer an instruction to this effect under **GC** Clause 13 [Variations and Adjustments].

9 Tests on Completion**9.1 Contractor's Obligations**

- 9.1.1 The Contractor shall carry out the Tests on Completion in accordance with this **GC** Clause and **GC** Clause 7.4 [Testing], after providing the documents in accordance with **GC** Clause 4.1.6(d) [Contractor's General Obligations].
- 9.1.2 The Contractor shall give to the Engineer not less than 21 days' notice of the date after which the Contractor will be ready to carry out each of the Tests on Completion. Unless otherwise agreed, Tests on Completion shall be carried out within 14 days after this date, on such day or days as the Engineer shall instruct.
- 9.1.3 In considering the results of the Tests on Completion, the Engineer shall make allowances for the effect of any use of the Works by the Employer on the performance or other characteristics of the Works. As soon as the Works, or a Section, have passed any Tests on Completion, the Contractor shall submit a certified report of the results of these Tests to the Engineer.

9.2 Delayed Tests

- 9.2.1 If the Tests on Completion are being unduly delayed by the Employer, **GC** Clause 7.4 [Testing] (fifth paragraph) and/or **GC** Clause 10.3 [Interference with Tests on Completion] shall be applicable.

9.2.2 If the Tests on Completion are being unduly delayed by the Contractor, the Engineer may by notice require the Contractor to carry out the Tests within 21 days after receiving the notice. The Contractor shall carry out the Tests on such day or days within that period as the Contractor may fix and of which he shall give notice to the Engineer.

9.2.3 If the Contractor fails to carry out the Tests on Completion within the period of 21 days, the Employer's Personnel may proceed with the Tests at the risk and cost of the Contractor. The Tests on Completion shall then be deemed to have been carried out in the presence of the Contractor and the results of the Tests shall be accepted as accurate.

9.3 Retesting

9.3.1 If the Works, or a Section, fail to pass the Tests on Completion, GC Clause 7.5 [Rejection] shall apply, and the Engineer or the Contractor may require the failed Tests, and Tests on Completion on any related work, to be repeated under the same terms and conditions.

9.4 Failure to Pass Tests on Completion

If the Works, or a Section, fail to pass the Tests on Completion repeated under GC Clause 9.3 [Retesting], the Engineer shall be entitled to:

- (a) order further repetition of Tests on Completion under GC Clause 9.3;
- (b) if the failure deprives the Employer of substantially the whole benefit of the Works or Section, reject the Works or Section (as the case may be), in which event the Employer shall have the same remedies as are provided in GC Clause 11.4.2(c) [Failure to Remedy Defects]; or
- (c) issue a Taking-Over Certificate, if the Employer so requests.

In the event of GC Clause 9.4.1(c), the Contractor shall proceed in accordance with all other obligations under the Contract, and the Contract Price shall be reduced by such amount as shall be appropriate to cover the reduced value to the Employer as a result of this failure. Unless the relevant reduction for this failure is stated (or its method of calculation is defined) in the Contract, the Employer may require the reduction to be (i) agreed by both Parties (in full satisfaction of this failure only) and paid before this Taking-Over Certificate is issued, or (ii) determined and paid under GC Clause 2.5 [Employer's Claims] and GC Clause 3.5 [Determinations].

Employer's Taking Over

Taking Over of the Works and Sections

Except as stated in GC Clause 9.4 [Failure to Pass Tests on Completion], the Works shall be taken over by the Employer when (i) the Works have been completed in accordance with the Contract, including the matters described in GC Clause 8.2 [Time for Completion] and except as allowed in GC Clause 10.1.3(a) below, and (ii) a Taking-Over Certificate for the Works has been issued, or is deemed to have been issued in accordance with this GC Clause.

The Contractor may apply by notice to the Engineer for a Taking-Over Certificate not earlier than 14 days before the Works will, in the Contractor's opinion, be complete and ready for taking over. If the Works are divided into Sections, the Contractor may similarly apply for a Taking-Over Certificate for each Section.

The Engineer shall, within 28 days after receiving the Contractor's application:

- (a) issue the Taking-Over Certificate to the Contractor, stating the date on which the Works or Section were completed in accordance with the Contract, except for any minor outstanding work and defects which will not substantially affect the use of the Works or Section for their intended purpose (either until or whilst this work is completed and these defects are remedied); or
- (b) reject the application, giving reasons and specifying the work required to be done by the Contractor to enable the Taking-Over Certificate to be issued. The Contractor shall then complete this work before issuing a further notice under this **GC** Clause.

10.1.4 If the Engineer fails either to issue the Taking-Over Certificate or to reject the Contractor's application within the period of 28 days, and if the Works or Section (as the case may be) are substantially in accordance with the Contract, the Taking-Over Certificate shall be deemed to have been issued on the last day of that period.

10.2 Taking Over of Parts of the Works

10.2.1 The Engineer may, at the sole discretion of the Employer, issue a Taking-Over Certificate for any part of the Permanent Works.

10.2.2 The Employer shall not use any part of the Works (other than as a temporary measure which is either specified in the Contract or agreed by both Parties) unless and until the Engineer has issued a Taking-Over Certificate for this part. However, if the Employer does use any part of the Works before the Taking-Over Certificate is issued:

- (a) the part which is used shall be deemed to have been taken over as from the date on which it is used,
- (b) the Contractor shall cease to be liable for the care of such part as from this date, when responsibility shall pass to the Employer, and
- (c) if requested by the Contractor, the Engineer shall issue a Taking-Over Certificate for this part.

10.2.3 After the Engineer has issued a Taking-Over Certificate for a part of the Works, the Contractor shall be given the earliest opportunity to take such steps as may be necessary to carry out any outstanding Tests on Completion. The Contractor shall carry out these Tests on Completion as soon as practicable before the expiry date of the relevant Defects Notification Period.

10.2.4 If the Contractor incurs Cost as a result of the Employer taking over and/or using a part of the Works, other than such use as is specified in the Contract or agreed by the Contractor, the Contractor shall (i) give notice to the Engineer and (ii) be entitled subject to **GC** Clause 20.1 [Contractor's Claims] to payment of any such Cost plus profit, which shall be included in the Contract Price. After receiving this notice, the Engineer shall proceed in accordance with **GC** Clause 3.5 [Determinations] to agree or determine this Cost and profit.

10.2.5 If a Taking-Over Certificate has been issued for a part of the Works (other than a Section), the delay damages thereafter for completion of the remainder of the Works shall be reduced. Similarly, the delay damages for the remainder of the Section (if any) in which this part is included shall also be reduced. For

any period of delay after the date stated in this Taking-Over Certificate, the proportional reduction in these delay damages shall be calculated as the proportion which the value of the part so certified bears to the value of the Works or Section (as the case may be) as a whole. The Engineer shall proceed in accordance with **GC** Clause 3.5 [Determinations] to agree or determine these proportions. The provisions of this paragraph shall only apply to the daily rate of delay damages under **GC** Clause 8.7 [Delay Damages], and shall not affect the maximum amount of these damages.

10.3 Interference with Tests on Completion

- 10.3.1 If the Contractor is prevented, for more than 14 days, from carrying out the Tests on Completion by a cause for which the Employer is responsible, the Employer shall be deemed to have taken over the Works or Section (as the case may be) on the date when the Tests on Completion would otherwise have been completed.
- 10.3.2 The Engineer shall then issue a Taking-Over Certificate accordingly, and the Contractor shall carry out the Tests on Completion as soon as practicable, before the expiry date of the Defects Notification Period. The Engineer shall require the Tests on Completion to be carried out by giving 14 days' notice and in accordance with the relevant provisions of the Contract.
- 10.3.3 If the Contractor suffers delay and/or incurs Cost as a result of this delay in carrying out the Tests on Completion, the Contractor shall give notice to the Engineer and shall be entitled subject to **GC** Clause 20.1 [Contractor's Claims] to:
- (a) an extension of time for any such delay, if completion is or will be delayed, under **GC** Clause 8.4 [Extension of Time for Completion], and
 - (b) payment of any such Cost plus profit, which shall be included in the Contract Price.
- 10.3.4 After receiving this notice, the Engineer shall proceed in accordance with **GC** Clause 3.5 [Determinations] to agree or determine these matters.

10.4 Surfaces Requiring Reinstatement

- 10.4.1 Except as otherwise stated in a Taking-Over Certificate, a certificate for a Section or part of the Works shall not be deemed to certify completion of any ground or other surfaces requiring reinstatement.

11 Defects Liability

11.1 Completion of Outstanding Work and Remedying Defects

- 11.1.1 In order that the Works and Contractor's Documents, and each Section, shall be in the condition required by the Contract (fair wear and tear excepted) by the expiry date of the relevant Defects Notification Period or as soon as practicable thereafter, the Contractor shall:
- (a) complete any work which is outstanding on the date stated in a Taking-Over Certificate, within such reasonable time as is instructed by the Engineer, and
 - (b) execute all work required to remedy defects or damage, as may be notified by (or on behalf of) the Employer on or before the expiry date of the Defects Notification Period for the Works or Section (as the case may be).

- 11.1.2 If a defect appears or damage occurs, the Contractor shall be notified accordingly, by (or on behalf of) the Employer.

11.2 Cost of Remedying Defects

- 11.2.1 All work referred to in **GC** Clause 11.1.1(b) [Completion of Outstanding Work and Remedying Defects] shall be executed at the risk and cost of the Contractor, if and to the extent that the work is attributable to:

- (a) any design for which the Contractor is responsible,
- (b) Plant, Materials or workmanship not being in accordance with the Contract, or
- (c) failure by the Contractor to comply with any other obligation.

- 11.2.2 If and to the extent that such work is attributable to any other cause, the Contractor shall be notified promptly by (or on behalf of) the Employer, and **GC** Clause 13.3 [Variation Procedure] shall apply.

11.3 Extension of Defects Notification Period

- 11.3.1 The Employer shall be entitled subject to **GC** Clause 2.5 [Employer's Claims] to an extension of the Defects Notification Period for the Works or a Section if and to the extent that the Works, Section or a major item of Plant (as the case may be, and after taking over) cannot be used for the purposes for which they are intended by reason of a defect or by reason of a damage attributable to the Contractor. However, a Defects Notification Period shall not be extended by more than two years.

- 11.3.2 If delivery and/or erection of Plant and/or Materials was suspended under **GC** Clause 8.8 [Suspension of Work] or **GC** Clause 16.1 [Contractor's Entitlement to Suspend Work], the Contractor's obligations under this **GC** Clause shall not apply to any defects or damage occurring more than two years after the Defects Notification Period for the Plant and/or Materials would otherwise have expired.

11.4 Failure to Remedy Defects

- 11.4.1 If the Contractor fails to remedy any defect or damage within a reasonable time, a date may be fixed by (or on behalf of) the Employer, on or by which the defect or damage is to be remedied. The Contractor shall be given reasonable notice of this date.

- 11.4.2 If the Contractor fails to remedy the defect or damage by this notified date and this remedial work was to be executed at the cost of the Contractor under **GC** Clause 11.2 [Cost of Remedying Defects], the Employer may (at his option):

- (a) carry out the work himself or by others, in a reasonable manner and at the Contractor's cost, but the Contractor shall have no responsibility for this work; and the Contractor shall subject to **GC** Clause 2.5 [Employer's Claims] pay to the Employer the costs reasonably incurred by the Employer in remedying the defect or damage;
- (b) require the Engineer to agree or determine a reasonable reduction in the Contract Price in accordance with **GC** Clause 3.5 [Determinations]; or
- (c) if the defect or damage deprives the Employer of substantially the whole benefit of the Works or any major part of the Works, terminate the Contract as a whole, or in respect of such major part which cannot be

put to the intended use. Without prejudice to any other rights, under the Contract or otherwise, the Employer shall then be entitled to recover all sums paid for the Works or for such part (as the case may be), plus financing costs and the cost of dismantling the same, clearing the Site and returning Plant and Materials to the Contractor.

11.5 Removal of Defective Work

- 11.5.1 If the defect or damage cannot be remedied expeditiously on the Site and the Employer gives consent, the Contractor may remove from the Site for the purposes of repair such items of Plant as are defective or damaged. This consent may require the Contractor to increase the amount of the Performance Security by the full replacement cost of these items, or to provide other appropriate security.

11.6 Further Tests

- 11.6.1 If the work of remedying of any defect or damage may affect the performance of the Works, the Engineer may require the repetition of any of the tests described in the Contract. The requirement shall be made by notice within 28 days after the defect or damage is remedied.
- 11.6.2 These tests shall be carried out in accordance with the terms applicable to the previous tests, except that they shall be carried out at the risk and cost of the Party liable, under **GC** Clause 11.2 [Cost of Remedying Defects], for the cost of the remedial work.

11.7 Right of Access

- 11.7.1 Until the Performance Certificate has been issued, the Contractor shall have such right of access to the Works as is reasonably required in order to comply with this **GC** Clause, except as may be inconsistent with the Employer's reasonable security restrictions.

11.8 Contractor to Search

- 11.8.1 The Contractor shall, if required by the Engineer, search for the cause of any defect, under the direction of the Engineer. Unless the defect is to be remedied at the cost of the Contractor under **GC** Clause 11.2 [Cost of Remedying Defects], the Cost of the search plus profit shall be agreed or determined by the Engineer in accordance with **GC** Clause 3.5 [Determinations] and shall be included in the Contract Price.

11.9 Performance Certificate

- 11.9.1 Performance of the Contractor's obligations shall not be considered to have been completed until the Engineer has issued the Performance Certificate to the Contractor, stating the date on which the Contractor completed his obligations under the Contract.
- 11.9.2 The Engineer shall issue the Performance Certificate within 28 days after the latest of the expiry dates of the Defects Notification Periods, or as soon thereafter as the Contractor has supplied all the Contractor's Documents and completed and tested all the Works, including remedying any defects. A copy of the Performance Certificate shall be issued to the Employer.
- 11.9.3 Only the Performance Certificate shall be deemed to constitute acceptance of the Works.

11.10 Unfulfilled Obligations

- 11.10.1 After the Performance Certificate has been issued, each Party shall remain liable for the fulfilment of any obligation which remains unperformed at that time. For the purposes of determining the nature and extent of unperformed obligations, the Contract shall be deemed to remain in force.

11.11 Clearance of Site

- 11.11.1 Upon receiving the Performance Certificate, the Contractor shall remove any remaining Contractor's Equipment, surplus material, wreckage, rubbish and Temporary Works from the Site.
- 11.11.2 If all these items have not been removed within 28 days after receipt by the Contractor of the Performance Certificate, the Employer may sell or otherwise dispose of any remaining items. The Employer shall be entitled to be paid the costs incurred in connection with, or attributable to, such sale or disposal and restoring the Site.
- 11.11.3 Any balance of the moneys from the sale shall be paid to the Contractor. If these moneys are less than the Employer's costs, the Contractor shall pay the outstanding balance to the Employer.

12 Measurement and Evaluation**12.1 Works to be Measured**

- 12.1.1 The Works shall be measured, and valued for payment, in accordance with this GC Clause. The Contractor shall show in each application under GC Clauses 14.3 [Application for Interim Payment Certificates], 14.10 [Statement at Completion], and 14.11 [Application for Final Payment Certificate] the quantities and other particulars detailing the amounts which he considers to be entitled under the Contract.
- 12.1.2 Whenever the Engineer requires any part of the Works to be measured, reasonable notice shall be given to the Contractor's Representative, who shall:
- (a) promptly either attend or send another qualified representative to assist the Engineer in making the measurement, and
 - (b) supply any particulars requested by the Engineer.
- 12.1.3 If the Contractor fails to attend or send a representative, the measurement made by (or on behalf of) the Engineer shall be accepted as accurate.
- 12.1.4 Except as otherwise stated in the Contract, wherever any Permanent Works are to be measured from records, these shall be prepared by the Engineer. The Contractor shall, as and when requested, attend to examine and agree the records with the Engineer, and shall sign the same when agreed. If the Contractor does not attend, the records shall be accepted as accurate.
- 12.1.5 If the Contractor examines and disagrees with the records, and/or does not sign them as agreed, then the Contractor shall give notice to the Engineer of the respects in which the records are asserted to be inaccurate. After receiving this notice, the Engineer shall review the records and either confirm or vary them and certify the payment of the undisputed part. If the Contractor does not so give notice to the Engineer within 14 days after being requested to

examine the records, they shall be accepted as accurate.

12.2 Method of Measurement

12.2.1 Except as otherwise stated in the Contract and notwithstanding local practice:

- (a) measurement shall be made of the net actual quantity of each item of the Permanent Works, and
- (b) the method of measurement shall be in accordance with the Bill of Quantities or other applicable Schedules.

12.3 Evaluation

12.3.1 Except as otherwise stated in the Contract, the Engineer shall proceed in accordance with **GC** Clause 3.5 [Determinations] to agree or determine the Contract Price by evaluating each item of work, applying the measurement agreed or determined in accordance with the above **GC** Clauses 12.1 and 12.2 and the appropriate rate or price for the item.

12.3.2 For each item of work, the appropriate rate or price for the item shall be the rate or price specified for such item in the Contract or, if there is no such item, specified for similar work.

12.3.3 Any item of work included in the Bill of Quantities for which no rate or price was specified shall be considered as included in other rates and prices in the Bill of Quantities and will not be paid for separately.

12.3.4 However, a new rate or price shall be appropriate for an item of work if:

- (a)
 - (i) the measured quantity of the item is changed by more than 25% from the quantity of this item in the Bill of Quantities or other Schedule,
 - (ii) this change in quantity multiplied by such specified rate for this item exceeds 0.25% of the Accepted Contract Amount,
 - (iii) this change in quantity directly changes the Cost per unit quantity of this item by more than 1%, and
 - (iv) this item is not specified in the Contract as a “fixed rate item”;

or

- (b)
 - (i) the work is instructed under **GC** Clause 13 [Variations and Adjustments],
 - (ii) no rate or price is specified in the Contract for this item, and
 - (iii) no specified rate or price is appropriate because the item of work is not of similar character, or is not executed under similar conditions, as any item in the Contract.

12.3.5 Each new rate or price shall be derived from any relevant rates or prices in the Contract, with reasonable adjustments to take account of the matters described

in **GC** Clause 12.3.4(a) and/or (b), as applicable. If no rates or prices are relevant for the derivation of a new rate or price, it shall be derived from the reasonable Cost of executing the work, together with profit, taking account of any other relevant matters.

- 12.3.6 Until such time as an appropriate rate or price is agreed or determined, the Engineer shall determine a provisional rate or price for the purposes of Interim Payment Certificates as soon as the concerned Works commences.

12.4 Omissions

- 12.4.1 Whenever the omission of any work forms part (or all) of a Variation, the value of which has not been agreed, if:

- (a) the Contractor will incur (or has incurred) cost which, if the work had not been omitted, would have been deemed to be covered by a sum forming part of the Accepted Contract Amount;
- (b) the omission of the work will result (or has resulted) in this sum not forming part of the Contract Price; and
- (c) this cost is not deemed to be included in the evaluation of any substituted work;

then the Contractor shall give notice to the Engineer accordingly, with supporting particulars. Upon receiving this notice, the Engineer shall proceed in accordance with **GC** Clause 3.5 [Determinations] to agree or determine this cost, which shall be included in the Contract Price.

13 Variations and Adjustments

13.1 Right to Vary

- 13.1.1 Variations may be initiated by the Engineer at any time prior to issuing the Taking-Over Certificate for the Works, either by an instruction or by a request for the Contractor to submit a proposal.

- 13.1.2 The Contractor shall execute and be bound by each Variation, unless the Contractor promptly gives notice to the Engineer stating (with supporting particulars) that (i) the Contractor cannot readily obtain the Goods required for the Variation, or (ii) such Variation triggers a substantial change in the sequence or progress of the Works. Upon receiving this notice, the Engineer shall cancel, confirm or vary the instruction.

- 13.1.3 Each Variation may include:

- (a) changes to the quantities of any item of work included in the Contract (however, such changes do not necessarily constitute a Variation),
- (b) changes to the quality and other characteristics of any item of work,
- (c) changes to the levels, positions and/or dimensions of any part of the Works,
- (d) omission of any work unless it is to be carried out by others,
- (e) any additional work, Plant, Materials or services necessary for the Permanent Works, including any associated Tests on Completion, boreholes and other testing and exploratory work, or

- (f) changes to the sequence or timing of the execution of the Works.

13.1.4 The Contractor shall not make any alteration and/or modification of the Permanent Works, unless and until the Engineer instructs or approves a Variation.

13.2 Value Engineering

13.2.1 The Contractor may, at any time, submit to the Engineer a written proposal which (in the Contractor's opinion) will, if adopted, (i) accelerate completion, (ii) reduce the cost to the Employer of executing, maintaining or operating the Works, (iii) improve the efficiency or value to the Employer of the completed Works, or (iv) otherwise be of benefit to the Employer.

13.2.2 The proposal shall be prepared at the cost of the Contractor and shall include the items listed in **GC** Clause 13.3 [Variation Procedure].

13.2.3 If a proposal, which is approved by the Engineer, includes a change in the design of part of the Permanent Works, then unless otherwise agreed by both Parties:

- (a) the Contractor shall design this part,
- (b) **GC** Clauses 4.1.6(a), 4.1.6(b), 4.1.6(c), and 4.1.6(d) [Contractor's General Obligations] shall apply, and
- (c) if this change results in a reduction in the contract value of this part, the Engineer shall proceed in accordance with **GC** Clause 3.5 [Determinations] to agree or determine a fee, which shall be included in the Contract Price. This fee shall be half (50%) of the difference between the following amounts:
 - (i) such reduction in contract value, resulting from the change, excluding adjustments under **GC** Clause 13.7 [Adjustments for Changes in Legislation] and **GC** Clause 13.8 [Adjustments for Changes in Cost], and
 - (ii) the reduction (if any) in the value to the Employer of the varied works, taking account of any reductions in quality, anticipated life or operational efficiencies.

13.2.4 However, if amount (i) is less than amount (ii), there shall not be a fee.

13.3 Variation Procedure

13.3.1 If the Engineer requests a proposal, prior to instructing a Variation, the Contractor shall respond in writing as soon as practicable, either by giving reasons why he cannot comply (if this is the case) or by submitting:

- (a) a description of the proposed work to be performed and a programme for its execution,
- (b) the Contractor's proposal for any necessary modifications to the programme according to **GC** Clause 8.3 [Programme] and to the Time for Completion, and
- (c) the Contractor's proposal for evaluation of the Variation.

- 13.3.2 The Engineer shall, as soon as practicable after receiving such proposal (under **GC** Clause 13.2 [Value Engineering] or otherwise), respond with approval, disapproval or comments. The Contractor shall not delay any work whilst awaiting a response.
- 13.3.3 Each instruction to execute a Variation, with any requirements for the recording of Costs, shall be issued by the Engineer to the Contractor, who shall acknowledge receipt.
- 13.3.4 Each Variation shall be evaluated in accordance with **GC** Clause 12 [Measurement and Evaluation], unless the Engineer instructs or approves otherwise in accordance with this **GC** Clause.

13.4 Payment in Applicable Currencies

- 13.4.1 If the Contract provides for payment of the Contract Price in more than one currency, then whenever an adjustment is agreed, approved or determined as stated above, the amount payable in each of the applicable currencies shall be specified. For this purpose, reference shall be made to the actual or expected currency proportions of the Cost of the varied work, and to the proportions of various currencies specified for payment of the Contract Price.

13.5 Provisional Sums

- 13.5.1 Each Provisional Sum shall only be used, in whole or in part, in accordance with the Engineer's instructions, and the Contract Price shall be adjusted accordingly. The total sum paid to the Contractor shall include only such amounts, for the work, supplies or services to which the Provisional Sum relates, as the Engineer shall have instructed. For each Provisional Sum, the Engineer may instruct:
- (a) work to be executed (including Plant, Materials or services to be supplied) by the Contractor and valued under **GC** Clause 13.3 [Variation Procedure]; and/or
 - (b) Plant, Materials or services to be purchased by the Contractor, from a nominated Subcontractor (as defined in **GC** Clause 5 [Nominated Subcontractors]) or otherwise; and for which there shall be included in the Contract Price:
 - (i) the actual amounts paid (or due to be paid) by the Contractor, and
 - (ii) a sum for overhead charges and profit, calculated as a percentage of these actual amounts by applying the relevant percentage rate (if any) stated in the appropriate Schedule. If there is no such rate, the percentage rate stated in the Particular Conditions shall be applied.

- 13.5.2 The Contractor shall, when required by the Engineer, produce quotations, invoices, vouchers and accounts or receipts in substantiation.

13.6 Day work

- 13.6.1 For work of a minor or incidental nature, the Engineer may instruct that a Variation shall be executed on a day work basis. The work shall then be valued in accordance with the Day work Schedule included in the Contract, and the following procedure shall apply. If a Day work Schedule is not included in the Contract, this **GC** Clause shall not apply.

- 13.6.2 Before ordering Goods for the work, the Contractor shall submit quotations to the Engineer. When applying for payment, the Contractor shall submit invoices, vouchers and accounts or receipts for any Goods.
- 13.6.3 Except for any items for which the Day work Schedule specifies that payment is not due, the Contractor shall deliver each day to the Engineer accurate statements in duplicate which shall include the following details of the resources used in executing the previous day's work:
- (a) the names, occupations and time of Contractor's Personnel,
 - (b) the identification, type and time of Contractor's Equipment and Temporary Works, and
 - (c) the quantities and types of Plant and Materials used.
- 13.6.4 One copy of each statement will, if correct, or when agreed, be signed by the Engineer and returned to the Contractor. The Contractor shall then submit priced statements of these resources to the Engineer, prior to their inclusion in the next Statement under GC Clause 14.3 [Application for Interim Payment Certificates].

13.7 Adjustments for Changes in Legislation

- 13.7.1 The Contract Price shall be adjusted to take account of any increase or decrease in Cost resulting from a change in the Laws of the Country (including the introduction of new Laws and the repeal or modification of existing Laws) or in the judicial or official governmental interpretation of such Laws, made after the Base Date, which affect the Contractor in the performance of obligations under the Contract.
- 13.7.2 If the Contractor suffers (or will suffer) delay and/or incurs (or will incur) additional Cost as a result of these changes in the Laws or in such interpretations, made after the Base Date, the Contractor shall give notice to the Engineer and shall be entitled subject to GC Clause 20.1 [Contractor's Claims] to:
- (a) an extension of time for any such delay, if completion is or will be delayed, under GC Clause 8.4 [Extension of Time for Completion], and
 - (b) payment of any such Cost, which shall be included in the Contract Price.
- 13.7.3 After receiving this notice, the Engineer shall proceed in accordance with GC Clause 3.5 [Determinations] to agree or determine these matters.
- 13.7.4 Notwithstanding the foregoing, the Contractor shall not be entitled to an extension of time if the relevant delay has already been taken into account in the determination of a previous extension of time and such Cost shall not be separately paid if the same shall already have been taken into account in the indexing of any inputs to the table of adjustment data in accordance with the provisions of GC Clause 13.8 [Adjustments for Changes in Cost].

13.8 Adjustments for Changes in Cost

- 13.8.1 In this GC Clause, "table of adjustment data" means the completed table of adjustment data for local and foreign currencies included in the Schedules. If there is no such table of adjustment data, this GC Clause shall not apply.
- 13.8.2 If this GC Clause applies, the amounts payable to the Contractor shall be adjusted for rises or falls in the cost of labour, Goods and other inputs to the

Works, by the addition or deduction of the amounts determined by the formulae prescribed in this **GC** Clause. To the extent that full compensation for any rise or fall in Costs is not covered by the provisions of this or other **GC** Clauses, the Accepted Contract Amount shall be deemed to have included amounts to cover the contingency of other rises and falls in costs.

- 13.8.3 The adjustment to be applied to the amount otherwise payable to the Contractor, as valued in accordance with the appropriate Schedule and certified in Payment Certificates, shall be determined from formulae for each of the currencies in which the Contract Price is payable. No adjustment is to be applied to work valued on the basis of Cost or current prices. The formulae shall be of the following general type:

$$P_n = a + b L_n / L_o + c E_n / E_o + d M_n / M_o + \dots$$

where:

“ P_n ” is the adjustment multiplier to be applied to the estimated contract value in the relevant currency of the work carried out in period “ n ”, this period being a month unless otherwise stated in the Particular Conditions;

“ a ” is a fixed coefficient, stated in the relevant table of adjustment data, representing the non-adjustable portion in contractual payments;

“ b ”, “ c ”, “ d ”, ... are coefficients representing the estimated proportion of each cost element related to the execution of the Works, as stated in the relevant table of adjustment data; such tabulated cost elements may be indicative of resources such as labour, equipment and materials;

“ L_n ”, “ E_n ”, “ M_n ”, ... are the current cost indices or reference prices for period “ n ”, expressed in the relevant currency of payment, each of which is applicable to the relevant tabulated cost element on the date 49 days prior to the last day of the period (to which the particular Payment Certificate relates); and

“ L_o ”, “ E_o ”, “ M_o ”, ... are the base cost indices or reference prices, expressed in the relevant currency of payment, each of which is applicable to the relevant tabulated cost element on the Base Date.

- 13.8.4 The cost indices or reference prices stated in the table of adjustment data shall be used. If their source is in doubt, it shall be determined by the Engineer. For this purpose, reference shall be made to the values of the indices at stated dates (quoted in the fourth and fifth columns respectively of the table) for the purposes of clarification of the source; although these dates (and thus these values) may not correspond to the base cost indices.
- 13.8.5 In cases where the “currency of index” (stated in the table) is not the relevant currency of payment, each index shall be converted into the relevant currency of payment at the selling rate, established by the central bank of the Country, of this relevant currency on the above date for which the index is required to be applicable
- 13.8.6 Until such time as each current cost index is available, the Engineer shall determine a provisional index for the issue of Interim Payment Certificates. When a current cost index is available, the adjustment shall be recalculated accordingly.
- 13.8.7 If the Contractor fails to complete the Works within the Time for Completion, adjustment of prices thereafter shall be made using either (i) each index or price applicable on the date 49 days prior to the expiry of the Time for Completion of the Works, or (ii) the current index or price, whichever is more

favourable to the Employer.

- 13.8.8 The weightings (coefficients) for each of the factors of cost stated in the table(s) of adjustment data shall only be adjusted if they have been rendered unreasonable, unbalanced or inapplicable, as a result of Variations.

14 Contract Price and Payment

14.1 The Contract Price

- 14.1.1 Unless otherwise stated in the Particular Conditions:

- (a) the Contract Price shall be agreed or determined under **GC** Clause 12.3 [Evaluation] and be subject to adjustments in accordance with the Contract;
- (b) the Contractor shall pay all taxes, duties and fees required to be paid by him under the Contract, and the Contract Price shall not be adjusted for any of these costs except as stated in **GC** Clause 13.7 [Adjustments for Changes in Legislation];
- (c) any quantities which may be set out in the Bill of Quantities or other Schedule are estimated quantities and are not to be taken as the actual and correct quantities:
 - (i) of the Works which the Contractor is required to execute, or
 - (ii) for the purposes of **GC** Clause 12 [Measurement and Evaluation]; and
- (d) the Contractor shall submit to the Engineer, within 28 days after the Commencement Date, a proposed breakdown of each lump sum price in the Schedules. The Engineer may take account of the breakdown when preparing Payment Certificates, but shall not be bound by it; and
- (e) notwithstanding the provisions of **GC** Clause 14.1.1(b), Contractor's Equipment, including essential spare parts therefore, imported by the Contractor for the sole purpose of executing the Contract shall be exempt from the payment of import duties and taxes upon importation.

14.2 Advance Payment

- 14.2.1 The Employer shall make an advance payment, as an interest-free loan for mobilisation and cash flow support, when the Contractor submits a guarantee in accordance with this **GC** Clause. The total advance payment, the number and timing of instalments (if more than one), and the applicable currencies and proportions, shall be as stated in the Particular Conditions.
- 14.2.2 Unless and until the Employer receives this guarantee, or if the total advance payment is not stated in the Particular Conditions, this **GC** Clause shall not apply.
- 14.2.3 The Engineer shall deliver to the Employer and to the Contractor an Interim Payment Certificate for the advance payment or its first instalment after receiving a Statement (under **GC** Clause 14.3 [Application for Interim Payment Certificates]) and after the Employer receives (i) the Performance Security in accordance with **GC** Clause 4.2 [Performance Security] and (ii) a guarantee in amounts and currencies equal to the advance payment. This guarantee shall be issued by a reputable bank or financial institution selected by the Contractor, and shall be in the form furnished in Section IX, Contract

Forms or in another form approved by the Employer.

- 14.2.4 The Contractor shall ensure that the guarantee is valid and enforceable until the advance payment has been repaid, but its amount shall be progressively reduced by the amount repaid by the Contractor as indicated in the Payment Certificates. If the terms of the guarantee specify its expiry date, and the advance payment has not been repaid by the date 28 days prior to the expiry date, the Contractor shall extend the validity of the guarantee until the advance payment has been repaid.
- 14.2.5 Unless stated otherwise in the Particular Conditions, the advance payment shall be repaid through percentage deductions from the interim payments determined by the Engineer in accordance with **GC** Clause 14.6 [Issue of Interim Payment Certificates], as follows:
- (a) deductions shall commence in the next interim Payment Certificate following that in which the total of all certified interim payments (excluding the advance payment and deductions and repayments of retention) exceeds 30 per cent (30%) of the Accepted Contract Amount less Provisional Sums; and
 - (b) deductions shall be made at the amortisation rate stated in the Particular Conditions of the amount of each Interim Payment Certificate (excluding the advance payment and deductions for its repayments as well as deductions for retention money) in the currencies and proportions of the advance payment until such time as the advance payment has been repaid; provided that the advance payment shall be completely repaid prior to the time when 90 per cent (90%) of the Accepted Contract Amount less Provisional Sums has been certified for payment.
- 14.2.6 If the advance payment has not been repaid prior to the issue of the Taking-Over Certificate for the Works, or prior to termination under **GC** Clause 15 [Termination by Employer], **GC** Clause 16 [Suspension and Termination by Contractor] or **GC** Clause 19.6 [Optional Termination, Payment and Release] (as the case may be), the whole of the balance then outstanding shall immediately become due, and in case of termination under **GC** Clause 15 [Termination by Employer], except for **GC** Clause 15.5 [Employer's Entitlement to Termination for Convenience], payable by the Contractor to the Employer.

14.3 Application for Interim Payment Certificates

- 14.3.1 The Contractor shall submit a Statement in six copies to the Engineer after the end of each month, in a form approved by the Engineer, showing in detail the amounts to which the Contractor considers himself to be entitled, together with supporting documents which shall include the report on the progress during this month in accordance with **GC** Clause 4.21 [Progress Reports].
- 14.3.2 The Statement shall include the following items, as applicable, which shall be expressed in the various currencies in which the Contract Price is payable, in the sequence listed:
- (a) the estimated contract value of the Works executed and the Contractor's Documents produced up to the end of the month (including Variations but excluding items described in this **GC** Clause 14.3.2 (b) to (g) below);
 - (b) any amounts to be added and deducted for changes in legislation and changes in cost, in accordance with **GC** Clause 13.7 [Adjustments for Changes in Legislation] and **GC** Clause 13.8 [Adjustments for Changes

in Cost];

- (c) any amount to be deducted for retention, calculated by applying the percentage of retention stated in the Particular Conditions to the total of the above amounts, until the amount so retained by the Employer reaches the limit of Retention Money (if any) stated in the Particular Conditions;
- (d) any amounts to be added for the advance payment (if more than one instalment) and to be deducted for its repayments in accordance with **GC Clause 14.2** [Advance Payment];
- (e) any amounts to be added and deducted for Plant and Materials in accordance with **GC Clause 14.5** [Plant and Materials intended for the Works];
- (f) any other additions or deductions which may have become due under the Contract or otherwise, including those under **GC Clause 20** [Claims, Disputes and Arbitration]; and
- (g) the deduction of amounts certified in all previous Payment Certificates.

14.4 Schedule of Payments

14.4.1 If the Contract includes a schedule of payments specifying the instalments in which the Contract Price will be paid, then unless otherwise stated in this schedule:

- (a) the instalments quoted in this schedule of payments shall be the estimated contract values for the purposes of **GC Clause 14.3.2(a)** [Application for Interim Payment Certificates];
- (b) **GC Clause 14.5** [Plant and Materials intended for the Works] shall not apply; and
- (c) if these instalments are not defined by reference to the actual progress achieved in executing the Works, and if actual progress is found to be less or more than that on which this schedule of payments was based, then the Engineer may proceed in accordance with **GC Clause 3.5** [Determinations] to agree or determine revised instalments, which shall take account of the extent to which progress is less or more than that on which the instalments were previously based.

14.4.2 If the Contract does not include a schedule of payments, the Contractor shall submit non-binding estimates of the payments which he expects to become due during each quarterly period. The first estimate shall be submitted within 42 days after the Commencement Date. Revised estimates shall be submitted at quarterly intervals, until the Taking-Over Certificate has been issued for the Works.

14.5 Plant and Materials intended for the Works

14.5.1 If this **GC Clause** applies, Interim Payment Certificates shall include, under **GC Clause 14.3.2(e)** [Application for Interim Payment Certificates], (i) an amount for Plant and Materials which have been sent to the Site for incorporation in the Permanent Works, and (ii) a reduction when the contract value of such Plant and Materials is included as part of the Permanent Works under **GC Clause 14.3.2(a)** [Application for Interim Payment Certificates].

14.5.2 If the lists referred to in **GC Clause 14.5.3(b)(i)**, or **GC Clause 14.5.3(c)(i)** below are not included in the Schedules, this **GC Clause** shall not apply.

14.5.3 The Engineer shall determine and certify each addition if the following conditions are satisfied:

(a) the Contractor has:

- (i) kept satisfactory records (including the orders, receipts, Costs and use of Plant and Materials) which are available for inspection, and
- (ii) submitted a statement of the Cost of acquiring and delivering the Plant and Materials to the Site, supported by satisfactory evidence;

and either:

(b) the relevant Plant and Materials:

- (i) are those listed in the Schedules for payment when shipped,
- (ii) have been shipped to the Country, en route to the Site, in accordance with the Contract; and
- (iii) are described in a clean shipped bill of lading or other evidence of shipment, which has been submitted to the Engineer together with evidence of payment of freight and insurance, any other documents reasonably required, and a bank guarantee in a form and issued by an entity approved by the Employer in amounts and currencies equal to the amount due under this **GC** Clause: this guarantee may be in a similar form to the form referred to in **GC** Clause 14.2 [Advance Payment] and shall be valid until the Plant and Materials are properly stored on Site and protected against loss, damage or deterioration;

or

(c) the relevant Plant and Materials:

- (i) are those listed in the Schedules for payment when delivered to the Site, and
- (ii) have been delivered to and are properly stored on the Site, are protected against loss, damage or deterioration, and appear to be in accordance with the Contract.

14.5.4 The additional amount to be certified shall be the equivalent of eighty percent of the Engineer's determination of the cost of the Plant and Materials (including delivery to Site), taking account of the documents mentioned in this **GC** Clause and of the contract value of the Plant and Materials.

14.5.5 The currencies for this additional amount shall be the same as those in which payment will become due when the contract value is included under **GC** Clause 14.3.2(a) [Application for Interim Payment Certificates]. At that time, the Payment Certificate shall include the applicable reduction which shall be equivalent to, and in the same currencies and proportions as, this additional amount for the relevant Plant and Materials

14.6 Issue of Interim Payment Certificates

- 14.6.1 No amount will be certified or paid until the Employer has received and approved the Performance Security. Thereafter, the Engineer shall, within 28 days after receiving a Statement and supporting documents, deliver to the Employer and to the Contractor an Interim Payment Certificate which shall state the amount which the Engineer fairly determines to be due, with all supporting particulars for any reduction or withholding made by the Engineer on the Statement.
- 14.6.2 However, prior to issuing the Taking-Over Certificate for the Works, the Engineer shall not be bound to issue an Interim Payment Certificate in an amount which would (after retention and other deductions) be less than the minimum amount of Interim Payment Certificates (if any) stated in the Particular Conditions. In this event, the Engineer shall give notice to the Contractor accordingly.
- 14.6.3 An Interim Payment Certificate shall not be withheld for any other reason, although:
- (a) if anything supplied or work done by the Contractor is not in accordance with the Contract, the cost of rectification or replacement may be withheld until rectification or replacement has been completed; and/or
 - (b) if the Contractor was or is failing to perform any work or obligation in accordance with the Contract, and had been so notified by the Engineer, the value of this work or obligation may be withheld until the work or obligation has been performed.
- 14.6.4 The Engineer may in any Payment Certificate make any correction or modification that should properly be made to any previous Payment Certificate. A Payment Certificate shall not be deemed to indicate the Engineer's acceptance, approval, consent or satisfaction.

14.7 Payment

- 14.7.1 The Employer shall pay to the Contractor:
- (a) the first instalment of the advance payment within 42 days after issuing the Letter of Acceptance or within 21 days after receiving the documents in accordance with **GC** Clause 4.2 [Performance Security] and **GC** Clause 14.2 [Advance Payment], whichever is later;
 - (b) the amount certified in each Interim Payment Certificate within 56 days after the Engineer receives the Statement and supporting documents; or, at a time when the Bank's loan or credit (from which part of the payments to the Contractor is being made) is suspended, the amount shown on any statement submitted by the Contractor within 14 days after such statement is submitted, any discrepancy being rectified in the next payment to the Contractor; and
 - (c) the amount certified in the Final Payment Certificate within 56 days after the Employer receives this Payment Certificate; or, at a time when the Bank's loan or credit (from which part of the payments to the Contractor is being made) is suspended, the undisputed amount shown in the Final Statement within 56 days after the date of notification of the suspension in accordance with **GC** Clause 16.2.
- 14.7.2 Payment of the amount due in each currency shall be made into the bank account, nominated by the Contractor, in the payment country (for this

currency) specified in the Contract.

14.8 Delayed Payment

- 14.8.1 If the Contractor does not receive payment in accordance with **GC** Clause 14.7 [Payment], the Contractor shall be entitled to receive financing charges compounded monthly on the amount unpaid during the period of delay. This period shall be deemed to commence on the date for payment specified in **GC** Clause 14.7 [Payment], irrespective (in the case of Clause 14.7.1(b)) of the date on which any Interim Payment Certificate is issued.
- 14.8.2 Unless otherwise stated in the Particular Conditions, these financing charges shall be calculated at the annual rate of three percentage points above the discount rate of the central bank in the country of the currency of payment, or if not available, the interbank offered rate, and shall be paid in such currency.
- 14.8.3 The Contractor shall be entitled to this payment without formal notice or certification, and without prejudice to any other right or remedy.

14.9 Payment of Retention Money

- 14.9.1 When the Taking-Over Certificate has been issued for the Works, the first half of the Retention Money shall be certified by the Engineer for payment to the Contractor. If a Taking-Over Certificate is issued for a Section or part of the Works, a proportion of the Retention Money shall be certified and paid. This proportion shall be half (50%) of the proportion calculated by dividing the estimated contract value of the Section or part, by the estimated final Contract Price.
- 14.9.2 Promptly after the latest of the expiry dates of the Defects Notification Periods, the outstanding balance of the Retention Money shall be certified by the Engineer for payment to the Contractor. If a Taking-Over Certificate was issued for a Section, a proportion of the second half of the Retention Money shall be certified and paid promptly after the expiry date of the Defects Notification Period for the Section. This proportion shall be half (50%) of the proportion calculated by dividing the estimated contract value of the Section by the estimated final Contract Price.
- 14.9.3 However, if any work remains to be executed under **GC** Clause 11 [Defects Liability], the Engineer shall be entitled to withhold certification of the estimated cost of this work until it has been executed.
- 14.9.4 When calculating these proportions, no account shall be taken of any adjustments under **GC** Clause 13.7 [Adjustments for Changes in Legislation] and **GC** Clause 13.8 [Adjustments for Changes in Cost].
- 14.9.5 Unless otherwise stated in the Particular Conditions, when the Taking-Over Certificate has been issued for the Works and the first half of the Retention Money has been certified for payment by the Engineer, the Contractor shall be entitled to substitute a guarantee, in the form stipulated in Section IX, Contract Forms or in another form approved by the Employer and issued by a reputable bank or financial institution selected by the Contractor, for the second half of the Retention Money. The Contractor shall ensure that the guarantee is in the amounts and currencies of the second half of the Retention Money and is valid and enforceable until the Contractor has executed and completed the Works and remedied any defects, as specified for the Performance Security in **GC** Clause 4.2. On receipt by the Employer of the required guarantee, the Engineer shall certify and the Employer shall pay the second half of the Retention Money. The release of the second half of the Retention Money against a guarantee shall then be in lieu of the release under **GC** Clause 14.9.2. The Employer shall return the guarantee to the Contractor

within 21 days after receiving a copy of the Performance Certificate.

- 14.9.6 If the Performance Security required under **GC** Clause 4.2 is in the form of a demand guarantee, and the amount guaranteed under it when the Taking-Over Certificate is issued is more than half of the Retention Money, then the Retention Money guarantee will not be required. If the amount guaranteed under the Performance Security when the Taking-Over Certificate is issued is less than half of the Retention Money, the Retention Money guarantee will only be required for the difference between half of the Retention Money and the amount guaranteed under the Performance Security.

14.10 Statement at Completion

- 14.10.1 Within 84 days after receiving the Taking-Over Certificate for the Works, the Contractor shall submit to the Engineer six copies of a Statement at completion with supporting documents, in accordance with **GC** Clause 14.3 [Application for Interim Payment Certificates], showing:

- (a) the value of all work done in accordance with the Contract up to the date stated in the Taking-Over Certificate for the Works,
- (b) any further sums which the Contractor considers to be due, and
- (c) an estimate of any other amounts which the Contractor considers will become due to him under the Contract. Estimated amounts shall be shown separately in this Statement at completion.

- 14.10.2 The Engineer shall then certify in accordance with **GC** Clause 14.6 [Issue of Interim Payment Certificates].

14.11 Application for Final Payment Certificate

- 14.11.1 Within 56 days after receiving the Performance Certificate, the Contractor shall submit, to the Engineer, six copies of a draft final statement with supporting documents showing in detail in a form approved by the Engineer:

- (a) the value of all work done in accordance with the Contract, and
- (b) any further sums which the Contractor considers to be due to him under the Contract or otherwise.

- 14.11.2 If the Engineer disagrees with or cannot verify any part of the draft final statement, the Contractor shall submit such further information as the Engineer may reasonably require within 28 days from receipt of the said draft and shall make such changes in the draft as may be agreed between them. The Contractor shall then prepare and submit to the Engineer the final statement as agreed. This agreed statement is referred to in these Conditions as the "Final Statement".

- 14.11.3 However, if, following discussions between the Engineer and the Contractor and any changes to the draft final statement which are agreed, it becomes evident that a dispute exists, the Engineer shall deliver to the Employer (with a copy to the Contractor) an Interim Payment Certificate for the agreed parts of the draft final statement. Thereafter, if the dispute is finally resolved under **GC** Clause 20.4 [Obtaining Dispute Board's Decision] or **GC** Clause 20.5 [Amicable Settlement], the Contractor shall then prepare and submit to the Employer (with a copy to the Engineer) a Final Statement.

14.12 Discharge

- 14.12.1 When submitting the Final Statement, the Contractor shall submit a discharge which confirms that the total of the Final Statement represents full and final settlement of all moneys due to the Contractor under or in connection with the Contract. This discharge may state that it becomes effective when the Contractor has received the Performance Security and the outstanding balance of this total, in which event the discharge shall be effective on such date.

14.13 Issue of Final Payment Certificate

- 14.13.1 Within 28 days after receiving the Final Statement and discharge in accordance with **GC** Clause 14.11 [Application for Final Payment Certificate] and **GC** Clause 14.12 [Discharge], the Engineer shall deliver to the Employer and to the Contractor, the Final Payment Certificate which shall state:

- (a) the amount which he fairly determines is finally due, and
- (b) after giving credit to the Employer for all amounts previously paid by the Employer and for all sums to which the Employer is entitled, the balance (if any) due from the Employer to the Contractor or from the Contractor to the Employer, as the case may be.

- 14.13.2 If the Contractor has not applied for a Final Payment Certificate in accordance with **GC** Clause 14.11 [Application for Final Payment Certificate] and **GC** Clause 14.12 [Discharge], the Engineer shall request the Contractor to do so. If the Contractor fails to submit an application within a period of 28 days, the Engineer shall issue the Final Payment Certificate for such amount as he fairly determines to be due.

14.14 Cessation of Employer's Liability

- 14.14.1 The Employer shall not be liable to the Contractor for any matter or thing under or in connection with the Contract or execution of the Works, except to the extent that the Contractor shall have included an amount expressly for it:

- (a) in the Final Statement, and also
- (b) (except for matters or things arising after the issue of the Taking-Over Certificate for the Works) in the Statement at completion described in **GC** Clause 14.10 [Statement at Completion].

- 14.14.2 However, this **GC** Clause shall not limit the Employer's liability under his indemnification obligations, or the Employer's liability in any case of fraud, deliberate default or reckless misconduct by the Employer.

14.15 Currencies of Payment

- 14.15.1 The Contract Price shall be paid in the currency or currencies named in the Schedule of Payment Currencies. If more than one currency is so named, payments shall be made as follows:

- (a) if the Accepted Contract Amount was expressed in Local Currency only:
 - (i) the proportions or amounts of the Local and Foreign Currencies, and the fixed rates of exchange to be used for calculating the payments, shall be as stated in the Schedule of Payment Currencies, except as otherwise agreed by both Parties;

- (ii) payments and deductions under **GC** Clause 13.5 [Provisional Sums] and **GC** Clause 13.7 [Adjustments for Changes in Legislation] shall be made in the applicable currencies and proportions; and
- (iii) other payments and deductions under **GC** Clauses 14.3.2(a), 14.3.2(b), 14.3.2(c), and 14.3.2(d) [Application for Interim Payment Certificates] shall be made in the currencies and proportions specified in **GC** Clause 14.15.1(a)(i) above;
- (b) payment of the damages specified in the Particular Conditions shall be made in the currencies and proportions specified in the Schedule of Payment Currencies;
- (c) other payments to the Employer by the Contractor shall be made in the currency in which the sum was expended by the Employer, or in such currency as may be agreed by both Parties;
- (d) if any amount payable by the Contractor to the Employer in a particular currency exceeds the sum payable by the Employer to the Contractor in that currency, the Employer may recover the balance of this amount from the sums otherwise payable to the Contractor in other currencies; and
- (e) if no rates of exchange are stated in the Schedule of Payment Currencies; they shall be those prevailing on the Base Date and determined by the central bank of the Country.

15 Termination by Employer

15.1 Notice to Correct

- 15.1.1 If the Contractor fails to carry out any obligation under the Contract, the Engineer may by notice require the Contractor to make good the failure and to remedy it within a specified reasonable time.

15.2 Termination by Employer

- 15.2.1 The Employer shall be entitled to terminate the Contract if the Contractor:

- (a) fails to comply with **GC** Clause 4.2 [Performance Security] or with a notice under **GC** Clause 15.1 [Notice to Correct],
- (b) abandons the Works or otherwise plainly demonstrates the intention not to continue performance of his obligations under the Contract,
- (c) without reasonable excuse fails:
 - (i) to proceed with the Works in accordance with **GC** Clause 8 [Commencement, Delays and Suspension], or
 - (ii) to comply with a notice issued under **GC** Clause 7.5 [Rejection] or **GC** Clause 7.6 [Remedial Work], within 28 days after receiving it,
- (d) subcontracts the whole of the Works or assigns the Contract without the required agreement,

- (e) becomes bankrupt or insolvent, goes into liquidation, has a receiving or administration order made against him, compounds with his creditors, or carries on business under a receiver, trustee or manager for the benefit of his creditors, or if any act is done or event occurs which (under applicable Laws) has a similar effect to any of these acts or events, or
- (f) gives or offers to give (directly or indirectly) to any person any bribe, gift, gratuity, commission or other thing of value, as an inducement or reward:
 - (i) for doing or forbearing to do any action in relation to the Contract, or
 - (ii) for showing or forbearing to show favour or disfavour to any person in relation to the Contract,or if any of the Contractor's Personnel, agents or Subcontractors gives or offers to give (directly or indirectly) to any person any such inducement or reward as is described in this GC Clause 15.2.1(f). However, lawful inducements and rewards to Contractor's Personnel shall not entitle termination.

15.2.2 In any of these events or circumstances, the Employer may, upon giving 14 days' notice to the Contractor, terminate the Contract and expel the Contractor from the Site. However, in the case of GC Clause 15.2.1(e) or (f), the Employer may by notice terminate the Contract immediately.

15.2.3 The Employer's election to terminate the Contract shall not prejudice any other rights of the Employer, under the Contract or otherwise.

15.2.4 The Contractor shall then leave the Site and deliver any required Goods, all Contractor's Documents, and other design documents made by or for him, to the Engineer. However, the Contractor shall use his best efforts to comply immediately with any reasonable instructions included in the notice (i) for the assignment of any subcontract, and (ii) for the protection of life or property or for the safety of the Works.

15.2.5 After termination, the Employer may complete the Works and/or arrange for any other entities to do so. The Employer and these entities may then use any Goods, Contractor's Documents and other design documents made by or on behalf of the Contractor.

15.2.6 The Employer shall then give notice that the Contractor's Equipment and Temporary Works will be released to the Contractor at or near the Site. The Contractor shall promptly arrange their removal, at the risk and cost of the Contractor. However, if by this time the Contractor has failed to make a payment due to the Employer, these items may be sold by the Employer in order to recover this payment. Any balance of the proceeds shall then be paid to the Contractor.

15.3 Valuation at Date of Termination

15.3.1 As soon as practicable after a notice of termination under GC Clause 15.2 [Termination by Employer] has taken effect, the Engineer shall proceed in accordance with GC Clause 3.5 [Determinations] to agree or determine the value of the Works, Goods and Contractor's Documents, and any other sums due to the Contractor for work executed in accordance with the Contract.

15.4 Payment after Termination

15.4.1 After a notice of termination under **GC** Clause 15.2 [Termination by Employer] has taken effect, the Employer may:

- (a) proceed in accordance with **GC** Clause 2.5 [Employer's Claims],
- (b) withhold further payments to the Contractor until the costs of execution, completion and remedying of any defects, damages for delay in completion (if any), and all other costs incurred by the Employer, have been established, and/or
- (c) recover from the Contractor any losses and damages incurred by the Employer and any extra costs of completing the Works, after allowing for any sum due to the Contractor under **GC** Clause 15.3 [Valuation at Date of Termination]. After recovering any such losses, damages and extra costs, the Employer shall pay any balance to the Contractor.

15.5 Employer's Entitlement to Termination for Convenience

15.5.1 The Employer shall be entitled to terminate the Contract, at any time for the Employer's convenience, by giving notice of such termination to the Contractor. The termination shall take effect 28 days after the later of the dates on which the Contractor receives this notice or the Employer returns the Performance Security. The Employer shall not terminate the Contract under this **GC** Clause in order to execute the Works himself or to arrange for the Works to be executed by another contractor or to avoid a termination of the Contract by the Contractor under **GC** Clause 16.2 [Termination by Contractor].

15.5.2 After this termination, the Contractor shall proceed in accordance with **GC** Clause 16.3 [Cessation of Work and Removal of Contractor's Equipment] and shall be paid in accordance with **GC** Clause 16.4 [Payment on Termination].

15.6 Fraud and Corruption

15.6.1 If the Employer determines, based on reasonable evidence, that the Contractor has engaged in corrupt, fraudulent, collusive, coercive or obstructive practices, in competing for or in executing the Contract, then the Employer may, after giving 14 days' notice to the Contractor, terminate the Contractor's employment under the Contract and expel him from the Site, and the provisions of **GC** Clause 15 shall apply as if such expulsion had been made under **GC** Clause 15.2 [Termination by Employer].

15.6.2 Should any employee of the Contractor be determined, based on reasonable evidence, to have engaged in corrupt, fraudulent, coercive or obstructive practice during the execution of the work then that employee shall be removed in accordance with **GC** Clause 6.9 [Contractor's Personnel].

15.6.3 It is the Bank's policy to require that Borrowers (including beneficiaries of Bank Financing), as well as bidders, suppliers, and contractors, and their agents (whether declared or not), subcontractors, sub-consultants, service providers or suppliers, and any personnel thereof, observe the highest standard of ethics during the procurement and execution of Bank-financed contracts¹⁸. In pursuance of this policy, the Bank:

- (a) defines, for the purposes of this provision, the terms set forth below as follows:

¹⁸ In this context, any action to influence the procurement process or contract execution for undue advantage is improper.

- (i) “Corrupt Practice” is the offering, giving, receiving, or soliciting, directly or indirectly, of anything of value to influence improperly the actions of another party¹⁹;
- (ii) “Fraudulent Practice” is any act or omission, including a misrepresentation that knowingly or recklessly misleads, or attempts to mislead, a party²⁰ to obtain financial or other benefit or to avoid an obligation;
- (iii) “Collusive Practice” is an arrangement between two or more parties²¹, designed to achieve an improper purpose, including to influence improperly the actions of another party; and
- (iv) “Coercive Practice” is impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party²²;
- (v) “obstructive practice” is
 - (v.1) deliberately destroying, falsifying, altering, or concealing of evidence material to the investigation or making false statements to investigators in order to materially impede a Bank investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; and/or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation, or
 - (v.2) acts intended to materially impede the exercise of the Bank’s inspection and audit rights provided for under clause 1.15 [Inspections and Audits by the Bank]
- (b) will reject a proposal for award if it determines that the bidder recommended for award or any of its personnel, or its agents, or its sub-consultants, sub-contractors, service providers, suppliers and/or their employees, has, directly or

¹⁹ For the purpose of this sub-paragraph, “another party” refers to a public official acting in relation to the procurement process or contract execution. In this context, “public official” includes Bank staff and employees of other organizations taking or reviewing procurement decisions.

²⁰ For the purpose of this sub-paragraph, “party” refers to a public official; the terms “benefit” and “obligation” relate to the procurement process or contract execution; and the “act or omission” is intended to influence the procurement process or contract execution.

²¹ For the purpose of this sub-paragraph, “parties” refers to participants in the procurement process (including public officials) attempting either themselves, or through another person or entity not participating in the procurement or selection process, to simulate competition or to establish bid prices at artificial, non-competitive levels, or are privy to each other’s bid prices or other conditions.

²² For the purpose of this sub-paragraph, “party” refers to a participant in the procurement process or contract execution.

indirectly, engaged in Corrupt, Fraudulent, Collusive, Coercive or obstructive Practices in competing for the contract in question;

- (c) will declare misprocurement and cancel the portion of the Financing allocated to a contract if it determines at any time that representatives of the Borrower or of a recipient of any part of the proceeds of such Financing engaged in Corrupt, Fraudulent, Collusive, Coercive or Obstructive Practices during the procurement or the implementation of that contract, without the Borrower having taken timely and appropriate action satisfactory to the Bank to address such practices when they occur, including by failing to inform the Bank in a timely manner at the time they knew of the practices;
- (d) will sanction a firm or individual, at any time, in accordance with the prevailing Bank's sanctions procedures²³, including by publicly declaring such firm or individual ineligible either indefinitely or for a stated period of time, (i) to be awarded Bank-financed contracts and (ii) to be a nominated²⁴ sub-contractor, consultant, supplier, or service provider of an otherwise eligible firm being awarded a Bank-financed contract; and
- (e) will require that a clause be included in bidding documents and in contracts financed by the Bank, requiring bidders, suppliers and contractors and their sub-contractors, agents, personnel, consultants, service providers, or suppliers to permit the Bank to inspect all accounts and records and other documents relating to the submission of bids and contract performance and to have them audited by auditors appointed by the Bank.

16 Suspension and Termination by Contractor

16.1 Contractor's Entitlement to Suspend Work

- 16.1.1 If the Engineer fails to certify in accordance with **GC** Clause 14.6 [Issue of Interim Payment Certificates] or the Employer fails to comply with **GC** Clause 2.4 [Employer's Financial Arrangements] or **GC** Clause 14.7 [Payment], the Contractor may, after giving not less than 21 days' notice to the Employer, suspend work (or reduce the rate of work) unless and until the Contractor has received the Payment Certificate, reasonable evidence or payment, as the case may be and as described in the notice.
- 16.1.2 Notwithstanding the above, if the Bank has suspended disbursements under the loan or credit from which payments to the Contractor are being made, in whole or in part, for the execution of the Works, and no alternative funds are available as provided for in **GC** Clause 2.4 [Employer's Financial Arrangements], the Contractor may by notice suspend work or reduce the rate of work at any time, but not less than 7 days after the Borrower having received the suspension notification from the Bank.

²³ A firm or an individual may be declared ineligible to be awarded a Bank financed contract: (i) upon completion of the Bank's sanctions proceedings as per its sanctions procedures, including, inter alia, cross-debarment as agreed with other International Financial Institutions, including Multilateral Development Banks, or otherwise decided by the Bank; and through the application of the Proposal for the Implementation of a Sanctions Process within the African Development Bank Group; and (ii) as a result of temporary suspension or early temporary suspension in connection with an on-going sanction proceeding. See footnote 18 and paragraph 9 of Appendix 1 of the Rules and Procedures for Procurement of Goods and Works.

²⁴ A nominated sub-contractor, consultant, manufacturer or supplier, or service provider (different names are used depending on the particular bidding documents) is one which has either been: (i) included by the bidder in its pre-qualification application or bid because it brings specific and critical experience and know-how that allow the bidder to meet the qualification requirement for the particular bid; or (ii) appointed by the Borrower."

- 16.1.3 The Contractor's action shall not prejudice his entitlements to financing charges under **GC** Clause 14.8 [Delayed Payment] and to termination under **GC** Clause 16.2 [Termination by Contractor].
- 16.1.4 If the Contractor subsequently receives such Payment Certificate, evidence or payment (as described in the relevant **GC** Clause and in the above notice) before giving a notice of termination, the Contractor shall resume normal working as soon as is reasonably practicable.
- 16.1.5 If the Contractor suffers delay and/or incurs Cost as a result of suspending work (or reducing the rate of work) in accordance with this **GC** Clause, the Contractor shall give notice to the Engineer and shall be entitled subject to **GC** Clause 20.1 [Contractor's Claims] to:
- (a) an extension of time for any such delay, if completion is or will be delayed, under **GC** Clause 8.4 [Extension of Time for Completion], and
 - (b) payment of any such Cost plus profit, which shall be included in the Contract Price.
- 16.1.6 After receiving this notice, the Engineer shall proceed in accordance with **GC** Clause 3.5 [Determinations] to agree or determine these matters.

16.2 Termination by Contractor

- 16.2.1 The Contractor shall be entitled to terminate the Contract if:
- (a) the Contractor does not receive the reasonable evidence within 42 days after giving notice under **GC** Clause 16.1 [Contractor's Entitlement to Suspend Work] in respect of a failure to comply with **GC** Clause 2.4 [Employer's Financial Arrangements],
 - (b) the Engineer fails, within 56 days after receiving a Statement and supporting documents, to issue the relevant Payment Certificate,
 - (c) the Contractor does not receive the amount due under an Interim Payment Certificate within 42 days after the expiry of the time stated in **GC** Clause 14.7 [Payment] within which payment is to be made (except for deductions in accordance with **GC** Clause 2.5 [Employer's Claims]),
 - (d) the Employer substantially fails to perform his obligations under the Contract in such manner as to materially and adversely affect the economic balance of the Contract and/or the ability of the Contractor to perform the Contract,
 - (e) the Employer fails to comply with **GC** Clause 1.6 [Contract Agreement] or **GC** Clause 1.7 [Assignment],
 - (f) a prolonged suspension affects the whole of the Works as described in **GC** Clause 8.11 [Prolonged Suspension], or
 - (g) the Employer becomes bankrupt or insolvent, goes into liquidation, has a receiving or administration order made against him, compounds with his creditors, or carries on business under a receiver, trustee or manager for the benefit of his creditors, or if any act is done or event occurs which (under applicable Laws) has a similar effect to any of these acts or events.
 - (h) the Contractor does not receive the Engineer's instruction recording the agreement of both Parties on the fulfilment of the conditions for the Commencement of Works under **GC** Clause 8.1 [Commencement of

Works].

- 16.2.2 In any of these events or circumstances, the Contractor may, upon giving 14 days' notice to the Employer, terminate the Contract. However, in the case of **GC** Clause 16.2.1(f) or (g), the Contractor may by notice terminate the Contract immediately.
- 16.2.3 In the event the Bank suspends the loan or credit from which part or whole of the payments to the Contractor are being made, if the Contractor has not received the sums due to him upon expiration of the 14 days referred to in **GC** Clause 14.7 [Payment] for payments under Interim Payment certificates, the Contractor may, without prejudice to the Contractor's entitlement to financing charges under **GC** Clause 14.8 [Delayed Payment], take one of the following actions, namely (i) suspend work or reduce the rate of work under **GC** Clause 16.1.3 above, or (ii) terminate his employment under the Contract by giving notice to the Employer, with a copy to the Engineer, such termination to take effect 14 days after the giving of the notice.
- 16.2.4 The Contractor's election to terminate the Contract shall not prejudice any other rights of the Contractor, under the Contract or otherwise.

16.3 Cessation of Work and Removal of Contractor's Equipment

- 16.3.1 After a notice of termination under **GC** Clause 15.5 [Employer's Entitlement to Termination for Convenience], **GC** Clause 16.2 [Termination by Contractor] or **GC** Clause 19.6 [Optional Termination, Payment and Release] has taken effect, the Contractor shall promptly:
- (a) cease all further work, except for such work as may have been instructed by the Engineer for the protection of life or property or for the safety of the Works,
 - (b) hand over Contractor's Documents, Plant, Materials and other work, for which the Contractor has received payment, and
 - (c) remove all other Goods from the Site, except as necessary for safety, and leave the Site.

16.4 Payment on Termination

- 16.4.1 After a notice of termination under **GC** Clause 16.2 [Termination by Contractor] has taken effect, the Employer shall promptly:
- (a) return the Performance Security to the Contractor,
 - (b) pay the Contractor in accordance with **GC** Clause 19.6 [Optional Termination, Payment and Release], and
 - (c) pay to the Contractor the amount of any loss or damage sustained by the Contractor as a result of this termination.

17 Risk and Responsibility

17.1 Indemnities

- 17.1.1 The Contractor shall indemnify and hold harmless the Employer, the Employer's Personnel, and their respective agents, against and from all claims, damages, losses and expenses (including legal fees and expenses) in respect of:

- (a) bodily injury, sickness, disease or death, of any person whatsoever arising out of or in the course of or by reason of the Contractor's design (if any), the execution and completion of the Works and the remedying of any defects, unless attributable to any negligence, wilful act or breach of the Contract by the Employer, the Employer's Personnel, or any of their respective agents, and
- (b) damage to or loss of any property, real or personal (other than the Works), to the extent that such damage or loss arises out of or in the course of or by reason of the Contractor's design (if any), the execution and completion of the Works and the remedying of any defects, unless and to the extent that any such damage or loss is attributable to any negligence, wilful act or breach of the Contract by the Employer, the Employer's Personnel, their respective agents, or anyone directly or indirectly employed by any of them.

17.1.2 The Employer shall indemnify and hold harmless the Contractor, the Contractor's Personnel, and their respective agents, against and from all claims, damages, losses and expenses (including legal fees and expenses) in respect of (1) bodily injury, sickness, disease or death, which is attributable to any negligence, wilful act or breach of the Contract by the Employer, the Employer's Personnel, or any of their respective agents, and (2) the matters for which liability may be excluded from insurance cover, as described in **GC** Clause 18.3.3(d)(i), (ii) and (iii) [Insurance Against Injury to Persons and Damage to Property].

17.2 Contractor's Care of the Works

17.2.1 The Contractor shall take full responsibility for the care of the Works and Goods from the Commencement Date until the Taking-Over Certificate is issued (or is deemed to be issued under **GC** Clause 10.1 [Taking Over of the Works and Sections]) for the Works, when responsibility for the care of the Works shall pass to the Employer. If a Taking-Over Certificate is issued (or is so deemed to be issued) for any Section or part of the Works, responsibility for the care of the Section or part shall then pass to the Employer.

17.2.2 After responsibility has accordingly passed to the Employer, the Contractor shall take responsibility for the care of any work which is outstanding on the date stated in a Taking-Over Certificate, until this outstanding work has been completed.

17.2.3 If any loss or damage happens to the Works, Goods or Contractor's Documents during the period when the Contractor is responsible for their care, from any cause not listed in **GC** Clause 17.3 [Employer's Risks], the Contractor shall rectify the loss or damage at the Contractor's risk and cost, so that the Works, Goods and Contractor's Documents conform with the Contract.

17.2.4 The Contractor shall be liable for any loss or damage caused by any actions performed by the Contractor after a Taking-Over Certificate has been issued. The Contractor shall also be liable for any loss or damage which occurs after a Taking-Over Certificate has been issued and which arose from a previous event for which the Contractor was liable.

17.3 Employer's Risks

17.3.1 The risks referred to in **GC** Clause 17.4 [Consequences of Employer's Risks] below, insofar as they directly affect the execution of the Works in the Country, are:

- (a) war, hostilities (whether war be declared or not), invasion, act of foreign enemies,
- (b) rebellion, terrorism, sabotage by persons other than the Contractor's Personnel, revolution, insurrection, military or usurped power, or civil war, within the Country,
- (c) riot, commotion or disorder within the Country by persons other than the Contractor's Personnel,
- (d) munitions of war, explosive materials, ionising radiation or contamination by radio-activity, within the Country, except as may be attributable to the Contractor's use of such munitions, explosives, radiation or radio-activity,
- (e) pressure waves caused by aircraft or other aerial devices travelling at sonic or supersonic speeds,
- (f) use or occupation by the Employer of any part of the Permanent Works, except as may be specified in the Contract,
- (g) design of any part of the Works by the Employer's Personnel or by others for whom the Employer is responsible, and
- (h) any operation of the forces of nature which is Unforeseeable or against which an experienced contractor could not reasonably have been expected to have taken adequate preventative precautions.

17.4 Consequences of Employer's Risks

- 17.4.1 If and to the extent that any of the risks listed in **GC** Clause 17.3 above results in loss or damage to the Works, Goods or Contractor's Documents, the Contractor shall promptly give notice to the Engineer and shall rectify this loss or damage to the extent required by the Engineer.
- 17.4.2 If the Contractor suffers delay and/or incurs Cost from rectifying this loss or damage, the Contractor shall give a further notice to the Engineer and shall be entitled subject to **GC** Clause 20.1 [Contractor's Claims] to:
- (a) an extension of time for any such delay, if completion is or will be delayed, under **GC** Clause 8.4 [Extension of Time for Completion], and
 - (b) payment of any such Cost, which shall be included in the Contract Price. In the case of **GC** Clause 17.3.1(f) and (g) [Employer's Risks], Cost plus profit shall be payable.
- 17.4.3 After receiving this further notice, the Engineer shall proceed in accordance with **GC** Clause 3.5 [Determinations] to agree or determine these matters.

17.5 Intellectual and Industrial Property Rights

- 17.5.1 In this **GC** Clause, "infringement" means an infringement (or alleged infringement) of any patent, registered design, copyright, trade mark, trade name, trade secret or other intellectual or industrial property right relating to the Works; and "claim" means a claim (or proceedings pursuing a claim) alleging an infringement.
- 17.5.2 Whenever a Party does not give notice to the other Party of any claim within 28 days of receiving the claim, the first Party shall be deemed to have waived any right to indemnity under this **GC** Clause.

- 17.5.3 The Employer shall indemnify and hold the Contractor harmless against and from any claim alleging an infringement which is or was:
- (a) an unavoidable result of the Contractor's compliance with the Contract, or
 - (b) a result of any Works being used by the Employer:
 - (i) for a purpose other than that indicated by, or reasonably to be inferred from, the Contract, or
 - (ii) in conjunction with anything not supplied by the Contractor, unless such use was disclosed to the Contractor prior to the Base Date or is stated in the Contract.
- 17.5.4 The Contractor shall indemnify and hold the Employer harmless against and from any other claim which arises out of or in relation to (i) the manufacture, use, sale or import of any Goods, or (ii) any design for which the Contractor is responsible.
- 17.5.5 If a Party is entitled to be indemnified under this **GC** Clause, the indemnifying Party may (at its cost) conduct negotiations for the settlement of the claim, and any litigation or arbitration which may arise from it. The other Party shall, at the request and cost of the indemnifying Party, assist in contesting the claim. This other Party (and its Personnel) shall not make any admission which might be prejudicial to the indemnifying Party, unless the indemnifying Party failed to take over the conduct of any negotiations, litigation or arbitration upon being requested to do so by such other Party.

17.6 Limitation of Liability

- 17.6.1 Neither Party shall be liable to the other Party for loss of use of any Works, loss of profit, loss of any contract or for any indirect or consequential loss or damage which may be suffered by the other Party in connection with the Contract, other than as specifically provided in **GC** Clause 8.7 [Delay Damages]; **GC** Clause 11.2 [Cost of Remedying Defects]; **GC** Clause 15.4 [Payment after Termination]; **GC** Clause 16.4 [Payment on Termination]; **GC** Clause 17.1 [Indemnities]; **GC** Clause 17.4 (b) [Consequences of Employer's Risks] and **GC** Clause 17.5 [Intellectual and Industrial Property Rights].
- 17.6.2 The total liability of the Contractor to the Employer, under or in connection with the Contract other than under **GC** Clause 4.19 [Electricity, Water and Gas], **GC** Clause 4.20 [Employer's Equipment and Free-Issue Material], **GC** Clause 17.1 [Indemnities] and **GC** Clause 17.5 [Intellectual and Industrial Property Rights], shall not exceed the sum resulting from the application of a multiplier (less or greater than one) to the Accepted Contract Amount, as stated in the Particular Conditions, or (if such multiplier or other sum is not so stated) the Accepted Contract Amount.
- 17.6.3 This **GC** Clause shall not limit liability in any case of fraud, deliberate default or reckless misconduct by the defaulting Party.

17.7 Use of Employer's Accommodation/Facilities

- 17.7.1 The Contractor shall take full responsibility for the care of the Employer provided accommodation and facilities, if any, as detailed in the Specification, from the respective dates of hand-over to the Contractor until cessation of occupation (where hand-over or cessation of occupation may take place after the date stated in the Taking-Over Certificate for the Works).

- 17.7.2 If any loss or damage happens to any of the above items while the Contractor is responsible for their care arising from any cause whatsoever other than those for which the Employer is liable, the Contractor shall, at his own cost, rectify the loss or damage to the satisfaction of the Engineer.

18 Insurance

18.1 General Requirements for Insurances

- 18.1.1 In this **GC** Clause, “insuring Party” means, for each type of insurance, the Party responsible for effecting and maintaining the insurance specified in the relevant **GC** Clause.
- 18.1.2 Wherever the Contractor is the insuring Party, each insurance shall be effected with insurers and in terms approved by the Employer. These terms shall be consistent with any terms agreed by both Parties before the date of the Letter of Acceptance. This agreement of terms shall take precedence over the provisions of this **GC** Clause
- 18.1.3 Wherever the Employer is the insuring Party, each insurance shall be effected with insurers and in terms acceptable to the Contractor. These terms shall be consistent with any terms agreed by both Parties before the date of the Letter of Acceptance. This agreement of terms shall take precedence over the provisions of this **GC** Clause.
- 18.1.4 If a policy is required to indemnify joint insured, the cover shall apply separately to each insured as though a separate policy had been issued for each of the joint insured. If a policy indemnifies additional joint insured, namely in addition to the insured specified in this **GC** Clause, (i) the Contractor shall act under the policy on behalf of these additional joint insured except that the Employer shall act for Employer’s Personnel, (ii) additional joint insured shall not be entitled to receive payments directly from the insurer or to have any other direct dealings with the insurer, and (iii) the insuring Party shall require all additional joint insured to comply with the conditions stipulated in the policy.
- 18.1.5 Each policy insuring against loss or damage shall provide for payments to be made in the currencies required to rectify the loss or damage. Payments received from insurers shall be used for the rectification of the loss or damage.
- 18.1.6 The relevant insuring Party shall, within the respective periods stated in the Particular Conditions (calculated from the Commencement Date), submit to the other Party:
- (a) evidence that the insurances described in this **GC** Clause have been effected, and
 - (b) copies of the policies for the insurances described in **GC** Clause 18.2 [Insurance for Works and Contractor’s Equipment] and **GC** Clause 18.3 [Insurance against Injury to Persons and Damage to Property].
- 18.1.7 When each premium is paid, the insuring Party shall submit evidence of payment to the other Party. Whenever evidence or policies are submitted, the insuring Party shall also give notice to the Engineer.
- 18.1.8 Each Party shall comply with the conditions stipulated in each of the insurance policies. The insuring Party shall keep the insurers informed of any relevant changes to the execution of the Works and ensure that insurance is maintained in accordance with this **GC** Clause.

- 18.1.9 Neither Party shall make any material alteration to the terms of any insurance without the prior approval of the other Party. If an insurer makes (or attempts to make) any alteration, the Party first notified by the insurer shall promptly give notice to the other Party.
- 18.1.10 If the insuring Party fails to effect and keep in force any of the insurances it is required to effect and maintain under the Contract, or fails to provide satisfactory evidence and copies of policies in accordance with this **GC** Clause, the other Party may (at its option and without prejudice to any other right or remedy) effect insurance for the relevant coverage and pay the premiums due. The insuring Party shall pay the amount of these premiums to the other Party, and the Contract Price shall be adjusted accordingly.
- 18.1.11 Nothing in this **GC** Clause limits the obligations, liabilities or responsibilities of the Contractor or the Employer, under the other terms of the Contract or otherwise. Any amounts not insured or not recovered from the insurers shall be borne by the Contractor and/or the Employer in accordance with these obligations, liabilities or responsibilities. However, if the insuring Party fails to effect and keep in force an insurance which is available and which it is required to effect and maintain under the Contract, and the other Party neither approves the omission nor effects insurance for the coverage relevant to this default, any moneys which should have been recoverable under this insurance shall be paid by the insuring Party.
- 18.1.12 Payments by one Party to the other Party shall be subject to **GC** Clause 2.5 [Employer's Claims] or **GC** Clause 20.1 [Contractor's Claims], as applicable.
- 18.1.13 The Contractor shall be entitled to place all insurance relating to the Contract (including, but not limited to the insurance referred to **GC** Clause 18) with insurers from any eligible source country, in accordance with the Bank's Rules and Procedures for Procurement of Goods and Works.

18.2 Insurance for Works and Contractor's Equipment

- 18.2.1 The insuring Party shall insure the Works, Plant, Materials and Contractor's Documents for not less than the full reinstatement cost including the costs of demolition, removal of debris and professional fees and profit. This insurance shall be effective from the date by which the evidence is to be submitted under **GC** Clause 18.1.6(a) [General Requirements for Insurances], until the date of issue of the Taking-Over Certificate for the Works.
- 18.2.2 The insuring Party shall maintain this insurance to provide cover until the date of issue of the Performance Certificate, for loss or damage for which the Contractor is liable arising from a cause occurring prior to the issue of the Taking-Over Certificate, and for loss or damage caused by the Contractor in the course of any other operations (including those under **GC** Clause 11 [Defects Liability]).
- 18.2.3 The insuring Party shall insure the Contractor's Equipment for not less than the full replacement value, including delivery to Site. For each item of Contractor's Equipment, the insurance shall be effective while it is being transported to the Site and until it is no longer required as Contractor's Equipment.
- 18.2.4 Unless otherwise stated in the Particular Conditions, insurances under this **GC** Clause:
- (a) shall be effected and maintained by the Contractor as insuring Party,
 - (b) shall be in the joint names of the Parties, who shall be jointly entitled to receive payments from the insurers, payments being held or allocated to

the Party actually bearing the costs of rectifying the loss or damage,

- (c) shall cover all loss and damage from any cause not listed in **GC** Clause 17.3 [Employer's Risks],
- (d) shall also cover, to the extent specifically required in the bidding documents of the Contract, loss or damage to a part of the Works which is attributable to the use or occupation by the Employer of another part of the Works, and loss or damage from the risks listed in **GC** Clause 17.3.1(c), (g) and (h) [Employer's Risks], excluding (in each case) risks which are not insurable at commercially reasonable terms, with deductibles per occurrence of not more than the amount stated in the Particular Conditions (if an amount is not so stated, this **GC** Clause 18.2.4(d) shall not apply), and
- (e) may however exclude loss of, damage to, and reinstatement of:
 - (i) a part of the Works which is in a defective condition due to a defect in its design, materials or workmanship (but cover shall include any other parts which are lost or damaged as a direct result of this defective condition and not as described in **GC** Clause 18.2.4(e)(ii) below),
 - (ii) a part of the Works which is lost or damaged in order to reinstate any other part of the Works if this other part is in a defective condition due to a defect in its design, materials or workmanship,
 - (iii) a part of the Works which has been taken over by the Employer, except to the extent that the Contractor is liable for the loss or damage, and
 - (iv) Goods while they are not in the Country, subject to **GC** Clause 14.5 [Plant and Materials intended for the Works].

18.2.5 If, more than one year after the Base Date, the cover described in **GC** Clause 18.2.4(d) above ceases to be available at commercially reasonable terms, the Contractor shall (as insuring Party) give notice to the Employer, with supporting particulars. The Employer shall then (i) be entitled subject to **GC** Clause 2.5 [Employer's Claims] to payment of an amount equivalent to such commercially reasonable terms as the Contractor should have expected to have paid for such cover, and (ii) be deemed, unless he obtains the cover at commercially reasonable terms, to have approved the omission under **GC** Clause 18.1 [General Requirements for Insurances].

18.3 Insurance against Injury to Persons and Damage to Property

18.3.1 The insuring Party shall insure against each Party's liability for any loss, damage, death or bodily injury which may occur to any physical property (except things insured under **GC** Clause 18.2 [Insurance for Works and Contractor's Equipment]) or to any person (except persons insured under **GC** Clause 18.4 [Insurance for Contractor's Personnel]), which may arise out of the Contractor's performance of the Contract and occurring before the issue of the Performance Certificate.

18.3.2 This insurance shall be for a limit per occurrence of not less than the amount stated in the Particular Conditions, with no limit on the number of occurrences. If an amount is not stated in the Particular Conditions, this **GC** Clause shall not apply.

- 18.3.3 Unless otherwise stated in the Particular Conditions, the insurances specified in this **GC** Clause:
- (a) shall be effected and maintained by the Contractor as insuring Party,
 - (b) shall be in the joint names of the Parties,
 - (c) shall be extended to cover liability for all loss and damage to the Employer's property (except things insured under **GC** Clause 18.2) arising out of the Contractor's performance of the Contract, and
 - (d) may however exclude liability to the extent that it arises from:
 - (i) the Employer's right to have the Permanent Works executed on, over, under, in or through any land, and to occupy this land for the Permanent Works,
 - (ii) damage which is an unavoidable result of the Contractor's obligations to execute the Works and remedy any defects, and
 - (iii) a cause listed in **GC** Clause 17.3 [Employer's Risks], except to the extent that cover is available at commercially reasonable terms.

18.4 Insurance for Contractor's Personnel

- 18.4.1 The Contractor shall effect and maintain insurance against liability for claims, damages, losses and expenses (including legal fees and expenses) arising from injury, sickness, disease or death of any person employed by the Contractor or any other of the Contractor's Personnel.
- 18.4.2 The insurance shall cover the Employer and the Engineer against liability for claims, damages, losses and expenses (including legal fees and expenses) arising from injury, sickness, disease or death of any person employed by the Contractor or any other of the Contractor's Personnel, except that this insurance may exclude losses and claims to the extent that they arise from any act or neglect of the Employer or of the Employer's Personnel.
- 18.4.3 The insurance shall be maintained in full force and effect during the whole time that these personnel are assisting in the execution of the Works. For a Subcontractor's employees, the insurance may be effected by the Subcontractor, but the Contractor shall be responsible for compliance with this **GC** Clause.

19 Force Majeure

19.1 Definition of Force Majeure

- 19.1.1 In this **GC** Clause, "Force Majeure" means an exceptional event or circumstance:
- (a) which is beyond a Party's control,
 - (b) which such Party could not reasonably have provided against before entering into the Contract,
 - (c) which, having arisen, such Party could not reasonably have avoided or overcome, and

(d) which is not substantially attributable to the other Party.

19.1.2 Force Majeure may include, but is not limited to, exceptional events or circumstances of the kind listed below, so long as conditions (a) to (d) above are satisfied:

- (i) war, hostilities (whether war be declared or not), invasion, act of foreign enemies,
- (ii) rebellion, terrorism, sabotage by persons other than the Contractor's Personnel, revolution, insurrection, military or usurped power, or civil war,
- (iii) riot, commotion, disorder, strike or lockout by persons other than the Contractor's Personnel,
- (iv) munitions of war, explosive materials, ionising radiation or contamination by radio-activity, except as may be attributable to the Contractor's use of such munitions, explosives, radiation or radio-activity, and
- (v) natural catastrophes such as earthquake, hurricane, typhoon or volcanic activity.

19.2 Notice of Force Majeure

19.2.1 If a Party is or will be prevented from performing its substantial obligations under the Contract by Force Majeure, then it shall give notice to the other Party of the event or circumstances constituting the Force Majeure and shall specify the obligations, the performance of which is or will be prevented. The notice shall be given within 14 days after the Party became aware, or should have become aware, of the relevant event or circumstance constituting Force Majeure.

19.2.2 The Party shall, having given notice, be excused performance of its obligations for so long as such Force Majeure prevents it from performing them.

19.2.3 Notwithstanding any other provision of this GC Clause, Force Majeure shall not apply to obligations of either Party to make payments to the other Party under the Contract

19.3 Duty to Minimise Delay

19.3.1 Each Party shall at all times use all reasonable endeavours to minimise any delay in the performance of the Contract as a result of Force Majeure.

19.3.2 A Party shall give notice to the other Party when it ceases to be affected by the Force Majeure.

19.4 Consequences of Force Majeure

19.4.1 If the Contractor is prevented from performing its substantial obligations under the Contract by Force Majeure of which notice has been given under GC Clause 19.2 [Notice of Force Majeure], and suffers delay and/or incurs Cost by reason of such Force Majeure, the Contractor shall be entitled subject to GC Clause 20.1 [Contractor's Claims] to:

- (a) an extension of time for any such delay, if completion is or will be delayed, under **GC** Clause 8.4 [Extension of Time for Completion], and
- (b) if the event or circumstance is of the kind described in **GC** Clause 19.1.2(i) to (iv) [Definition of Force Majeure] and, in the case of **GC** Clause 19.1.2(ii) to (iv), occurs in the Country, payment of any such Cost, including the costs of rectifying or replacing the Works and/or Goods damaged or destroyed by Force Majeure, to the extent they are not indemnified through the insurance policy referred to in **GC** Clause 18.2 [Insurance for Works and Contractor's Equipment].

19.4.2 After receiving this notice, the Engineer shall proceed in accordance with **GC** Clause 3.5 [Determinations] to agree or determine these matters.

19.5 Force Majeure Affecting Subcontractor

19.5.1 If any Subcontractor is entitled under any contract or agreement relating to the Works to relief from force majeure on terms additional to or broader than those specified in this **GC** Clause, such additional or broader force majeure events or circumstances shall not excuse the Contractor's non-performance or entitle him to relief under this **GC** Clause.

19.6 Optional Termination, Payment and Release

19.6.1 If the execution of substantially all the Works in progress is prevented for a continuous period of 84 days by reason of Force Majeure of which notice has been given under **GC** Clause 19.2 [Notice of Force Majeure], or for multiple periods which total more than 140 days due to the same notified Force Majeure, then either Party may give to the other Party a notice of termination of the Contract. In this event, the termination shall take effect 7 days after the notice is given, and the Contractor shall proceed in accordance with **GC** Clause 16.3 [Cessation of Work and Removal of Contractor's Equipment].

19.6.2 Upon such termination, the Engineer shall determine the value of the work done and issue a Payment Certificate which shall include:

- (a) the amounts payable for any work carried out for which a price is stated in the Contract;
- (b) the Cost of Plant and Materials ordered for the Works which have been delivered to the Contractor, or of which the Contractor is liable to accept delivery: this Plant and Materials shall become the property of (and be at the risk of) the Employer when paid for by the Employer, and the Contractor shall place the same at the Employer's disposal;
- (c) other Costs or liabilities which in the circumstances were reasonably and necessarily incurred by the Contractor in the expectation of completing the Works;
- (d) the Cost of removal of Temporary Works and Contractor's Equipment from the Site and the return of these items to the Contractor's works in his country (or to any other destination at no greater cost); and
- (e) the Cost of repatriation of the Contractor's staff and labour employed wholly in connection with the Works at the date of termination.

19.7 Release from Performance

19.7.1 Notwithstanding any other provision of this **GC** Clause, if any event or circumstance outside the control of the Parties (including, but not limited to,

Force Majeure) arises which makes it impossible or unlawful for either or both Parties to fulfil its or their contractual obligations or which, under the law governing the Contract, entitles the Parties to be released from further performance of the Contract, then upon notice by either Party to the other Party of such event or circumstance:

- (a) the Parties shall be discharged from further performance, without prejudice to the rights of either Party in respect of any previous breach of the Contract, and
- (b) the sum payable by the Employer to the Contractor shall be the same as would have been payable under **GC** Clause 19.6 [Optional Termination, Payment and Release] if the Contract had been terminated under **GC** Clause 19.6.

20 Claims, Disputes and Arbitration

20.1 Contractor's Claims

20.1.1 If the Contractor considers himself to be entitled to any extension of the Time for Completion and/or any additional payment, under any Clause of these Conditions or otherwise in connection with the Contract, the Contractor shall give notice to the Engineer, describing the event or circumstance giving rise to the claim. The notice shall be given as soon as practicable, and not later than 28 days after the Contractor became aware, or should have become aware, of the event or circumstance.

20.1.2 If the Contractor fails to give notice of a claim within such period of 28 days, the Time for Completion shall not be extended, the Contractor shall not be entitled to additional payment, and the Employer shall be discharged from all liability in connection with the claim. Otherwise, the following provisions of this **GC** Clause shall apply.

20.1.3 The Contractor shall also submit any other notices which are required by the Contract, and supporting particulars for the claim, all as relevant to such event or circumstance.

20.1.4 The Contractor shall keep such contemporary records as may be necessary to substantiate any claim, either on the Site or at another location acceptable to the Engineer. Without admitting the Employer's liability, the Engineer may, after receiving any notice under this **GC** Clause, monitor the record-keeping and/or instruct the Contractor to keep further contemporary records. The Contractor shall permit the Engineer to inspect all these records, and shall (if instructed) submit copies to the Engineer.

20.1.5 Within 42 days after the Contractor became aware (or should have become aware) of the event or circumstance giving rise to the claim, or within such other period as may be proposed by the Contractor and approved by the Engineer, the Contractor shall send to the Engineer a fully detailed claim which includes full supporting particulars of the basis of the claim and of the extension of time and/or additional payment claimed. If the event or circumstance giving rise to the claim has a continuing effect:

- (a) this fully detailed claim shall be considered as interim;
- (b) the Contractor shall send further interim claims at monthly intervals, giving the accumulated delay and/or amount claimed, and such further particulars as the Engineer may reasonably require; and
- (c) the Contractor shall send a final claim within 28 days after the end of the effects resulting from the event or circumstance, or within such other

period as may be proposed by the Contractor and approved by the Engineer.

- 20.1.6 Within 42 days after receiving a claim or any further particulars supporting a previous claim, or within such other period as may be proposed by the Engineer and approved by the Contractor, the Engineer shall respond with approval, or with disapproval and detailed comments. He may also request any necessary further particulars, but shall nevertheless give his response on the principles of the claim within the above defined time period.
- 20.1.7 Within the above defined period of 42 days, the Engineer shall proceed in accordance with **GC** Clause 3.5 [Determinations] to agree or determine (i) the extension (if any) of the Time for Completion (before or after its expiry) in accordance with **GC** Clause 8.4 [Extension of Time for Completion], and/or (ii) the additional payment (if any) to which the Contractor is entitled under the Contract.
- 20.1.8 Each Payment Certificate shall include such additional payment for any claim as have been reasonably substantiated as due under the relevant provision of the Contract. Unless and until the particulars supplied are sufficient to substantiate the whole of the claim, the Contractor shall only be entitled to payment for such part of the claim as he has been able to substantiate.
- 20.1.9 If the Engineer does not respond within the timeframe defined in this **GC** Clause, either Party may consider that the claim is rejected by the Engineer and any of the Parties may refer it to the Dispute Board in accordance with **GC** Clause 20.4 [Obtaining Dispute Board's Decision].
- 20.1.10 The requirements of this **GC** Clause are in addition to those of any other **GC** Clause which may apply to a claim. If the Contractor fails to comply with this or another **GC** Clause in relation to any claim, any extension of time and/or additional payment shall take account of the extent (if any) to which the failure has prevented or prejudiced proper investigation of the claim, unless the claim is excluded under the second paragraph of this **GC** Clause.

20.2 Appointment of the Dispute Board

- 20.2.1 Disputes shall be referred to a DB for decision in accordance with **GC** Clause 20.4 [Obtaining Dispute Board's Decision]. The Parties shall appoint a DB by the date stated in the Particular Conditions.
- 20.2.2 The DB shall comprise, as stated in the Particular Conditions, either one or three suitably qualified persons ("the members"), each of whom shall be fluent in the language for communication defined in the Contract and shall be a professional experienced in the type of construction involved in the Works and with the interpretation of contractual documents. If the number is not so stated and the Parties do not agree otherwise, the DB shall comprise three persons.
- 20.2.3 If the Parties have not jointly appointed the DB 21 days before the date stated in the Particular Conditions and the DB is to comprise three persons, each Party shall nominate one member for the approval of the other Party. The first two members shall recommend and the Parties shall agree upon the third member, who shall act as chairman.
- 20.2.4 However, if a list of potential members has been agreed by the Parties and is included in the Contract, the members shall be selected from those on the list, other than anyone who is unable or unwilling to accept appointment to the DB.
- 20.2.5 The agreement between the Parties and either the sole member or each of the three members shall incorporate by reference the General Conditions of

Dispute Board Agreement contained in the Appendix to these General Conditions, with such amendments as are agreed between them.

- 20.2.6 The terms of the remuneration of either the sole member or each of the three members, including the remuneration of any expert whom the DB consults, shall be mutually agreed upon by the Parties when agreeing the terms of appointment. Each Party shall be responsible for paying one-half of this remuneration.
- 20.2.7 If at any time the Parties so agree, they may jointly refer a matter to the DB for it to give its opinion. Neither Party shall consult the DB on any matter without the agreement of the other Party.
- 20.2.8 If a member declines to act or is unable to act as a result of death, disability, resignation or termination of appointment, a replacement shall be appointed in the same manner as the replaced person was required to have been nominated or agreed upon, as described in this GC Clause.
- 20.2.9 The appointment of any member may be terminated by mutual agreement of both Parties, but not by the Employer or the Contractor acting alone. Unless otherwise agreed by both Parties, the appointment of the DB (including each member) shall expire when the discharge referred to in GC Clause 14.12 [Discharge] shall have become effective.

20.3 Failure to Agree on the Composition of the Dispute Board

- 20.3.1 If any of the following conditions apply, namely:
- (a) the Parties fail to agree upon the appointment of the sole member of the DB by the date stated in the first paragraph of GC Clause 20.2, [Appointment of the Dispute Board]
 - (b) either Party fails to nominate a member (for approval by the other Party) or fails to approve a member nominated by the other Party, of a DB of three persons by such date,
 - (c) the Parties fail to agree upon the appointment of the third member (to act as chairman) of the DB by such date, or
 - (d) the Parties fail to agree upon the appointment of a replacement person within 42 days after the date on which the sole member or one of the three members declines to act or is unable to act as a result of death, disability, resignation or termination of appointment,

then the appointing entity or official named in the Particular Conditions shall, upon the request of either or both of the Parties and after due consultation with both Parties, appoint this member of the DB. This appointment shall be final and conclusive. Each Party shall be responsible for paying one-half of the remuneration of the appointing entity or official.

20.4 Obtaining Dispute Board's Decision

- 20.4.1 If a dispute (of any kind whatsoever) arises between the Parties in connection with, or arising out of, the Contract or the execution of the Works, including any dispute as to any certificate, determination, instruction, opinion or valuation of the Engineer, either Party may refer the dispute in writing to the DB for its decision, with copies to the other Party and the Engineer. Such reference shall state that it is given under this GC Clause.
- 20.4.2 For a DB of three persons, the DB shall be deemed to have received such reference on the date when it is received by the chairman of the DB.

- 20.4.3 Both Parties shall promptly make available to the DB all such additional information, further access to the Site, and appropriate facilities, as the DB may require for the purposes of making a decision on such dispute. The DB shall be deemed to be not acting as arbitrator(s).
- 20.4.4 Within 84 days after receiving such reference, or within such other period as may be proposed by the DB and approved by both Parties, the DB shall give its decision, which shall be reasoned and shall state that it is given under this **GC Clause**. The decision shall be binding on both Parties, who shall promptly give effect to it unless and until it shall be revised in an amicable settlement or an arbitral award as described below. Unless the Contract has already been abandoned, repudiated or terminated, the Contractor shall continue to proceed with the Works in accordance with the Contract.
- 20.4.5 If either Party is dissatisfied with the DB's decision, then either Party may, within 28 days after receiving the decision, give a Notice of Dissatisfaction to the other Party indicating its dissatisfaction and intention to commence arbitration. If the DB fails to give its decision within the period of 84 days (or as otherwise approved) after receiving such reference, then either Party may, within 28 days after this period has expired, give a Notice of Dissatisfaction to the other Party.
- 20.4.6 In either event, this notice of dissatisfaction shall state that it is given under this **GC Clause**, and shall set out the matter in dispute and the reason(s) for dissatisfaction. Except as stated in **GC Clause 20.7** [Failure to Comply with Dispute Board's Decision] and **GC Clause 20.8** [Expiry of Dispute Board's Appointment], neither Party shall be entitled to commence arbitration of a dispute unless a notice of dissatisfaction has been given in accordance with this **GC Clause**.
- 20.4.7 If the DB has given its decision as to a matter in dispute to both Parties, and no notice of dissatisfaction has been given by either Party within 28 days after it received the DB's decision, then the decision shall become final and binding upon both Parties.

20.5 Amicable Settlement

- 20.5.1 Where a notice of dissatisfaction has been given under **GC Clause 20.4** above, both Parties shall attempt to settle the dispute amicably before the commencement of arbitration. However, unless both Parties agree otherwise, the Party giving a Notice of Dissatisfaction in accordance with **GC Clause 20.4** above, should move to commence arbitration after the fifty-sixth (56) day from the day on which a notice of dissatisfaction was given, even if no attempt at amicable settlement has been made.

20.6 Arbitration

- 20.6.1 Any dispute between the Parties arising out of or in connection with the Contract not settled amicably in accordance with **GC Clause 20.5** above, and in respect of which the DB's decision (if any) has not become final and binding, shall be finally settled by arbitration. Arbitration shall be conducted as follows:
- (a) for contracts with foreign contractors, international arbitration (i) with proceedings administered by the arbitration institution designated in the Particular Conditions, and conducted under the rules of arbitration of such institution; or, if so specified in the Particular Conditions, (ii) international arbitration in accordance with the arbitration rules of the United Nations Commission on International Trade Law (UNCITRAL); or (iii) if neither an arbitration institution or UNCITRAL arbitration

rules is specified in the Particular Conditions, with proceedings administered by the International Chamber of Commerce (ICC), and conducted under the ICC Rules of Arbitration; by one or more arbitrators appointed in accordance with the said arbitration rules.

The place of arbitration shall be the neutral location specified in the Particular Conditions, and the arbitration shall be conducted in the language for communications defined in **GC** Clause 1.4 [Law and Language].

- (b) for contracts with domestic contractors, arbitration with proceedings conducted in accordance with the laws of the Employer's country.

20.6.2 The arbitrators shall have full power to open up, review and revise any certificate, determination, instruction, opinion or valuation of the Engineer, and any decision of the DB, relevant to the dispute. Nothing shall disqualify representatives of the Parties and the Engineer from being called as a witness and giving evidence before the arbitrators on any matter whatsoever relevant to the dispute.

20.6.3 Neither Party shall be limited in the proceedings before the arbitrators to the evidence nor arguments previously put before the DB to obtain its decision, or to the reasons for dissatisfaction given in its notice of dissatisfaction. Any decision of the DB shall be admissible in evidence in the arbitration.

20.6.4 Arbitration may be commenced prior to or after completion of the Works. The obligations of the Parties, the Engineer and the DB shall not be altered by reason of any arbitration being conducted during the progress of the Works.

20.7 Failure to Comply with Dispute Board's Decision

20.7.1 In the event that a Party fails to comply with a final and binding DB decision, then the other Party may, without prejudice to any other rights it may have, refer the failure itself to arbitration under **GC** Clause 20.6 [Arbitration]. **GC** Clause 20.4 [Obtaining Dispute Board's Decision] and **GC** Clause 20.5 [Amicable Settlement] shall not apply to this reference.

2.8 Expiry of Dispute Board's Appointment

20.8.1 If a dispute arises between the Parties in connection with, or arising out of, the Contract or the execution of the Works and there is no DB in place, whether by reason of the expiry of the DB's appointment or otherwise:

- (a) **GC** Clause 20.4 [Obtaining Dispute Board's Decision] and **GC** Clause 20.5 [Amicable Settlement] shall not apply, and
- (b) the dispute may be referred directly to arbitration under **GC** Clause 20.6 [Arbitration].

APPENDIX

A General Conditions of Dispute Board Agreement

1 Definitions

Each “Dispute Board Agreement” is a tripartite agreement by and between:

- (a) the “Employer”;
- (b) the “Contractor”; and
- (c) the “Member” who is defined in the Dispute Board Agreement as being:
 - (i) the sole member of the "DB" and, where this is the case, all references to the “Other Members” do not apply, or
 - (ii) one of the three persons who are jointly called the “DB” (or “Dispute Board”) and, where this is the case, the other two persons are called the “Other Members”.

The Employer and the Contractor have entered (or intend to enter) into a contract, which is called the "Contract" and is defined in the Dispute Board Agreement, which incorporates this Appendix. In the Dispute Board Agreement, words and expressions which are not otherwise defined shall have the meanings assigned to them in the Contract.

2 General Provisions

Unless otherwise stated in the Dispute Board Agreement, it shall take effect on the latest of the following dates:

- (a) the Commencement Date defined in the Contract,
- (b) when the Employer, the Contractor and the Member have each signed the Dispute Board Agreement, or
- (c) when the Employer, the Contractor and each of the Other Members (if any) have respectively each signed a dispute board agreement.

This employment of the Member is a personal appointment. At any time, the Member may give not less than 70 days’ notice of resignation to the Employer and to the Contractor, and the Dispute Agreement shall terminate upon the expiry of this period.

3 Warranties

The Member warrants and agrees that he/she is and shall be impartial and independent of the Employer, the Contractor and the Engineer. The Member shall promptly disclose, to each of them and to the Other Members (if any), any fact or circumstance which might appear inconsistent with his/her warranty and agreement of impartiality and independence.

When appointing the Member, the Employer and the Contractor relied upon the Member’s representations that he/she is:

- (a) experienced in the work which the Contractor is to carry out under the Contract,
- (b) experienced in the interpretation of contract documentation, and

- (c) fluent in the language for communications defined in the Contract.

4 General Obligations of the Member

The Member shall:

- (a) have no interest financial or otherwise in the Employer, the Contractor or Engineer, nor any financial interest in the Contract except for payment under the Dispute Board Agreement;
- (b) not previously have been employed as a consultant or otherwise by the Employer, the Contractor or the Engineer, except in such circumstances as were disclosed in writing to the Employer and the Contractor before they signed the Dispute Board Agreement;
- (c) have disclosed in writing to the Employer, the Contractor and the Other Members (if any), before entering into the Dispute Board Agreement and to his/her best knowledge and recollection, any professional or personal relationships with any director, officer or employee of the Employer, the Contractor or the Engineer, and any previous involvement in the overall project of which the Contract forms part;
- (d) not, for the duration of the Dispute Board Agreement, be employed as a consultant or otherwise by the Employer, the Contractor or the Engineer, except as may be agreed in writing by the Employer, the Contractor and the Other Members (if any);
- (e) comply with the annexed procedural rules and with **GC** Clause 20.4 of the Conditions of Contract;
- (f) not give advice to the Employer, the Contractor, the Employer's Personnel or the Contractor's Personnel concerning the conduct of the Contract, other than in accordance with the annexed procedural rules;
- (g) not while a Member enter into discussions or make any agreement with the Employer, the Contractor or the Engineer regarding employment by any of them, whether as a consultant or otherwise, after ceasing to act under the Dispute Board Agreement;
- (h) ensure his/her availability for all site visits and hearings as are necessary;
- (i) become conversant with the Contract and with the progress of the Works (and of any other parts of the project of which the Contract forms part) by studying all documents received which shall be maintained in a current working file;
- (j) treat the details of the Contract and all the DB's activities and hearings as private and confidential, and not publish or disclose them without the prior written consent of the Employer, the Contractor and the Other Members (if any); and
- (k) be available to give advice and opinions, on any matter relevant to the Contract when requested by both the Employer and the Contractor, subject to the agreement of the Other Members (if any).

5 General Obligations of the Employer and the Contractor

The Employer, the Contractor, the Employer's Personnel and the Contractor's Personnel shall not request advice from or consultation with the Member regarding the Contract, otherwise than in the normal course of the DB's activities under the Contract and the Dispute Board Agreement. The Employer and the Contractor shall be responsible for compliance with this provision, by the Employer's Personnel and the Contractor's Personnel respectively.

The Employer and the Contractor undertake to each other and to the Member that the Member shall not, except as otherwise agreed in writing by the Employer, the Contractor, the Member and the Other Members (if any):

- (a) be appointed as an arbitrator in any arbitration under the Contract;

- (b) be called as a witness to give evidence concerning any dispute before arbitrator(s) appointed for any arbitration under the Contract; or
- (c) be liable for any claims for anything done or omitted in the discharge or purported discharge of the Member's functions, unless the act or omission is shown to have been in bad faith.

The Employer and the Contractor hereby jointly and severally indemnify and hold the Member harmless against and from claims from which he is relieved from liability under the preceding paragraph.

Whenever the Employer or the Contractor refers a dispute to the DB under GC Clause 20.4 of the Conditions of Contract, which will require the Member to make a site visit and attend a hearing, the Employer or the Contractor shall provide appropriate security for a sum equivalent to the reasonable expenses to be incurred by the Member. No account shall be taken of any other payments due or paid to the Member.

6 Payment

The Member shall be paid as follows, in the currency named in the Dispute Board Agreement:

- (a) a retainer fee per calendar month, which shall be considered as payment in full for:
 - (i) being available on 28 days' notice for all site visits and hearings;
 - (ii) becoming and remaining conversant with all project developments and maintaining relevant files;
 - (iii) all office and overhead expenses including secretarial services, photocopying and office supplies incurred in connection with his duties; and
 - (iv) all services performed hereunder except those referred to in sub-paragraphs (b) and (c) of this Clause.

The retainer fee shall be paid with effect from the last day of the calendar month in which the Dispute Board Agreement becomes effective; until the last day of the calendar month in which the Taking-Over Certificate is issued for the whole of the Works.

With effect from the first day of the calendar month following the month in which the Taking-Over Certificate is issued for the whole of the Works, the retainer fee shall be reduced by one third. This reduced fee shall be paid until the first day of the calendar month in which the Member resigns or the Dispute Board Agreement is otherwise terminated.

- (b) a daily fee which shall be considered as payment in full for:
 - (i) each day or part of a day up to a maximum of two days' travel time in each direction for the journey between the Member's home and the site, or another location of a meeting with the Other Members (if any);
 - (ii) each working day on Site visits, hearings or preparing decisions; and
 - (iii) each day spent reading submissions in preparation for a hearing.
- (c) all reasonable expenses including necessary travel expenses (air fare in less than first class, hotel and subsistence and other direct travel expenses) incurred in connection with the Member's duties, as well as the cost of telephone calls, courier charges, faxes and telexes: a receipt shall be required for each item in excess of five percent of the daily fee referred to in sub-paragraph (b) of this Clause;
- (d) any taxes properly levied in the Country on payments made to the Member (unless a national or permanent resident of the Country) under this Clause 6.

The retainer and daily fees shall be as specified in the Dispute Board Agreement. Unless it specifies otherwise, these fees shall remain fixed for the first 24 calendar months, and shall thereafter be adjusted by agreement between the Employer, the Contractor and the Member, at each anniversary of the date on which the Dispute Board Agreement became effective.

If the parties fail to agree on the retainer fee or the daily fee, the appointing entity or official named in the Particular Conditions shall determine the amount of the fees to be used.

The Member shall submit invoices for payment of the monthly retainer and air fares quarterly in advance. Invoices for other expenses and for daily fees shall be submitted following the conclusion of a site visit or hearing. All invoices shall be accompanied by a brief description of activities performed during the relevant period and shall be addressed to the Contractor.

The Contractor shall pay each of the Member's invoices in full within 56 calendar days after receiving each invoice and shall apply to the Employer (in the Statements under the Contract) for reimbursement of one-half of the amounts of these invoices. The Employer shall then pay the Contractor in accordance with the Contract.

If the Contractor fails to pay to the Member the amount to which he/she is entitled under the Dispute Board Agreement, the Employer shall pay the amount due to the Member and any other amount which may be required to maintain the operation of the DB; and without prejudice to the Employer's rights or remedies. In addition to all other rights arising from this default, the Employer shall be entitled to reimbursement of all sums paid in excess of one-half of these payments, plus all costs of recovering these sums and financing charges calculated at the rate specified in Clause 14.8 of the Conditions of Contract.

If the Member does not receive payment of the amount due within 70 days after submitting a valid invoice, the Member may (i) suspend his/her services (without notice) until the payment is received, and/or (ii) resign his/her appointment by giving notice under Clause 7.

7 Termination

At any time: (i) the Employer and the Contractor may jointly terminate the Dispute Board Agreement by giving 42 days' notice to the Member; or (ii) the Member may resign as provided for in Clause 2.

If the Member fails to comply with the Dispute Board Agreement, the Employer and the Contractor may, without prejudice to their other rights, terminate it by notice to the Member. The notice shall take effect when received by the Member.

If the Employer or the Contractor fails to comply with the Dispute Board Agreement, the Member may, without prejudice to his other rights, terminate it by notice to the Employer and the Contractor. The notice shall take effect when received by them both.

Any such notice, resignation and termination shall be final and binding on the Employer, the Contractor and the Member. However, a notice by the Employer or the Contractor, but not by both, shall be of no effect.

8 Default of the Member

If the Member fails to comply with any of his obligations under Clause 4 (a) - (d) above, he shall not be entitled to any fees or expenses hereunder and shall, without prejudice to their other rights, reimburse each of the Employer and the Contractor for any fees and expenses received by the Member and the Other Members (if any), for proceedings or decisions (if any) of the DB which are rendered void or ineffective by the said failure to comply.

If the Member fails to comply with any of his obligations under Clause 4 (e) - (k) above, he shall not be entitled to any fees or expenses hereunder from the date and to the extent of the non-compliance and shall, without prejudice to their other rights, reimburse each of the Employer and the Contractor for any fees and expenses already received by the Member, for proceedings or decisions (if any) of the DB which are rendered void or ineffective by the said failure to comply.

9 Disputes

Any dispute or claim arising out of or in connection with this Dispute Board Agreement, or the breach, termination or invalidity thereof, shall be finally settled by institutional arbitration. If no other arbitration institute is agreed, the arbitration shall be conducted under the Rules of Arbitration of the International Chamber of Commerce by one arbitrator appointed in accordance with these Rules of Arbitration.

PROCEDURAL RULES

Unless otherwise agreed by the Employer and the Contractor, the DB shall visit the site at intervals of not more than 140 days, including times of critical construction events, at the request of either the Employer or the Contractor. Unless otherwise agreed by the Employer, the Contractor and the DB, the period between consecutive visits shall not be less than 70 days, except as required to convene a hearing as described below.

The timing of and agenda for each site visit shall be as agreed jointly by the DB, the Employer and the Contractor, or in the absence of agreement, shall be decided by the DB. The purpose of site visits is to enable the DB to become and remain acquainted with the progress of the Works and of any actual or potential problems or claims, and, as far as reasonable, to endeavour to prevent potential problems or claims from becoming disputes.

Site visits shall be attended by the Employer, the Contractor and the Engineer and shall be co-ordinated by the Employer in co-operation with the Contractor. The Employer shall ensure the provision of appropriate conference facilities and secretarial and copying services. At the conclusion of each site visit and before leaving the site, the DB shall prepare a report on its activities during the visit and shall send copies to the Employer and the Contractor.

The Employer and the Contractor shall furnish to the DB one copy of all documents which the DB may request, including Contract documents, progress reports, variation instructions, certificates and other documents pertinent to the performance of the Contract. All communications between the DB and the Employer or the Contractor shall be copied to the other Party. If the DB comprises three persons, the Employer and the Contractor shall send copies of these requested documents and these communications to each of these persons.

If any dispute is referred to the DB in accordance with **GC** Clause 20.4 of the Conditions of Contract, the DB shall proceed in accordance with **GC** Clause 20.4 and these Rules. Subject to the time allowed to give notice of a decision and other relevant factors, the DB shall:

- (a) act fairly and impartially as between the Employer and the Contractor, giving each of them a reasonable opportunity of putting his case and responding to the other's case, and
- (b) adopt procedures suitable to the dispute, avoiding unnecessary delay or expense.

The DB may conduct a hearing on the dispute, in which event it will decide on the date and place for the hearing and may request that written documentation and arguments from the Employer and the Contractor be presented to it prior to or at the hearing.

Except as otherwise agreed in writing by the Employer and the Contractor, the DB shall have power to adopt an inquisitorial procedure, to refuse admission to hearings or audience at hearings to any persons other than representatives of the Employer, the Contractor and the Engineer, and to proceed in the absence of any party who the DB is satisfied received notice of the hearing; but shall have discretion to decide whether and to what extent this power may be exercised.

The Employer and the Contractor empower the DB, among other things, to:

- (a) establish the procedure to be applied in deciding a dispute,
- (b) decide upon the DB's own jurisdiction, and as to the scope of any dispute referred to it,
- (c) conduct any hearing as it thinks fit, not being bound by any rules or procedures other than those contained in the Contract and these Rules,
- (d) take the initiative in ascertaining the facts and matters required for a decision,
- (e) make use of its own specialist knowledge, if any,
- (f) decide upon the payment of financing charges in accordance with the Contract,
- (g) decide upon any provisional relief such as interim or conservatory measures, and
- (h) open up, review and revise any certificate, decision, determination, instruction, opinion or valuation of the Engineer, relevant to the dispute.

The DB shall not express any opinions during any hearing concerning the merits of any arguments advanced by the Parties. Thereafter, the DB shall make and give its decision in accordance with GC Clause 20.4, or as otherwise agreed by the Employer and the Contractor in writing. If the DB comprises three persons:

- (a) it shall convene in private after a hearing, in order to have discussions and prepare its decision;
- (b) it shall endeavour to reach a unanimous decision: if this proves impossible the applicable decision shall be made by a majority of the Members, who may require the minority Member to prepare a written report for submission to the Employer and the Contractor; and
- (c) if a Member fails to attend a meeting or hearing, or to fulfil any required function, the other two Members may nevertheless proceed to make a decision, unless:
 - (i) either the Employer or the Contractor does not agree that they do so, or
 - (ii) the absent Member is the chairman and he/she instructs the other Members to not make a decision.

Section VIII. Particular Conditions (PC)

The following Particular Conditions shall supplement the GC. Whenever there is a conflict, the provisions herein shall prevail over those in the GC.

Particular Conditions

Part A - Contract Data

Employer's name and address	1.1.2.2 & 1.3	Chief Executive Officer Athi Water Works Development Agency Africa-Re Centre, Hospital Road, Upper Hill, P.O Box 45283 - 00100 Nairobi, Kenya Tel: +254-20-2724292/3, 2711342 Fax: +254-20-2724295 Email: info@awwda.go.ke Website: www.awwda.go.ke
Engineer's name and address	1.1.2.4 & 1.3	The Project Manager is : Chief Manager Water and Sanitation Services Athi Water Works Development Agency Africa-Re Centre, Hospital Road, Upper Hill, P.O Box 45283 - 00100 Nairobi, Kenya Tel: +254-20-2724292/3, 2711342 Fax: +254-20-2724295 Email: info@awwda.go.ke Website: www.awwda.go.ke
Bank's name	1.1.2.11	The Bank is : African Development Fund
Borrower's name	1.1.2.12	The Government of Kenya
Time for Completion	1.1.3.3	18 Months
Defects Notification Period	1.1.3.7	12 Months
Sections	1.1.5.6	If Sections are to be used, refer to Table: Summary of Sections below
Addresses for Communication	1.3.1(b)	The Employer's address for the purpose of communications is: Chief Executive Officer Athi Water Works Development Agency Africa-Re Centre, Hospital Road, Upper Hill, P.O Box 45283 - 00100 Nairobi, Kenya Tel: +254-20-2724292/3, 2711342 Fax: +254-20-2724295 Email: info@awwda.go.ke Website: www.awwda.go.ke

		The Contractor's address for the purpose of communications is: [State full address, telephone, fax and e-mail]
Governing Law	1.4	The governing Law is that of Kenya
Ruling language	1.4	English
Language for communications	1.4	English
Deadline for entering into a Contract, after Contractor receives Letter of Acceptance	1.6.1	28 Days
Permits and Permissions to be obtained by the Employer	1.13.2(a)	National Environment Management Authority (NEMA) License, NCA Permit
Notices, Taxes, Duties, Permits, Licences, Approvals to be given and/or obtained by Contractor	1.13.2(b)	Blasting permit from Mines and Geology, Contractors NCA construction Permit
Time for access to the Site	2.1.1	28 days after Commencement Date
Situations in which the Engineer shall obtain approval from the Employer before exercising a specific authority	3.1.3	Not Applicable
Engineer's Duties and Authority	3.1.6(b)(ii)	Variations resulting in an increase of the Accepted Contract Amount shall require approval of the Employer.
Parts of the Permanent Works to be designed by the Contractor	4.1.6	Not Applicable
Performance Security	4.2.1	The performance security will be in the form of unconditional bank guarantee acceptable to the employer in the amount(s) of 10% of the Accepted Contract Amount and in the same currency(ies) of the Accepted Contract Amount.
Monthly Progress Reports	4.21.1	Once a Month
Normal working hours	6.5.1	Normal working hours are: 8:00 am to 1:00

		pm and 2:00 pm to 5:00 pm Monday to Friday (Except Public Holidays)
Delay damages for the Works	8.7.1 & 14.15.1(b)	<u>0.1</u> % of the Contract Price per day. If Sections are to be used, refer to Table: Summary of Sections below
Maximum amount of delay damages	8.7.1	10% of the final Contract Price.
Adjustments for Changes in Cost	13.8.3	<u>Not Applicable</u>
Contract Price Specificities	14.1.1	Not Applicable
Total advance payment	14.2.1	15 % Percentage of the Accepted Contract Amount payable in the currencies and proportions in which the Accepted Contract Amount is payable and shall be paid to the Contractor no later than: [45 days after commencement date]
Repayment amortisation rate of advance payment	14.2.5(b)	Repayment will begin when amount of work certified by the Engineer attains 20% of the Contract Price and be completed by the time work certified by the Engineer attains 80% of the Contract Price
Percentage of Retention	14.3.2	10% of interim payment certificates
Limit of Retention Money	14.3.2	10% of the Accepted Contract Amount
Minimum Amount of Interim Payment Certificates	14.6.2	2% of the Accepted Contract Amount
Calculation of Financing Charges	14.8.1	Local Currency: 90 day CBK Treasury Bill rate Foreign Currency: LIBOR+1%
Substitution Guarantee for Second Half of Retention Money	14.9.5	An Unconditional Bank Guarantee or equivalent in Freely Convertible Currency of equal amount in the same currency(ies) as the Accepted Contract Amount.
Maximum total liability of the Contractor to the Employer	17.6.2	Accepted Contract Amount

Periods for submission of insurance: a. evidence of insurance. b. relevant policies	18.1.6	14 days 28 days
Maximum amount of deductibles for insurance of the Employer's risks	18.2.4(d)	The minimum insurance amounts and deductibles shall be: (a) for loss or damage to the Works, Plant and Materials: [Kshs 3,000,000] (b) for loss or damage to Equipment: [Kshs 5,000,000] (c) for loss or damage to property (except the Works, Plant, Materials, and Equipment) in connection with Contract: [Kshs 3,000,000] (d) for personal injury or death: (i) of the Contractor's employees: [Kshs 3,000,000] (ii) of other people: [Kshs 2,000,000]
Minimum amount of third party insurance	18.3.2	As per applicable laws of Kenya
Date by which the DB shall be appointed	20.2.1	28 days after the Commencement
The DB shall be comprised of	20.2.2	Three Members
Appointment (if not agreed) to be made by	20.3.1	Chartered Institute of Arbitrators Kenya Chapter
International Arbitration Institution	20.6.1(a)	"Rules of Conciliation and Arbitration of the International Chamber of Commerce (ICC):
Place of International Arbitration	20.6.1(a)	Kigali, Rwanda

Particular Conditions

Part B – Specific Provisions

GC Clause 14.1 The Contract Price

(Alternative text for **GC Clause 14.1.1(e)**)

(e): Notwithstanding the provisions of **GC Clause 14.1.1(b)**, Contractor's Equipment, including essential spare parts therefore, imported by the Contractor for the sole purpose of executing the Contract shall be temporarily exempt from the payment of import duties and taxes upon initial importation, provided the Contractor shall post with the customs authorities at the port of entry an approved export bond or bank guarantee, valid until the Time for Completion plus six months, in an amount equal to the full import duties and taxes which would be payable on the assessed imported value of such Contractor's Equipment and spare parts, and callable in the event the Contractor's Equipment is not exported from the Country on completion of the Contract. A copy of the bond or bank guarantee endorsed by the customs authorities shall be provided by the Contractor to the Employer upon the importation of individual items of Contractor's Equipment and spare parts. Upon export of individual items of Contractor's Equipment or spare parts, or upon the completion of the Contract, the Contractor shall prepare, for approval by the customs authorities, an assessment of the residual value of the Contractor's Equipment and spare part to be exported, based on the depreciation scale(s) and other criteria used by the customs authorities for such purposes under the provisions of the applicable Laws. Import duties and taxes shall be due and payable to the customs authorities by the Contractor on (a) the difference between the initial imported value and the residual value of the Contractor's Equipment and spare parts to be exported; and (b) on the initial imported value that Contractor's Equipment and spare parts remaining in the Country after completion of the Contract. Upon payment of such dues within 28 days of being invoiced, the bond or bank guarantee shall be reduced or released accordingly; otherwise the security shall be called in the full amount remaining.

Section IX. Contract Forms

This Section contains Contract Forms which, once completed, will constitute part of the Contract. The forms for Contract Agreement, Performance Security and Advance Payment Security, when required, shall only be completed by the successful Bidder, after contract award

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Letter of Acceptance

[on letterhead paper of the Employer]

..... **[date]**

To: [name and address of the Contractor]

Subject: [Notification of Award Contract No].

This is to notify you that your Bid dated **[Insert date]** for execution of the
 **[insert name of the contract and identification number]** for the
 amount of **[insert amount (s) in figures and words and name(s) of
 currency(ies)]**, as corrected and modified in accordance with the Instructions to Bidders
 is hereby accepted by us.

**You are requested to furnish the Performance Security in the amount of [insert
 amount (s) in figures and words and name(s) of currency(ies)] within 28 days²⁵ in
 accordance with the Conditions of Contract, using for that purpose the Performance
 Security Form included in Section IX (Contract Forms) of the Bidding Document.**

Authorised Signature:

Name and Title of Signatory:

Name of Agency:

Attachment: Contract Agreement

²⁵ Or, the alternative deadline stipulated in the Particular Conditions.

Contract Agreement

THIS CONTRACT AGREEMENT is made on the [**insert number**] day of [**insert month**], [**insert year**].

BETWEEN

(1) [**insert complete name of the Employer**], a [**insert description of type of legal entity, for example, an agency of the Ministry of**] of the Government of { **insert name of Country of the Employer** }, or corporation incorporated under the laws of { **insert name of Country of the Employer** } and having its principal place of business at [**insert address of the Employer**] (hereinafter called “the Employer”),
and

(2) [**insert name of the Contractor**], a corporation incorporated under the laws of [**insert country of Contractor**] and having its principal place of business at [**insert address of Contractor**] (hereinafter called “the Contractor”).

WHEREAS the Employer invited bids for the Works, described as [**insert brief description of the Works**] and has accepted a Bid by the Contractor for the execution and completion of these Works and the remedying of any defects therein, and the Employer agrees to pay the Contractor the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

The Employer and the Contractor agree as follows:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Contract documents referred to.

2. The following documents shall be deemed to form and be read and construed as part of this Agreement. This Agreement shall prevail over all other Contract documents.

- (a) **the Letter of Acceptance**
- (b) **the Bid**
- (c) **the Particular Conditions**
- (d) **the General Conditions**
- (e) **the Specification**
- (f) **the Drawings; and**
- (g) **the completed Schedules,**

3. In consideration of the payments to be made by the Employer to the Contractor as indicated in this Agreement, the Contractor hereby covenants with the Employer to execute the Works and to remedy defects therein in conformity in all respects with the provisions of the Contract.

4. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects therein, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

Agreement to be executed in accordance with the laws of [insert name of the borrowing country] on the day, month and year indicated above.

Signed by: Signed by:

For and on behalf of the Employer for and on behalf the Contractor

In the presence of: in the presence of:

Witness, Name, Signature, Address, Date

Witness, Name, Signature, Address, Date

Option I: Performance Security (Unconditional Bank Guarantee)

[The bank, as requested by the successful Bidder, shall fill in this form in accordance with the instructions indicated]

Date: **[insert date (e.g., day, month, and year)]**

Bidding Process Reference: **[insert no. and title of bidding process]**

Bank's Branch or Office: **[insert complete name of Guarantor]**

Beneficiary: **[insert complete name of Employer]**

PERFORMANCE GUARANTEE No.: **[insert Performance Guarantee number]**

We have been informed that **[insert complete name of the Contractor]** (hereinafter called "the Contractor") has entered into Contract No. **[insert number]** dated **[insert day and month]**, **[insert year]** with you, for the execution and completion of **[insert description of the Works]** and the remedying of any defects therein (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, a Performance Guarantee is required.

At the request of the Employer, we hereby irrevocably undertake to pay you any sum(s) not exceeding **[insert amount(s)²⁶ in figures and words]** such sum being payable in the types and proportions of currencies in which the Contract Price is payable, upon receipt by us of your first demand in writing declaring the Contractor to be in default under the Contract, without cavil or argument, or your needing to prove or to show grounds or reasons for your demand or the sum specified therein.

This Guarantee shall expire no later than the **[insert number]** day of **[insert month]**, **[insert year]**,²⁷ and any demand for payment under it must be received by us at this office on or before that date. This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 458, except that subparagraph (ii) of Sub-article 20(a) is hereby excluded.

²⁶ The bank shall insert the amount(s) specified in the **PC** and denominated, as specified in the **PC**, either in the currency(ies) of the Contract or a freely convertible currency acceptable to the Employer.

²⁷ Insert the date twenty-eight days after the expected completion date. The Employer should note that in the event of an extension of the time for completion of the Contract, the Employer would need to request an extension of this guarantee from the Guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee. In preparing this guarantee, the Employer might consider adding the following text to the form, at the end of the penultimate paragraph: "The Guarantor agrees to a one-time extension of this guarantee for a period not to exceed **[six months]****[one year]**, in response to the Employer's written request for such extension, such request to be presented to the Guarantor before the expiry of the guarantee."

[signatures of authorised representatives of the bank]

Option II: Performance Bond-N/A

By this Bond _____ as Principal (hereinafter called “the Contractor”) and _____ as Surety (hereinafter called “the Surety”), are held and firmly bound unto _____ as Oblige (hereinafter called “the Employer”) in the amount of _____, for the payment of which sum well and truly to be made in the types and proportions of currencies in which the Contract Price is payable, the Contractor and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS the Contractor has entered into a written Agreement with the Employer dated the _____ day of _____, 20____, for _____ in accordance with the documents, plans, specifications, and amendments thereto, which to the extent herein provided for, are by reference made part hereof and are hereinafter referred to as the Contract.

NOW, THEREFORE, the Condition of this Obligation is such that, if the Contractor shall promptly and faithfully perform the said Contract (including any amendments thereto), then this obligation shall be null and void; otherwise, it shall remain in full force and effect. Whenever the Contractor shall be, and declared by the Employer to be, in default under the Contract, the Employer having performed the Employer’s obligations thereunder, the Surety may promptly remedy the default, or shall promptly:

- (1) complete the Contract in accordance with its terms and conditions; or
- (2) obtain a Bid or bids from qualified Bidders for submission to the Employer for completing the Contract in accordance with its terms and conditions, and upon determination by the Employer and the Surety of the lowest responsive Bidder, arrange for a Contract between such Bidder and Employer and make available as work progresses (even though there should be a default or a succession of defaults under the Contract or Contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less the Balance of the Contract Price; but not exceeding, including other costs and damages for which the Surety may be liable hereunder, the amount set forth in the first paragraph hereof. The term “Balance of the Contract Price,” as used in this paragraph, shall mean the total amount payable by Employer to Contractor under the Contract, less the amount properly paid by Employer to Contractor; or
- (3) pay the Employer the amount required by Employer to complete the Contract in accordance with its terms and conditions up to a total not exceeding the amount of this Bond.

The Surety shall not be liable for a greater sum than the specified penalty of this Bond.

Any suit under this Bond must be instituted before the expiration of one year from the date of the issuing of the Taking-Over Certificate.

No right of action shall accrue on this Bond to or for the use of any person or corporation other than the Employer named herein or the heirs, executors, administrators, successors, and assigns of the Employer.

In testimony whereof, the Contractor has hereunto set his hand and affixed his seal, and the Surety has caused these presents to be sealed with his corporate seal duly attested by the signature of his legal representative, this _____ day of _____ 20 ____.

Advance Payment Security (Unconditional bank Guarantee)

[The bank, as requested by the successful Bidder, shall fill in this form in accordance with the instructions indicated.]

Date: [insert date (e.g., day, month, and year) of Bid Submission]

Bidding Process Reference: [insert number and title of bidding process]

[bank's letterhead]

Beneficiary: [insert legal name and address of Employer]

ADVANCE PAYMENT GUARANTEE No.: [insert Advance Payment Guarantee no.]

We have been informed that [insert name of the Contractor]. (hereinafter called "the Contractor") has entered into Contract No. [insert reference number of the Contract]. dated [insert day and month], [insert year]. with you, for the execution of [insert name of contract and brief description of Works] (hereinafter called "the Contract").

Furthermore, we understand that, according to the Conditions of the Contract, an advance payment in the sum .. . [insert currency and amount in figures]²⁸. (. [insert currency and amount in words].) is to be made against an advance payment guarantee.

At the request of the Employer, we [insert name of the bank]. hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of [insert currency and amount in figures]*. (. [insert currency and amount in words].) upon receipt by us of your first demand in writing accompanied by a written statement stating that the Contractor is in breach of its obligation under the Contract because the Contractor used the advance payment for purposes other than performing his obligations under the Contract or the costs of mobilisation in respect of the Works.

It is a condition for any claim and payment under this guarantee to be made that the advance payment referred to above must have been received by the Contractor on its account number [insert Contractor's account number]. at [insert name and address of the bank].

The maximum amount of this guarantee shall be progressively reduced by the amount of the advance payment repaid by the Contractor as indicated in copies of interim statements or payment certificates which shall be presented to us. This guarantee shall expire, at the latest, upon our receipt of a copy of the interim payment certificate indicating that eighty (80) percent of the Contract Price has been certified for payment, or on the . . . day of ,²⁹, whichever is earlier. Consequently, any demand for payment under this guarantee must be received by us at this office on or before that date.

²⁸ The Guarantor shall insert an amount representing the amount of the advance payment denominated either in the currency(ies) of the advance payment as specified in the Contract, or in a freely convertible currency acceptable to the Employer

²⁹ Insert the expected expiration date of the Time for Completion. The Employer should note that in the event of an extension of the time for completion of the Contract, the Employer would need to request an extension of this guarantee from the Guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee. In preparing this guarantee, the Employer might consider adding the following text to the form, at the end of the penultimate paragraph: "The Guarantor agrees to a one-time extension of this guarantee for a period not to exceed [insert number of months], in response to the Employer's written request for such extension, such request to be presented to the Guarantor before the expiry of the guarantee."

This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 458, except that subparagraph (ii) of Sub-article 20(a) is hereby excluded..

. **[Seal of bank and Signature(s)]**.

Note –

All italicised text (**including footnotes**) is for guidance on how to prepare this demand guarantee and shall be deleted from the final document.

Retention Money Security (Unconditional Bank Guarantee)

Demand Guarantee

_____ [insert Bank's Name, and Address of Issuing Branch or Office]

Beneficiary: _____ [insert Name and Address of Employer]

Date: _____ [insert date (e.g., day, month, and year)]

RETENTION MONEY GUARANTEE No.: [insert Retention Money Guarantee no.]

We have been informed that _____ [insert name of Contractor] (hereinafter called "the Contractor") has entered into Contract No. _____ [insert reference number of contract] dated _____ [insert date] with you, for the execution of _____ [insert name of contract and brief description of Works] (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, when the Taking-Over Certificate has been issued for the Works and the first half of the Retention Money has been certified for payment, payment of [insert **either** "the second half of the Retention Money", or, if the amount guaranteed under the Performance Guarantee, when the Taking-Over Certificate is issued, is less than half of the Retention Money, "the difference between half of the Retention Money and the amount guaranteed under the Performance Security"] is to be made against a Retention Money guarantee.

At the request of the Employer, we _____ [insert name of Bank] hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of _____ [insert amount in figures] (_____) [insert amount in words]¹ upon receipt by us of your first demand in writing accompanied by a written statement stating that the Contractor is in breach of its obligation under the Contract because the Contractor used the advance payment for purposes other than the costs of mobilisation in respect of the Works.

¹ The Guarantor shall insert an amount representing the amount of the second half of the Retention Money or, if the amount guaranteed under the Performance Guarantee when the Taking-Over Certificate is issued is less than half of the Retention Money, the difference between half of the Retention Money and the amount guaranteed under the Performance Security and denominated either in the currency(ies) of the second half of the Retention Money as specified in the Contract, or in a freely convertible currency acceptable to the Employer.

It is a condition for any claim and payment under this guarantee to be made that the payment of the second half of the Retention Money referred to above must have been received by the Contractor on its account number _____ **[insert Contractor's account number]** at _____ **[insert name and address of the Bank]**.

This guarantee shall expire, at the latest, 21 days after the date when the Employer has received a copy of the Performance Certificate issued by the Engineer. Consequently, any demand for payment under this guarantee must be received by us at this office on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 458.

[signature(s)]

Note: All italicised text (including footnotes) is for use in preparing this form and shall be deleted from the final product.