REPUBLIC OF KENYA

RIFT VALLEY WATER SERVICES BOARD

MILIMA TATU WATER SUPPLY PROJECT

(PRIORITY PROJECTS PROGRAMME)

TENDER No:

RVWSB/MLM-TAT/EQ /2017-2018

TENDER DOCUMENT

EMPLOYER
RIFT VALLEY WATER SERVICES BOARD
MAJI PLAZA PRISON ROAD
P.O. BOX 2451-20100
NAKURU
TEL: 0718-313557

PROJECT MANAGER
THE CHIEF EXECUTIVE OFFICER
RIFT VALLEY WATER SERVICE BOARD
MAJI PLAZA PRISON ROAD
P.O. BOX 2451-20100
NAKURU
Email: info@rvwsb.go.ke:
TEL 0718-313557
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SECTION I: INVITATION FOR TENDERS (IFT)
RIFT VALLEY WATER SERVICES BOARD

PROCUREMENT OF WORKS FOR TURKANA, WEST POKOT AND NAROK COUNTIES - EQUALIZATION FUND PROGRAMME

TENDER NOTICE

1.0 General Background
Rift Valley Water Services Board (RVWSB) is a state corporation operating under the Ministry of Water and Irrigation. The Board's mandate is to develop and improve water infrastructure in the following counties: Nakuru, Narok, Nyandarua, Baringo, ElgeyoMarakwet, West Pokot and Turkana Counties

2.0 Project Background
The Government through RVWSB has prioritized the development of Rural Water Supply Project for Boards area of jurisdiction under the Priority Projects Programme. In this regard, RVWSB now intends to commence the implementation of works in order to realize these goals.

3.0 Requirements and Projects Scope
The Board (RVWSB) therefore invites qualified contractors to submit sealed Bids for the tender as shown below. The minimum eligibility requirement comprises of:
   a. Certified copies of tax compliance certificate
   b. Proof of legal existence.
   c. Proof of similar works of similar magnitude carried out in the last 3 years.
   d. Bid security of 2% of the entire tender sum, in form of a bank guarantee from a reputable bank or insurance company.
   e. Availability of appropriate equipment and relevant skills among staff.
   f. Registration with National Construction Authority under categories and classes stated below:

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   g) Mandatory Pretender site visit is to be carried out as follows: **Not Applicable**
5.0 Obtaining Bidding documents.

Interested contractors may purchase Tender documents at RVWSB Headquarters upon payment of KES. 1000 during normal working hours or freely download them from the Board’s website www.rvwsb.go.ke or at http://supplier.treasury.go.ke/site/tenders.go/index.php/tenders. IFMIS portal, the bidders who choose to download the documents can send their details to procurement@rvwsb.go.ke.

6.0 Submission of bids

Completed tender documents enclosed in plain envelopes must be delivered to the address below at or before 22nd of September 2017, at 12.00 noon. Tenders will be opened in the presence of Bidders’ representatives, who choose to attend at 12.05p.m.on 22nd September 2017 at the Board’s conference room.

The Tenders should be clearly marked with tender number and the project name.

The address referred to above is:

Chief Executive Officer
Rift Valley Water Services Board.
Maji Plaza, Prisons Rd
P.O. Box 2451-20100 Nakuru, Kenya.
MOBILE NO. 0718-313557, Fax (051) 2214915,
E-mail: info@rvwsb.go.ke
SECTION II: INSTRUCTIONS TO TENDERERS (ITT)
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## A. Introduction

### 1. Scope of Tender

1.1 The Procuring Entity indicated in the Tender Data Sheet (TDS) invites Tenders for the construction of works as specified in the Tender Data Sheet and Sections VI (Technical Specifications) and VII (Drawings).

1.2 The successful Tenderer will be expected to complete the works by the required completion date specified in the Tender Data Sheet.

1.3 The objectives of the works are listed in the Tender Data Sheet. These are mandatory requirements. Any subsequent detail is offered to support these objectives and must not be used to dilute their importance.

### 2. Source of Funds

2.1 The Government of Kenya has set aside funds for the use of the Procuring Entity named in the Tender Data Sheet during the Financial Year indicated in the Tender Data Sheet. It is intended that part of the proceeds of the funds will be applied to cover eligible payments under the contract for the works as described in the Tender Data Sheet.

Or

The Government of Kenya through Procuring Entity named in the Tender Data Sheet has applied for/received/ intends to apply for a [loan/credit/grant] from the financing institution named in the Tender Data Sheet towards the cost of the Project named in the Tender Data Sheet. The Government of Kenya intends to apply a part of the proceeds of this [loan/credit/grant] to payments under the Contract described in the Tender Data Sheet.

2.2 Payments will be made directly by the Procuring Entity (or by financing institution specified in the Tender Data Sheet upon request of the Procuring Entity to so pay) and will be subject in all respects to the terms and conditions of the resulting contract placed by the Procuring Entity.

### 3. Eligible Tenderers

3.1 A Tenderer may be a natural person, private or public company, government-owned institution, subject to sub-Clause 3.4 or any combination of them with a formal intent to enter into an agreement or under an existing agreement in the form of a joint venture, consortium, or association. In the case of a joint venture, consortium, or association, unless otherwise specified in the Tender Data Sheet, all parties shall be jointly and severally liable.

3.2 The Invitation for Tenders is open to all suppliers as defined in the Public Procurement and Disposal Act, 2005 and the Public Procurement and Disposal Regulations, 2006 except as provided hereinafter.

3.3 National Tenderers shall satisfy all relevant licensing and/or
registration with the appropriate statutory bodies in Kenya, such as the Ministry of Public Works or the Energy Regulatory Commission.

3.4 A Tenderer shall not have a conflict of interest. All Tenderers found to have a conflict of interest shall be disqualified. A Tenderer may be considered to have a conflict of interest with one or more parties in this Tendering process, if they:

a) Are associated or have been associated in the past directly or indirectly with employees or agents of the Procuring Entity or a member of a board or committee of the Procuring Entity;

b) Are associated or have been associated in the past, directly or indirectly with a firm or any of its affiliates which have been engaged by the Procuring Entity to provide consulting services for the preparation of the design, specifications and other documents to be used for the procurement of the works under this Invitation for Tenders;

c) Have controlling shareholders in common; or

d) Receive or have received any direct or indirect subsidy from any of them; or

e) Have the same legal representative for purposes of this Tender; or

f) 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 Tender of another Tenderer, or influence the decisions of the Procuring Entity regarding this Tendering process; or

g) Submit more than one Tender in this Tendering process, However, this does not limit the participation of subcontractors in more than one Tender, or as Tenderer and subcontractor simultaneously.

3.5 A Tenderer will be considered to have a conflict of interest if they participated as a consultant in the preparation of the design or technical specification of the project and related services that are the subject of the Tender.

3.6 Tenderers shall not be under a declaration of ineligibility for corrupt and fraudulent practices issued by the Government of Kenya in accordance with GCC sub-Clause 3.2.

3.7 Government owned enterprises in Kenya may participate only if they are legally and financially autonomous, if they operate under commercial law, are registered by the relevant registration board or authorities and if they are not a dependent agency of the Government.

3.7 Tenderers shall provide such evidence of their continued
eligibility satisfactory to the Procuring Entity, as the Procuring Entity shall reasonably request.

4. **One Tender per Tenderer**

   4.1 A firm shall submit only one Tender, in the same Tendering process, either individually as a Tenderer or as a partner in a joint venture pursuant to ITT Clause 5.

   4.2 No firm can be a subcontractor while submitting a Tender individually or as a partner of a joint venture in the same Tendering process.

   4.3 A firm, if acting in the capacity of subcontractor in any Tender, may participate in more than one Tender but only in that capacity.

   4.4 A Tenderer who submits or participates in more than one Tender (other than as a subcontractor or in cases of alternatives that have been permitted or requested) will cause all the Tenders in which the Tenderer has participated to be disqualified.

5. **Alternative Tenders by Tenderers**

   5.1 Tenderers shall submit offers that comply with the requirements of the Tendering documents, including the basic Tenderer’s technical design as indicated in the specifications and Drawings and Bill of Quantities. Alternatives will not be considered, unless specifically allowed for in the Tender Data Sheet. If so allowed, sub-Clause 5.2 and 5.3 shall govern.

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

   5.3 If so allowed in the Tender Data Sheet, Tenderers wishing to offer technical alternatives to the requirements of the Tendering documents must also submit a Tender that complies with the requirements of the Tendering documents, including the basic technical design as indicated in the specifications. In addition to submitting the basic Tender, the Tenderer shall provide all information necessary for a complete evaluation of the alternative by the Procuring Entity, including technical specifications, breakdown of prices, and other relevant details. Only the technical alternatives, if any, of the lowest evaluated Tenderer conforming to the basic technical requirements shall be considered by the Procuring Entity.

6. **Cost of Tendering**

   6.1 The Tenderer shall bear all costs associated with the preparation and submission of its Tender, and the Procuring Entity shall in no case be responsible or liable for those costs, regardless of the conduct or outcome of the Tendering process.

7. **Site Visit and Pre-Tender Meeting**

   7.1 The Tenderer, at the Tenderer’s own responsibility and risk, is advised to visit and examine the Site of Works and its surroundings and obtain all information that may be necessary for preparing the Tender and entering into a contract for construction of the Works. The costs of visiting the Site shall be
at the Tenderer’s own expense.

7.2 The Procuring Entity may conduct a site visit and a pre-Tender meeting. The purpose of the pre-Tender meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.

7.3 The Tenderer’s designated representative is invited to attend a site visit and pre-Tender meeting which, if convened, will take place at the venue and time stipulated in the Tender Data Sheet.

7.4 The Tenderer is requested as far as possible, to submit any questions in writing or by electronic means to reach the procuring Entity before the pre-Tender meeting. It may not be practicable at the meeting to answer all questions, but questions and responses will be transmitted in accordance with sub-Clause 7.5.

7.5 Minutes of the pre-Tender meeting, including the text of the questions raised and the responses given together with any responses prepared after the pre-Tender meeting will be transmitted within the time stated in the Tender Data Sheet to all purchasers of the Tendering documents. Any modification of the Tendering documents listed in sub-Clause 8.1 that may become necessary as a result of the pre-Tender meeting shall be made by the Procuring Entity exclusively through the issue of an Addendum pursuant to ITT sub Clause 10.2 and not through the minutes of the pre-Tender meeting.

7.6 Non attendance during the site visit or pre-Tender meeting will not be a cause for disqualification of a Tenderer unless specified to the contrary in the Tender Data Sheet.

B. Tendering Documents

8. Content of Tendering Documents

8.1 The works required, Tendering procedures, and contract terms are prescribed in the Tendering Documents. In addition to the Section I Invitation for Tenders, Tendering documents which should be read in conjunction with any addenda issued in accordance with ITT sub Clause 10.2 include:

- Section II Instructions to Tenderers
- Section IIITender Data Sheet
- Section IV General Conditions of Contract
- Section V Contract Data Sheet
- Section VI Specifications
- Section VII Drawings
- Section VIII Bill of Quantities
- Section IX Forms of Tender
- Form of Tender
- Appendix to Tender
- Confidential Business Questionnaire
- Integrity Declaration
The number of copies to be completed and returned with the Tender is specified in the Tender Data Sheet.

The Invitation for Tenders (Section I) issued by the Procuring Entity is not part of the Tendering Documents and is included for reference purposes only. In case of discrepancies between the Invitation for Tenders and the Tendering Documents listed in sub-Clause 8.1 above, the said Tendering Documents will take precedence.

The Procuring Entity is not responsible for the completeness of the Tendering Documents and their addenda, if they were not obtained directly from the authorized staff of the Procuring Entity.

The Tenderer is expected to examine all instructions, forms, terms and specifications in the Tendering documents. Failure to furnish all information required by the Tendering Documents or to submit a Tender substantially responsive to the Tendering documents in every respect will be at the Tenderer’s risk and may result in the rejection of its Tender.

A prospective Tenderer requiring any clarification of the Tendering documents may notify the Procuring Entity in writing, e-mail or facsimile at the Procuring Entity's address indicated in the Tender Data Sheet.

The Procuring Entity will within the period stated in the Tender Data Sheet respond in writing to any request for clarification provided that such request is received no later than the period indicated in the Tender Data Sheet prior to the deadline for the submission of Tenders prescribed in sub-Clause 22.1.

Copies of the procuring entity’s response will be forwarded to all Purchasers of the Tendering documents, including a description of the inquiry, but without identifying its source.

Should the Procuring Entity deem it necessary to amend the Tendering documents as a result of a clarification, it shall do so following the procedure under ITT Clause 10.
10. Amendments of the Tendering Documents

10.1 Before the deadline for submission of Tenders, the Procuring Entity may, for any reason, whether at its own initiative or in response to a clarification requested by a prospective Tenderer, modify the Tendering documents by issuing addenda.

10.2 Any addendum issued shall be part of the Tender documents pursuant to sub-Clause 8.1 and shall be communicated in writing, by e-mail or facsimile to all who have obtained the Tendering documents directly from the Procuring Entity.

10.3 In order to allow prospective Tenderers reasonable time in which to take an addendum into account in preparing their Tenders, the Procuring Entity at its discretion shall extend, as necessary, the deadline for submission of Tenders, in accordance with sub-Clause 22.2

C. Preparation of Tenders

11. Language of Tender

11.1 The Tender, and all correspondence and documents related to the Tender exchanged by the Tenderer and the Procuring Entity shall be written in the Tender language stipulated in the Tender Data Sheet. Supporting documents and printed literature furnished by the Tenderer may be in another language provided they are accompanied by an accurate translation of the relevant passages in the above stated language, in which case, for purposes of interpretation of the Tender, the translation shall prevail.

12. Documents Constituting the Tender

12.1 The Tender submitted by the Tenderer shall consist of the following components:

   a) The Form of Tender (in the format indicated in Section IX) completed in accordance with ITT Clause 15, 16 and 17;

   b) Information requested by Instructions to TenderersITT sub-Clause 13.2; 13.3 and 13.4;

   c) Tender Security or Tender Securing Declaration in accordance with Instructions to TenderersITT Clause 19;

   d) Priced Bill of Quantities;

   e) Qualification Information Form and Documents;

   f) Alternative offers where invited in accordance with Instructions to TenderersITT Clause 5;

   g) Written confirmation authorizing the signatory of the Tender to commit the Tenderer in accordance with Instructions to TenderersITT sub Clause 19.2; and
h) And any information or other materials required to be completed and submitted by Tenderers, as specified in the Tender Data Sheet.

13. Documents Establishing Eligibility and Qualifications of the Tenderer

13.1 Pursuant to ITT Clause 13, the Tenderer shall furnish, as part of its Tender, documents establishing the Tenderer's eligibility to Tender and its qualifications to perform the contract if its Tender is accepted.

13.2 In the event that pre-qualification of potential Tenderers has been undertaken, only Tenders from pre-qualified Tenderers will be considered for award of contract. These qualified Tenderers should submit their Tenders with any information updating the original pre-qualification applications or, alternatively, confirm in their Tenders that the originally submitted pre-qualification information remains essentially correct as of the date of Tender submission. The update or confirmation should be provided in Section IX.

13.3 If the Procuring Entity has not undertaken pre-qualification of potential Tenderers, to qualify for award of the contract, Tenderers shall meet the minimum qualifying criteria specified in the Tender Data Sheet:

13.4 Tenders submitted by a joint venture of two or more firms as partners shall comply with the following requirements, unless otherwise stated in the Tender Data Sheet:

a) The Tender shall include all the information listed in the Tender Data Sheet pursuant to sub-Clause 13.3 above for each joint venture partner;

b) The Tender shall be signed so as to be legally binding on all partners;

c) One of the partners will be nominated as being in charge, and this authorization shall be evidenced by submitting a power of attorney signed by legally authorized signatories of all the partners;

d) The partner in charge shall be authorized to incur liabilities and receive instructions for and on behalf of any and all partners of a joint venture and the entire execution of the Contract, including payment, shall be done exclusively with the partner in charge;

e) All partners of the joint venture shall be liable jointly and severally for the execution of the contract in accordance with the contract terms and a statement to this effect shall be included in the authorization mentioned under (c) above as well as in the Tender and in the Agreement (in case of a successful Tender); and
f) A copy of the joint venture agreement entered into by all partner shall be submitted with the Tender. Alternatively, a Letter of Intent to execute a joint venture agreement in the event of a successful Tender shall be signed by all partners and submitted with the Tender, together with a copy of the proposed Agreement.

g) The Tender Security and Tender Securing Declaration as stated in accordance with ITT Clause 19, and in case of a successful Tender, the Agreement, shall be signed so as to be legally binding on all partners.

14. Lots Package

14.1 When Tendering for more than one contract under the lots arrangements, the Tenderer must provide evidence that it meets or exceeds the sum of all the individual requirements for the lots being tendered in regard to:

- a) Average annual turnover;
- b) Particular experience including key production rates;
- c) Financial means, etc;
- d) Personnel capabilities; and
- e) Equipment capabilities.

14.2 In case the Tenderer fail to fully meet any of these criteria, it may be qualified only for those lots for which the Tenderer meets the above requirement.

15. Form of Tender

15.1 The Tenderer shall fill the Form of Tender furnished in the Tendering Documents. The Form of Tender must be completed without any alterations to its format and no substitute shall be accepted.

16. Tender Prices

16.1 The Contract shall be for the whole Works, as described in sub-Clause 1.1, based on the priced Bill of Quantities submitted by the Tenderer.

16.2 The Tenderer shall fill in rates and prices for all items of the Works described in the Bill of Quantities. Items for which no rate or price is entered by the Tenderer will not be paid for by the Procuring Entity when executed and shall be deemed covered by the other rates and prices in the Bill of quantities.

16.3 All duties, taxes and other levies payable by the Contractor under the Contract, or for any other cause, as of the date 15 days prior to the deadline for submission of Tenders, shall be included in the rates, prices and total Tender price submitted by the Tenderer.

16.4 The rates and prices quoted by the Tenderer shall be subject to adjustment during the performance of the Contract if provided for in the Tender Data Sheet and the provisions of the Conditions of Contract. The
17. Tender Currencies

17.1 The unit rates and prices shall be quoted by the Tenderer in the currency as specified in the Tender Data Sheet.

17.2 Tenderers shall indicate details of their expected foreign currency requirements in the Tender, if any. The rates of exchange to be used by the Tenderers in arriving at the local currency equivalent shall be the selling rates for similar transactions established by the authority specified in the Tender Data Sheet prevailing on the date 28 days prior to the latest deadline for submission of Tenders. These exchange rates shall apply for all payments so that no exchange risk will be borne by the Tenderer. In any case, payments will be computed using the rates quoted in the Tender.

17.3 Tenderers may be required by the Procuring Entity to clarify their foreign currency requirements and to substantiate that the amounts included in the rates and prices and in the Contract Data Sheet are reasonable and responsive to sub-Clause 17.1.

18. Tender Validity Period

18.1 Tenders shall remain valid for the period specified in the Tender Data Sheet after the Tender submission deadline prescribed by the Procuring Entity, pursuant to ITT Clause 22. A Tender valid for a shorter period shall be rejected by the Procuring Entity as non-responsive.

18.2 In exceptional circumstances, prior to expiry of the original Tender validity period, the Procuring Entity may request that the Tenderers extend the period of validity for a specified additional period. The request and the Tenderers' responses shall be made in writing or by cable. A Tenderer may refuse the request without forfeiting its Tender Security or causing to be executed its Tender Securing declaration. A Tenderer agreeing to the request will not be required or permitted to otherwise modify the Tender, but will be required to extend the validity of its Tender Security or Tender Securing declaration for the period of the extension, and in compliance with ITT Clause 19 in all respects.

18.3 In the case of fixed price contracts, if the award is delayed by a period exceeding sixty (60) days beyond the expiry of the initial Tender validity period, the contract price will be increased by a factor specified in the request for extension. The Tender evaluation shall be based on the Tender price without taking into consideration on the above correction.

19. Tender Security and Tender

19.1 Pursuant to ITT Clause 12, where required in the Tender Data Sheet, the Tenderer shall furnish as part of its Tender, a Tender Security in original form and in the
Securing Declaration

amount and currency specified in the Tender Data Sheet. A Tender Securing Declaration as specified in the Tender Data Sheet in the format provided in section X shall be provided as a mandatory requirement.

19.2 The Tender Security or Tender Securing Declaration is required to protect the Procuring Entity against the risk of Tenderer’s conduct which would warrant the security’s forfeiture, pursuant to ITT sub-Clause 19.9.

19.3 The Tender Security shall be denominated in the currency of the Tender and shall be in one of the following forms:

a) Cash;

b) A Bank Guarantee;

c) An Insurance Bond issued by an insurance firm approved by the PPOA located in Kenya;

d) An irrevocable letter of credit issued by a reputable bank.

19.4 The Tender Security shall be in accordance with the Form of the Tender Security included in Section X or another form approved by the Procuring Entity prior to the Tender submission.

19.5 The Tender Security shall be payable promptly upon written demand by the Procuring Entity in case any of the conditions listed in sub-Clause 19.8 are invoked.

19.6 Any Tender not accompanied by a Tender Security in accordance with sub-Clauses 19.1 or 19.3 shall be rejected by the Procuring Entity as non-responsive, pursuant to ITT Clause 28.

19.7 The Procuring Entity shall immediately release any Tender Security if:

a) The procuring proceedings are terminated;

b) The Procuring Entity determines that none of the submitted Tenders is responsive;

c) A contract for the procurement is entered into.

19.8 The Tender Security shall be forfeited and the Tender Securing Declaration executed if the Tenderer:

a) Withdraws its Tender after the deadline for submitting Tenders but before the expiry of the period during which Tenders must remain valid;

b) Rejects a correction of an arithmetic error pursuant to
sub-Clause 29.2;

c) Refuse to enter into a written contract in accordance with ITT Clause 40;

d) Fails to furnish the Performance Security in accordance with ITT Clause 41.

19.9 The Tender Security and Tender Securing Declaration of a joint venture must be in the name of the joint venture submitting the Tender.

19.10 A Tenderer shall be suspended from being eligible for Tendering in any contract with the Procuring Entity for the period of time indicated in the Tender Securing Declaration:

a) If the Tenderer withdraws its Tender, except as provided in ITT sub-Clauses 18.2 and 29.2; or

b) In the case of a successful Tenderer, if the Tenderer fails within the specified time limit to:

   (i) Sign the contract; or

   (ii) Furnish the required Performance Security.

20. Format and Signing of Tender

20.1 The Tenderer shall prepare one original of the documents comprising the Tender as described in ITT Clause 12 of these Instructions to Tenderers, with the Form of Tender, and clearly marked “ORIGINAL”. In addition, the Tenderer shall submit copies of the Tender, in the number specified in the Tender Data Sheet, and clearly marked as “COPIES”. In the event of discrepancy between them, the original shall prevail.

20.2 The original and all copies of the Tenders shall be typed or written in indelible ink and shall be signed by a person or persons duly authorized to sign on behalf of the Tenderer. This authorization shall consist of a written confirmation as specified in the Tender Data Sheet and shall be attached to the Tender. The name and position held by each person signing the authorization must be typed or printed below the signature. All pages of the Tender, except for un-amended printed literature, shall be initialled by the person or persons signing the Tender.

20.3 Any interlineations, erasures, or overwriting shall be valid only if they are initialled by the person or persons signing the Tender.

20.4 The Tenderer shall furnish information as described in the Form of Tender on commissions or gratuities, if any, paid or to be paid to agents relating to this Tender and to contract execution if the Tenderer is awarded the contract.
D. Submission of Tenders

21. Sealing and Marking of Tenders

21.1 The Tenderer shall seal the original and each copy of the Tender in separate envelopes, duly marking the envelopes as “ORIGINAL” and “COPY”. The envelopes shall then be sealed in an outer envelope securely sealed in such a manner that opening and resealing cannot be achieved undetected.

21.2 The inner and outer envelopes shall:

a) Be addressed to the Procuring Entity at the address given in the Tender Data Sheet; and

b) Bear the Project name indicated in the Tender Data Sheet, the Invitation for Tenders (IFB) title and number indicated in the Tender Data Sheet, and a statement: “DO NOT OPEN BEFORE,” to be completed with the time and the date specified in the Tender Data Sheet, pursuant to ITT sub-Clause 22.1.

21.3 In addition to the identification required in sub-Clause 21.2, the inner envelopes shall also indicate the name and address of the Tenderer to enable the Tender be returned unopened in case it is declared late, pursuant to sub-Clause 22.1 and for matching purpose under ITT Clause 23.

21.4 If the outer envelope is not sealed and marked as required by ITT sub clause 21.2, the Procuring Entity shall assume no responsibility for misplacement or premature opening of the Tender.

22. Deadline for Submission of Tenders

22.1 Tenders shall be received by the Procuring Entity at the address specified under ITT sub-Clause 21.2 no later than the date and time specified in the Tender Data Sheet.

22.2 The Procuring Entity may, in exceptional circumstances and at its discretion, extend the deadline for the submission of Tenders by amending the Tendering documents in accordance with ITT Clause 9, in which case all rights and obligations of the Procuring Entity and Tenderers previously subject to the deadline will thereafter be subject to the new deadline.

22.3 The extension of the deadline for submission of Tenders shall not be made later than the period specified in the Tender Data Sheet before the expiry of the original deadline.

23. Late Tenders

23.1 The Procuring Entity shall not consider for evaluation any Tender that arrives after the deadline for submission of Tenders, in accordance with ITT Clause 22.
23.2 Any Tender received by the Procuring Entity after the deadline for submission of Tenders shall be declared late, rejected and returned unopened to the Tenderer.

24. Modification, Substitution and Withdrawal of Tenders

24.1 A Tenderer may modify or substitute or withdraw its Tender after it has been submitted, provided that written notice of the modification, including substitution or withdrawal of the Tender, is received by the Procuring Entity prior to the deadline prescribed for submission of Tenders prescribed under ITT sub-Clause 22.1.

24.2 The Tenderer’s modification or substitution or withdrawal notice shall be prepared, sealed, marked, and dispatched in accordance with the provisions of ITT Clauses 20 and 21 with the outer and inner envelopes additionally marked “MODIFICATION” or “SUBSTITUTION” or “WITHDRAWAL” as appropriate. The notice may also be sent by electronic mail and facsimile, but followed by a signed confirmation copy, postmarked not later than the deadline for submission of Tenders.

24.3 No Tender may be withdrawn, replaced or modified in the interval between the deadline for submission of Tenders and the expiration of the period of Tender validity specified by the Tenderer on the Tender Form. Withdrawal of a Tender during this interval shall result in the Tenderer’s forfeiture of its Tender Security or execution of Tender Securing Declaration, pursuant to the ITT sub-Clause 19.9.

24.4 Withdrawal of a Tender between the deadline for submission of Tenders and the expiration of the period of Tender validity specified in the Tender Data Sheet or as extended pursuant to sub-Clause 22.2 shall result in the forfeiture of the Tender Security and execution of Tender Securing Declaration pursuant to ITT sub-Clause 19.9.

24.5 Tenderers may only offer discounts to, or otherwise modify the prices of their Tenders by submitting Tender modifications in accordance with this Clause, or included in the original Tender submission.

E. Opening and Evaluation of Tenders

25. Opening of Tenders

25.1 The Procuring Entity will open all Tenders including modifications, substitution or withdraw notices made pursuant to ITT Clause 24, in public, in the presence of Tenderers or their representatives who choose to attend and other parties with legitimate interest and Tender proceedings, at the place on the date and at time specified in the Tender Data Sheet. The Tenderers’ representatives who are present shall sign a register as proof of their attendance.

25.2 Envelopes marked “WITHDRAWAL” shall be opened and read out first. Tenders for which an acceptable notice
of withdrawal has been submitted pursuant to ITT Clause 24 shall not be opened but returned to the Tenderer. If the withdrawal envelope does not contain a copy of the “Power of Attorney” confirming the signature as a person duly authorized to sign on behalf of the Tenderer, the corresponding Tender will be opened. Subsequently, all envelopes marked "MODIFICATION" shall be opened and the submissions therein read out in appropriate detail. Thereafter all envelopes marked or "SUBSTITUTION" opened and the submissions therein read out in appropriate detail.

25.3 All other envelopes shall be opened one at a time. The Tenderers' names, the Tender prices, the total amount of each Tender and of any alternative Tender (if alternatives have been requested or permitted), any discounts, the presence or absence of Tender security, and such other details as the appropriate tender opening committee may consider appropriate, will be announced by the Secretary of the Tender Opening Committee at the opening.

25.4 Tenders or modifications that are not opened and not read out at Tender opening shall not be considered further for evaluation, irrespective of the circumstances. In particular, any discount offered by a Tenderer which is not read out at Tender opening shall not be considered further.

25.5 Tenderers are advised to send in a representative with the knowledge of the content of the Tender who shall verify the information read out from the submitted documents. Failure to send a representative or to point out any unread information by the sent Tenderer’s representative shall indemnify the Procuring Entity against any claim or failure to read out the correct information contained in the Tenderer’s Tender.

25.6 No Tender will be rejected at Tender opening except for late Tenders which will be returned unopened to the Tenderer, pursuant to ITT Clause 23.

25.7 The Secretary of the appropriate tender opening committee shall prepare minutes of the Tender opening. The record of the Tender opening shall include, as a minimum: the name of the Tenderers and whether or not there is a withdrawal, substitution or modification, the Tender price per Lot if applicable, including any discounts and alternative offers and the presence or absence of a Tender Security or Tender Securing Declaration.

25.8 The Tenderers’ representatives who are present shall be requested to sign the record. The omission of a Tenderer’s signature on the record shall not invalidate the contents and affect the record.

25.9 A copy of the minutes of the Tender opening shall be
furnished to individual Tenderers upon request.

26. Confidentiality

26.1 Information relating to the examination, clarification, evaluation, and comparison of Tenders and recommendations for the award of a Contract shall not be disclosed to Tenderers or any other persons not officially concerned with such process until the award to the successful Tenderer has been announced.

26.2 Any effort by a Tenderer to influence the Procuring Entity’s processing of Tenders or award decisions may result in the rejection of his Tender.

26.3 Notwithstanding sub-Clause 26.2, from the time of Tender opening to the time of Contract award, if any Tenderer wishes to contact the Procuring Entity on any matter related to the Tendering process, it should do so in writing.

27. Clarification of Tenders

27.1 To assist in the examination, evaluation, comparison of Tenders and post-qualification of the Tenderer, the Procuring Entity may, at its discretion, ask a Tenderer for clarification of its Tender including breakdown of prices. Any clarification submitted by a Tenderer that is not in response to a request by the Procuring Entity shall not be considered.

27.2 The request for clarification and the response shall be in writing. No change in the prices or substance of the Tender shall be sought, offered, or permitted except to confirm the correction of arithmetic errors discovered by the Procuring Entity in the evaluation of Tenders in accordance with ITT Clause 29.

27.3 From the time of Tender opening to the time of Contract award if any Tenderer wishes to contact the Procuring Entity on any matter related to the Tender it should do so in writing.

28. Preliminary Examination of Tenders

28.1 Prior to the detailed evaluation of Tenders, the Procuring Entity will determine whether:

a) The Tender has been submitted in the required format;

b) Any Tender Security submitted is in the required form, amount and validity period;

c) The Tender has been signed by the person lawfully authorized to do so;

d) The required number of copies of the Tender have been submitted;

e) The Tender is valid for the period required;

f) All required documents and information have been
submitted; and

28.2 The Procuring Entity will confirm that the documents and information specified under ITT Clause 12 and ITT Clause 13 have been provided in the Tender. If any of these documents or information is missing, or is not provided in accordance with the Instructions to Tenderers, the Tender shall be rejected.

28.3 The Procuring Entity may waive any minor informality, nonconformity, or irregularity in a Tender which does not constitute a material deviation, provided such waiver does not prejudice or affect the relative ranking of any Tenderer.

28.4 A substantially responsive Tender is one which conforms to all the terms, conditions, and specifications of the Tendering documents, without material deviation or reservation. A material deviation or reservation is one that:

a) Affects in any substantial way the scope, quality, or execution of the Works;

b) Limits in any substantial way, inconsistent with the Tendering documents, the Procuring Entity's rights or the Tenderer’s obligations under the Contract; or

c) If rectified, would affect unfairly the competitive position of other Tenderers presenting substantially responsive Tenders.

28.5 If a Tender is not substantially responsive, it will be rejected by the Procuring Entity, and may not subsequently be made responsive by correction or withdrawal of the non-conforming deviation or reservation.

29. Correction of Errors

29.1 Tenders determined to be substantially responsive will be checked by the Procuring Entity for any arithmetic errors. Errors will be corrected by the Procuring Entity as follows:

a) If there is a discrepancy between unit prices 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 Procuring Entity there is an obvious misplacement of the decimal point in the unit price, in which the total price as quoted shall govern and the unit price shall be corrected;

b) 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

c) Where there is a discrepancy between the amounts in
figures and in words, the amount in words will govern.

29.2 The amount stated in the Tender will, be adjusted by the Procuring Entity in accordance with the above procedure for the correction of errors and, with, the concurrence of the Tenderer, shall be considered as binding upon the Tenderer. If the Tenderer does not accept the corrected amount, its Tender will then be rejected, and the Tender Security may be forfeited and the Tender Securing Declaration may be executed in accordance with sub-Clause 19.9.

30. Conversion to Single Currency

30.1 To facilitate the evaluation and comparison, the Procuring Entity will convert all Tender prices expressed in the amounts in various currencies in which the Tender prices are payable to Kenya Shillings at the selling exchange rate established for similar transactions by the Central Bank of Kenya ruling on the date specified in the Tender Data Sheet.

31. Comparison of Tenders

31.1 The Procuring Entity shall evaluate and compare only the Tenders determined to be substantially responsive in accordance with ITT Clause 28.

31.2 In evaluating the Tenders, the Procuring Entity will determine for each Tender the evaluated Tender price by adjusting the Tender price as follows: Making any correction for errors pursuant to ITT Clause 29; Excluding provisional sums and the provision, if any for contingencies in the Bill of Quantities, but including Day work, where priced competitively; and Making appropriate adjustments to reflect discounts or other price modifications offered in accordance with sub-Clause 24.5.

31.3 The Procuring Entity may waive any minor informality or non-conformity, which does not constitute a material deviation, provided such waiver does not prejudice or affect the relative standing of any Tenderer. Variations, deviations, and alternative offers and other factors, which are in excess of the requirements of the Tendering documents or otherwise result in unsolicited benefits for the Procuring Entity will not be taken into account in Tender evaluation.

32. National Preference

32.1 In the evaluation of Tenders the Procuring Entity shall apply exclusive preference to citizens of Kenya where:

a) The funding is 100% from the Government of Kenya or a Kenyan body;

b) The amounts are below the prescribed threshold of KShs.200 million;
32.2 To qualify for the preference the candidate shall provide evidence of eligibility by:

a) Proving Kenyan citizenship by production of a Kenyan Identity Card; or

b) Providing proof of being a “citizen contractor” in terms of section 3(1) of the Act, i.e. being a natural person or an incorporated company wholly owned and controlled by persons who are citizens of Kenya.

32.3 The Minister of Finance may prescribe additional preference and/or reservation schemes, for example for procurements above these thresholds. If such additional preference schemes apply, details will be given in the Tender Data Sheet.

33. Determination of the Lowest Evaluated Tender
33.1 The Tender with the lowest evaluated price from among those which are eligible, compliant and substantially responsive shall be the lowest evaluated Tender.

34. Post-qualification of Tenderer
34.1 If specified in the Tender Data Sheet, post-qualification shall be undertaken.

34.2 The Procuring Entity will determine to its satisfaction whether the Tenderer that is selected as having submitted the lowest evaluated responsive Tender is qualified to perform the contract satisfactorily, in accordance with the criteria listed in sub-Clause 13.3.

34.3 The determination will take into account the Tenderer’s financial, technical, and production capabilities. It will be based upon an examination of the documentary evidence of the Tenderer’s qualifications submitted by the Tenderer, pursuant to sub-Clause 13.3, as well as such other information as the Procuring Entity deems necessary and appropriate. Factors not included in these Tendering documents shall not be used in the evaluation of the Tenderer’s qualifications.

34.4 An affirmative determination will be a prerequisite for award of the contract to the Tenderer. A negative determination will result in rejection of the Tenderer’s Tender, in which event the Procuring Entity will proceed to the next lowest evaluated Tender to make a similar determination of that Tenderer’s capabilities to perform satisfactorily.

F. Award of Contract

35. Criteria of Award
35.1 Subject to ITT Clause 35 and 36, the Procuring Entity will award the Contract to the Tenderer whose Tender has been determined to be substantially responsive to the Tendering
documents and who has offered the lowest Evaluated Tender Price, provided that such Tenderer has been determined to be:

a) Eligible in accordance with the provisions of ITT Clause 3;

b) Is determined to be qualified to perform the Contract satisfactorily;

c) Successful negotiations have been concluded.

35.2 If, pursuant to sub-Clause 14.1, this Contract is being awarded on a “lot and package” basis, the lowest evaluated Tender price will be determined when evaluating this Contract in conjunction with other Contracts to be awarded concurrently, taking into account any discounts offered by the Tenderer for award of more than one Contract.

36. Clarifications

36.1 Clarifications may be undertaken with the lowest evaluated Tenderer relating to the following areas:

a) A minor alteration to the technical details of the statement of requirements;

b) Reduction of quantities for budgetary reasons, where the reduction is in excess of any provided for in the Tendering documents;

c) A minor amendment to the Contract Data Sheet;

d) Finalizing payment arrangements;

e) Mobilization arrangements;

f) Agreeing final delivery or work schedule to accommodate any changes required by the Procuring Entity;

g) The methodology or staffing; or

h) Clarifying details that were not apparent or could not be finalized at the time of Tendering.

36.2 Clarifications shall not change the substance of the tender.

37. Procuring Entity’s Right to Accept any Tender and to Reject any or all Tenders

37.1 Notwithstanding ITT Clause 35, the Procuring Entity reserves the right to accept or reject any Tender, and to cancel the Tendering process and reject all Tenders, at any time prior to the award of Contract, without thereby incurring any liability to the affected Tenderer or Tenderers.
37.2 Notice of the rejection of all Tenders shall be given promptly within 14 days to all Contractors that have submitted Tenders.

37.3 The Procuring Entity shall upon request communicate to any Tenderer the grounds for its rejection of its Tenders, but is not required to justify those grounds.

38. Procuring Entities Right to Vary Quantities at the Time of Award

38.1 The Procuring Entity reserves the right at the time of contract award to increase or decrease the quantity of goods or related services originally specified in these Tendering documents (schedule of requirements) provided this does not exceed by the percentage indicated in the Tender Data Sheet, without any change in unit price or other terms and conditions of the Tender and Tendering documents.

39. Notification of Award

39.1 The Tenderer whose Tender has been accepted will be notified of the award by the Procuring Entity prior to expiration of the Tender validity period by e-mail or facsimile confirmed by registered letter. This letter (hereinafter and in the Conditions of Contract called the "Letter of Acceptance") will state the sum that the Procuring Entity will pay the Contractor in consideration of the provision and maintenance of the Work(s) as prescribed by the Contract (hereinafter and in the Contract called the “Contract Price”).

39.2 The notification of award will constitute the formation of the Contract, subject to the Tenderer furnishing the Performance Security in accordance with ITT Clause 41 and signing the Contract in accordance with sub-Clause 40.2

39.3 At the same time as the person submitting the successful Tender is notified, the Procuring Entity will notify each unsuccessful Tenderer, the name of the successful Tenderer and the Contract amount and will discharge the Tender Security and Tender Securing Declaration of the Tenderer pursuant to ITT sub Clause 19.7.

39.4 If, after notification of award, a Tenderer wishes to ascertain the grounds on which it’s Tender or application for pre-qualification was unsuccessful, it should address its request to the secretary of the Tender Committee that authorized the award of contract. The secretary of the Tender Committee shall, within fourteen days after a request, provide written reasons as to why the Tender, proposal or application to be pre-qualified was unsuccessful.
However, failure to take this opportunity to clarify the grounds for rejection does not affect the Tenderer’s right to seek immediate review by the Public Procurement Administrative Review Board under Clause 45.

**40. Signing of Contract**

40.1 Promptly, and in no case later than 14 days, after notification, Procuring Entity shall send the successful Tenderer the Agreement and Contract Data Sheet, incorporating all agreements between the parties obtained as a result of Contract negotiations.

40.2 Within the period specified in the notification or Tender Data Sheet but not earlier than fourteen (14) days since notification of award of contract, the successful Tenderer shall sign and date the contract and return it to the Procuring Entity.

**41. Performance Security**

41.1 Within thirty (30) days but after 14 days after receipt of the Letter of Acceptance, the successful Tenderer shall deliver to the Procuring Entity a Performance Security in the amount and in the form stipulated in the Tender Data Sheet and the Contract Data Sheet, denominated in the type and proportions of currencies in the Letter of Acceptance and in accordance with the Conditions of Contract.

41.2 If the Performance Security is provided by the successful Tenderer in the form of a Bank Guarantee or Insurance Bond, it shall be issued either:

a) At the Tenderer’s option, by a bank or insurance firm located in Kenya, or a foreign bank or insurance firm through a correspondent bank or insurance firm located in Kenya;

b) With the consent of the Procuring entity, directly by a foreign bank acceptable to the Procuring entity.

41.3 Failure of the successful Tenderer to comply with the requirement of sub-Clause 41.1 shall constitute sufficient grounds for the annulment of the award and forfeiture of the Tender Security, in which event the Procuring Entity may make the award to the next lowest evaluated Tenderer or call for new Tenders.

**42. Advance Payment**

42.1 The Procuring Entity will provide an Advance Payment as stipulated in the Conditions of Contract, subject to a maximum amount, as stated in the Tender Data Sheet.
42.2 The Advance Payment request shall be accompanied by an Advance Payment Security (Guarantee) in the form provided in Section X. For the purpose of receiving the Advance Payment, the Tenderer shall make an estimate of, and include in its Tender, the expenses that will be incurred in order to commence work. These expenses will relate to the purchase of equipment, machinery, materials, and on the engagement of labour during the first month beginning with the date of the Procuring Entity’s “Notice to Commence” as specified in the Contract Data Sheet.

43. Adjudicator

43.1 The Procuring Entity proposes the person named in the Tender Data Sheet to be appointed as Adjudicator under the Contract, at an hourly fee specified in the Tender Data Sheet, plus reimbursable expenses. If the Tenderer disagrees with this proposal, the Tenderer should so state in the Tender. If, in the Letter of Acceptance, the Procuring Entity has not agreed on the appointment of the Adjudicator, the Adjudicator shall be appointed by the Appointing Authority designated in the Contract Data Sheet at the request of either party.

G. Review of Procurement Decisions

44. Right to Review

44.1 A Tenderer who claims to have suffered or risk suffering, loss or damage or injury as a result of breach of a duty imposed on a Procuring Entity or an Approving Authority by the Public Procurement and Disposal Act, 2005 and the Public Procurement and Disposal Regulations 2006, the procurement proceedings or processes, may seek administrative review as prescribed by the Act. The following matters, however, shall not be subject to the administrative review:

   a) The choice of procurement method;

   b) a decision by the Procuring Entity to reject all Tenders, proposals or quotations;

   c) Where a contract is signed in accordance to Section 68 of the Public Procurement and Disposal Act, 2005;

   d) Where an appeal is frivolous.
45. Time Limit on Review

45.1 The Tenderer shall submit an application for review in the number of copies and pay fees as prescribed by the Public Procurement and Disposal Regulations 2006 within fourteen (14) days of the time the Tenderer became or should have become aware of the circumstances giving rise to the complaint or dispute.

46. Submission of Applications for Review by the Public Procurement Administrative Review Board

46.1 Any application for administrative review shall be submitted in writing to the Secretary, Public Procurement Administrative Review Board on Form RB 1 at the address shown in the Tender Data Sheet. The secretary to the review board shall immediately after filing of the request, serve a copy thereof on the Procuring Entity or Director-General as the case may be.

46.2 The application for administrative review shall be in accordance with the requirements of Regulation 73 of the Public Procurement and Disposals Regulations, 2006, including:

a) Reasons for the complaint, including any alleged breach of the Act or Regulations;

b) An explanation of how the provisions of the Act and or Regulation has been breached or omitted, including the dates and name of the responsible public officer, where known;

c) Statements or other evidence supporting the complaint where available as the applicant considers necessary in support of its request;

d) Remedies sought;

e) Any other information relevant to the complaint.

47. Decision by the Public Procurement Administrative Review Board

47.1 The Administrative Review Board shall within thirty days after receipt of an application for administrative review deliver a written decision which shall indicate:

a) Annulling anything the Procuring Entity has done in the procurement proceedings, including annulling the procurement proceedings in their entirety;

b) Giving directions to the Procuring Entity with respect to anything to be done or redone in the procurement proceedings;

c) Substituting the decision of the Review Board for any decision of the Procuring Entity in the procurement proceedings;

d) Order the payment of costs as between parties to the review.
47.2 The decision made by the Review Board shall, be final and binding on the parties unless judicial review thereof commences within fourteen (14) days from the date of the Review Board’s decision.

48. Appeal on the decision of the Review Board

48.1 Any party to the review aggrieved by the decision of the Review Board may appeal to the High Court and the decision of the High Court shall be final.
SECTION III: TENDER DATA SHEET
Tender Data Sheet (TDS)

Instructions to Tenderers Clause Reference

<table>
<thead>
<tr>
<th>TDS Reference Number</th>
<th>ITT Clause Number</th>
<th>Amendments of, and Supplements to, Clauses in the Instruction to Tenderers</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Introduction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. 1.1</td>
<td></td>
<td>The Procuring Entity is <strong>Rift Valley Water Services Board</strong></td>
</tr>
<tr>
<td>2. 1.1</td>
<td></td>
<td>Name of Project is <strong>MilimaTatu Water Supply Project</strong></td>
</tr>
<tr>
<td>3. 1.2</td>
<td></td>
<td>The expected completion date of the works is <strong>22nd January, 2018</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The Objectives of the Project is to <strong>improve on efficiency and reliability of the water supply in MilimaTatu area.</strong></td>
</tr>
<tr>
<td>5. 2.1</td>
<td></td>
<td>Name of financing institution is <strong>Government of Kenya</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Name of the Procuring Entity is <strong>Rift Valley Water Services Board</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Financial Year <strong>2017-2018</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Describe works under the contract:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• <strong>Purchasing and laying of HDPE 2” Rolls pipe (100mm length)</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• <strong>Purchasing, installing and testing submersible pump of 8m³/hr against a head of 115m</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• <strong>Purchasing, installing and testing Genset to supply power to the submersible pump</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• <strong>Purchasing, installing and testing lorentzPS7K2 controller for controlling the pumping system monitoring of the operating state and incorporates the following alarm functions, overcurrent, under voltage, over speed, overtemperatue, reverse polarity and low water.</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• <strong>Purchasing, installing and testing solar modules:125W, 12 V Multi-crystalline PV Solar modules to provide a maximum of 900W output and a serve capacity over the rated power requirements of the pump of 7500W.</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• <strong>Purchasing, installing and testing solar system accessories and installation sundries to meet the pump requirement</strong></td>
</tr>
<tr>
<td>6. 2.2</td>
<td></td>
<td>The loan/ credit number is: <strong>N/A</strong></td>
</tr>
<tr>
<td>7. 5.1</td>
<td></td>
<td>Alternative Tenders: <strong>Not allowed</strong></td>
</tr>
<tr>
<td>8. 5.2</td>
<td></td>
<td>Alternative time for completion : <strong>Not applicable</strong></td>
</tr>
</tbody>
</table>
9. | 3.1 | Only Tenderers registered with National Construction Authority category NCA 7 and above Civil/Water works  
This Tender is exclusively reserved for national contractors |

10. | 7.5 | The minutes of the pre-Tender meeting will be transmitted within 7 (seven) days after the pre-tender site visit. NOT APPLICABLE |

11. | 7.6 | Non-attendance at the pre-tender meeting: will result in disqualification. NOT APPLICABLE |

**B. Tendering Documents**

12. | 8.2 | The number of copies to be completed and returned with the Tender are 2 (two) copies i.e. One original and 1 copy. |

13. | 8.1 | Address for clarification of Tendering Document is Chief Executive Officer, Rift Valley Water Services Board, P.O. Box 2451-20100, Nakuru. or email to info@rvwsb.go.ke and copy to procurement@rvwsb.go.ke |

14. | 9.2 | Period to Respond to request for clarification by the Procuring Entity 4 (Four) days before deadline for submission.  
Period Prior to deadline for submission of Tenders for Tenderers to request clarification at least 6 (Six) days to deadline for submission |

**C. Preparation of Tenders**

15. | 11.1 | Language of Tender and all correspondence shall be: English |

16. | 13.3 | Evaluation and comparison of Tenders: The following evaluation criteria shall be applied notwithstanding any other requirement in the tender documents.  

*a) Mandatory Requirements (MR)*  
The following requirements must be met by the tenderer

<table>
<thead>
<tr>
<th>No.</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>MR1</td>
<td>Must Submit a copy of certificate of Registration/Incorporation</td>
</tr>
<tr>
<td>MR2</td>
<td>Must Submit a copy of Valid Tax Compliance certificate</td>
</tr>
<tr>
<td>MR3</td>
<td>Registered with the National Construction Authority category 7 and above, Water/Civil works class</td>
</tr>
<tr>
<td>MR4</td>
<td>Signatory has authorized power of attorney for Joint Ventures</td>
</tr>
<tr>
<td>MR5</td>
<td>Must Fill the Bill of Quantities in the Format provided</td>
</tr>
<tr>
<td>MR6</td>
<td>Must Fill the Form of Tender in the Format provided</td>
</tr>
<tr>
<td>MR7</td>
<td>Must submit a Tender Security in the format</td>
</tr>
</tbody>
</table>
At this stage, the tenderer’s submission will either be responsive or non-responsive. The non-responsive submissions will be eliminated from the entire evaluation process and will not be considered further.

### 17. 13.4

#### b) Technical Scores (TS)

This section (Technical Evaluation) will be marked out of 100 and will determine the technical score (TS)

<table>
<thead>
<tr>
<th>No.</th>
<th>Evaluation Attribute</th>
<th>Weighting Score</th>
</tr>
</thead>
</table>
| T.S.1 | **Key Personnel (Attach evidence)**<br>(i) **Site Agent** At least diploma in a civil/water engineering or equivalent. with 10 years relevant experience | - Less than diploma: 0  
- Diploma or above with 10 or more years experience: 16  
- Diploma or above with less than 10 years: No. of years x 16/10 |
| T.S.3 | (ii) **Foreman; At least 1 No.** Each, at least trade test grade 2 in Electrical, plumbing, masonry or equivalent. with 8 years relevant experience | For each;  
- Less than grade 2: 0  
- Grade 2 or above with 8 or more years’ experience: 8  
- Grade 2 or above with less than 8 years: No. of years x 8/8 |
| T.S.4 | (ii) **Plumber 1 No.** Each, at least trade test grade 2 in plumbing or equivalent. with 5 years | No trade test grade 2: 0  
5yrs experience & above: 6  
Below 5 yrs experience: No. of yrs x 6/5 |
| T.S.5 | (ii) **Mason 1 No.** Each, at least trade test grade 2 in masonry or equivalent. with 5 years | No trade test grade 2: 0  
5yrs experience & above: 6  
Below 5 yrs experience: No. of yrs x 6/5 |
| T.S.6 | (ii) **Electrician 1 No.** Each, at least trade test grade 2 in electrical or equivalent. with 5 years | No trade test grade 2: 0  
5yrs experience & above: 6  
Below 5 yrs experience: No. of yrs x 6/5 |
| T.S.7 | **At least 2 No Project of similar nature, complexity and Magnitude completed or at 70%** | - 2 No projects done to more than 70%: 16  
- One project done to 70%: 8 |
<table>
<thead>
<tr>
<th>T.S. 8</th>
<th><strong>Not more than 3 No. ongoing projects</strong> of similar nature, complexity and magnitude whose contract period extends beyond 22nd October 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No projects : 8 Up to 3 projects: 8- (2*number of projects) 4 or more projects: 0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>T.S. 9</th>
<th><strong>Schedules of contractors equipment and transport</strong> (proof of evidence of ownership, lease or hiring)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pick-up........................................2  Pipe threading........................................2  Pipe wrenches .................2  Equipment for submersible pumps installation......................2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>T.S. 10</th>
<th><strong>Audited financial reports for the (last three (3) years</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• For last 3 or more years : 6 2 x No. of reports</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>T.S. 11</th>
<th><strong>Average Annual Turnover (AAT) for the last three years is Ksh10 million</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• AAT &gt;= 10 million : 12  • AAT&lt;10; AAT(m) /10(m) x 12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>T.S. 12</th>
<th><strong>Evidence of Financial Resources (cash in hand, lines of credit, over draft facility, etc.)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Has financial resources equal or above the cost of the project(as per the bid sum)… 8</td>
</tr>
</tbody>
</table>

| TOTAL | 100 |

Only bidders who score 70% and above will be subjected to the financial comparison. Financial comparison will be in accordance to Section 82 ,PPADA 2015.

<table>
<thead>
<tr>
<th>e18.</th>
<th>16.4</th>
<th>The price shall be <strong>fixed</strong> Information to be submitted with the Tender are: N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>19.</td>
<td>17.1</td>
<td>The currency in which the prices shall be quoted shall be: <strong>Kenyan Shilling</strong></td>
</tr>
<tr>
<td>20.</td>
<td>17.2</td>
<td>The authority for establishing the rates of exchange shall be Central Bank of Kenya. N/A</td>
</tr>
</tbody>
</table>
The applicable date for exchange rates for tendering and evaluation purposes is 28 days earlier than the final deadline for the submission of tenders. N/A

| 21. | 18.1 | The Tender validity period shall be 90 (Ninety) days. |
| 22. | 19.1 | The amount of Tender Security shall be 2 (Two) % of the Tender amount from Bank or reputable Insurance firm |
| 23. | 20.1 | In addition to the original of the Tender, the Tenderer should submit 2 (two) copies of the Tender |
| 24. | 20.2 | Written confirmation of authorization are: Provide Power of Attorney for Joint Ventures |

**D. Submission of Tenders**

| 25. | 21.2 | Tenders shall be submitted to Chief Executive Officer Rift Valley Water Services Board, Maji Plaza, Prisons Road, off Nakuru-Eldama Ravine Road P.O. Box 2451-20100, Nakuru. |
| 26. | 21.2 | Project name: MILIMA TATU WATER SUPPLY PROJECT Tender number RVWSB/MLM-TAT/EQ/2017-2018 Time and date for submission 12.00 noon on 22nd September, 2017 |
| 27. | 22.1 | The deadline for Tender submission is a) Date 22nd September, 2017 b) Time 12.00 noon |
| 28. | 22.3 | The extension of the deadline for submission of Tenders shall be made not later than 3 (Three) days before the expiry of the original deadline. |
| 29. | 24.4 | Expiry of Tender validity is (90) Ninety days after opening of tenders (22nd September, 2017) |

**E. Opening and Evaluation of Tenders**

| 29. | 25.1 | The Tender opening shall take place at: Rift Valley Water Services Board, Maji Plaza, Board room located along Prisons Road, off Nakuru-Eldama Ravine Road Board room Date 22nd September, 2017 Time 12.05 pm |
| 30. | 32.3 | Additional Preference N/A |
| 31. | 34.1 | Post-qualification will be undertaken |
| 32. | 38.1 | Percentage for quantities increase or decrease is 15% |
### F. Award of Contract

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>33.</td>
<td><strong>41.1</strong></td>
<td>The amount of Performance Security shall be <strong>10% of the contract price</strong></td>
</tr>
<tr>
<td>34.</td>
<td><strong>42.1</strong></td>
<td>The Advance Payment shall be : <strong>Not Applicable</strong></td>
</tr>
<tr>
<td>35.</td>
<td><strong>43.1</strong></td>
<td>The proposed adjudicator for the project is: <strong>the person appointed by the Chairman of Institution of Engineers of Kenya</strong></td>
</tr>
</tbody>
</table>

### G. Review of Procurement Decisions

|   | **46.1** | The address for submitting appeals to Administrative Review Board:
The Secretary, Public Procurement Administrative Review Board, The Public Procurement Regulatory Authority, 10th Floor, National Bank House, P.O. Box 58583-00200, NAIROBI, Kenya. Tel: +254 (0) 20 3244000 Email: info@PPRA.go.ke Website: www.PPRA.go.ke |
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**Bookmark not defined.**

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**Bookmark not defined.**

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A. General

1. Definitions

1.1 Boldface type is used to identify defined terms.

The **Adjudicator** is the person appointed jointly by the Procuring Entity and the Contractor to resolve disputes in the first instance, as provided for in Clauses 27 and 28 hereunder.

**Bill of Quantities** means the priced and completed Bill of Quantities forming part of the Tender.

**Compensation Events** are those defined in Clause 47 hereunder.

The **Completion Date** is the date of completion of the Works as certified by the Project Manager, in accordance with Sub-Clause 58.1.

The **Contract** is the Contract between the Procuring Entity and the Contractor to execute, complete, and maintain the Works. It consists of the documents listed in Clause 2.3 below.

The **Contractor** is a person or corporate body whose Tender to carry out the Works has been accepted by the Procuring Entity.

The **Contractor’s Tender** is the completed Tendering document submitted by the Contractor to the Procuring Entity.

The **Contract Price** is the price stated in the Letter of Acceptance and thereafter as adjusted in accordance with the provisions of the Contract.

**Days** are calendar days; months are calendar months.

**Day works** are varied work inputs subject to payment on a time basis for the Contractor’s employees and Equipment, in addition to payments for associated Materials and Plant.

A **Defect** is any part of the Works not completed in accordance with the Contract.

The **Defects Liability Certificate** is the certificate issued by the Project Manager upon correction of defects by the Contractor.

The **Defects Liability Period** is the period named in the Contract Data Sheet and calculated from the Completion Date.

**Drawings** include calculations and other information provided or approved by the Project Manager for the execution of the Contract.

The **Procuring Entity** is the party who employs the Contractor to carry out the Works.

**Equipment** is the Contractor’s machinery and vehicles brought temporarily to the Site to construct the Works.

The **Initial Contract Price** is the Contract Price listed in the Procuring Entity’s Letter of Acceptance.

The **Intended Completion Date** is the date on which it is
intended that the Contractor shall complete the Works. The Intended Completion Date is specified in the Contract Data Sheet. The Intended Completion Date may be revised only by the Project Manager by issuing an extension of time or an acceleration order.

Materials are all supplies, including consumables, used by the Contractor for incorporation in the Works.

Plant is any integral part of the Works that shall have a mechanical, electrical, chemical, or biological function.

The Project Manager is the person named in the Contract Data Sheet (or any other competent person appointed by the Procuring Entity and notified to the Contractor, to act in replacement of the Project Manager) who is responsible for supervising the execution of the Works and administering the Contract and shall be an “Architect” or a “Quantity Surveyor” registered under the Architects and Quantity Surveyors Act Cap 525 or an “Engineer” registered under Engineers Registration Act Cap 530.

The Site is the area defined as such in the Contract Data Sheet.

Site Investigation Reports are those that were included in the Tendering documents and are factual and interpretative reports about the surface and subsurface conditions at the Site.

Specification means the Specification of the Works included in the Contract and any modification or addition made or approved by the Project Manager.

The Start Date is given in the Contract Data Sheet. It is the latest date when the Contractor shall commence execution of the Works. It does not necessarily coincide with any of the Site Possession Dates.

A Subcontractor is a person or corporate body who has a Contract with the Contractor to carry out a part of the work in the Contract, which includes work on the Site.

Temporary Works are works designed, constructed, installed, and removed by the Contractor that are needed for construction or installation of the Works.

A Variation is an instruction given by the Project Manager that varies the Works.

The Works are what the Contract requires the Contractor to construct, install, and turn over to the Procuring Entity, as defined in the Contract Data Sheet.

“Force Majeure” means an event which is beyond the reasonable control of a Party and which makes a Party’s performance of its obligations under the Contract impossible or so impractical as to be considered impossible under the circumstances.

2. Interpretation

2.1 In interpreting these Conditions of Contract, singular also means plural, male also means female or neuter, and the other
way round. Headings have no significance. Words have their normal meaning under the language of the Contract unless specifically defined. The Project Manager will provide instructions clarifying queries about these Conditions of Contract.

2.2 If sectional completion is specified in the Contract Data Sheet, references in the Conditions of Contract to the Works, the Completion Date, and the Intended Completion Date apply to any Section of the Works (other than references to the Completion Date and Intended Completion Date for the whole of the Works).

2.3 The documents forming the Contract shall be interpreted in the order of priority given in the Contract Data Sheet:

(1) Agreement;
(2) Letter of Acceptance;
(3) Contract Data Sheet;
(4) Conditions of Contract;
(5) Technical Specifications;
(6) Contractor’s Tender;
(7) Drawings;
(8) Bill of Quantities; and
(9) Any other document listed in the Contract Data Sheet as forming part of the Contract.

3. Language, Law, Fraud and Corruption

3.1 The language of the Contract and the law governing the Contract are stated in the Contract Data Sheet.

3.2 The Government requires that Procuring Entities (including beneficiaries of Government funded projects) as well as Tenderers/Suppliers/Contractors under Government financed contracts, observe the highest standard of ethics during the procurement and execution of such contracts. It is the responsibility of the Procuring Entity to ensure that Tenderers, suppliers, and contractors and their subcontractors observe the highest standard of ethics during the procurement and execution of such contracts. In pursuance of this policy:

For the purpose of this provision, the following definitions are provided:

(i). “Corruption” has the meaning assigned to it in the Anti-Corruption and Economic Crime Act 2003 and includes the offering, giving, receiving or soliciting of anything of value to influence the action of a public official in the procurement or disposal process or in contract execution;

(ii). “Fraudulent Practice” includes misrepresentation of fact in order to influence a procurement or
disposal process or the execution of a contract to the detriment of the Procuring Entity and includes collusive practices amongst Tenderers prior to or after Tender submission designed to establish Tender prices at artificial non-competitive levels and deprive the Procuring Entity of the benefits of free and open competition;

(iii). “Collusive Practice” means an arrangement between two or more suppliers, contractors and subcontractors designed to achieve an improper purpose, including to influence improperly the actions of the Procuring Entity prior to or after Tender submission, designed to establish Tender prices at artificial non-competitive levels and to deprive the Procuring Entity of the benefit of free and open competition;

(iv). “Coercive Practice” means impairing or harming, or threatening to impair or harm, directly or indirectly a supplier, contractor or subcontractor or the property of any of them to influence improperly the actions of a Procuring Entity;

(v). “Obstructive Practice” means deliberately destroying, falsifying, altering or concealing of evidence material to the investigation or making false statements to investigators in order to materially impede an 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.

A Procuring Entity has the right to require that Tenderers, suppliers, and contractors and their subcontractors permit persons duly appointed by EACC/PPRA/KNAO to inspect their accounts and records and other documents relating to the Tender submission and contract performance;

The Procuring Entity will reject a proposal for award if it determines that the Tenderer recommended for award has engaged in corrupt, fraudulent practices or others stated under Clause 44.1.a in competing for the contract;

In pursuit of the policy defined in sub-Clause 44.1 the Procuring Entity will cancel the portion of the funds allocated to a contract for goods, works, or services if it at any time determines that corrupt or fraudulent practices were engaged in by representatives of the Procuring Entity or Approving Authority or of a beneficiary of the funds during the procurement or the execution of that contract;

In the event that the Procuring Entity or Approving Authority does not take timely and appropriate action satisfactory to the Government of Kenya to remedy the situation, then the Director-General may order an investigation of procurement
proceedings for the purpose of determining whether there has been a breach of the Public Procurement and Asset Disposal Act, 2015.

3.3 The Director-General may, on the advice of the Advisory Board, debar a person from participating in procurement proceedings on the ground that the person has committed an offence under the Public Procurement and Asset Disposal Act, 2015. A debarment shall be for a period of time of not less than five years. Before a person is so debarred, he/she will be given an opportunity to make representations to the Director-General and may request the Review Board to review the debarment.

3.4 Any communication between the Tenderers and the Procuring Entity related to matters of alleged fraud or corruption must be made in writing.

4. Confidentiality 4.1 The Service Providers, their Subcontractors, and the Personnel of either of them shall not disclose any proprietary or confidential information relating to the Project, the Services, this Contract, or the Procuring Entity’s business or operations without the prior written consent of the Procuring Entity.

5. Project Manager’s Decisions 5.1 Except where otherwise specifically stated, the Project Manager will decide contractual matters between the Procuring Entity and the Contractor in the role representing the Procuring Entity.

6. Delegation 6.1 The Project Manager may delegate any of his duties and responsibilities to other people except to the Adjudicator, after notifying the Contractor, and may cancel any delegation after notifying the Contractor.

7. Communication 7.1 Communications between parties that are referred to in the Conditions shall be effective only when in writing. A notice shall be effective only when it is delivered.

8. Subcontracting 8.1 The Contractor may subcontract with the approval of the Project Manager, but may not assign the Contract without the approval of the Procuring Entity in writing. Subcontracting shall not alter the Contractor’s obligations.

9. Other Contractors 9.1 The Contractor shall cooperate and share the Site with other contractors, public authorities, utilities, and the Procuring Entity between the dates given in the Schedule of Other Contractors, as referred to in the Contract Data Sheet. The Contractor shall also provide facilities and services for them as described in the Schedule. The Procuring Entity may modify the Schedule of Other Contractors, and shall notify the Contractor of any such modification.

10. Personnel 10.1 The Contractor shall employ the key personnel named in the Schedule of Key Personnel, as referred to in the Contract Data Sheet, who shall be appropriately qualified and registered with the appropriate bodies to carry out the functions stated in the
10.2 If the Project Manager asks the Contractor to remove a person who is a member of the Contractor’s staff or work force, stating the reasons, the Contractor shall ensure that the person leaves the Site within seven days and has no further connection with the work in the Contract.

11. Procuring Entity’s and Contractor’s Risks

11.1 The Procuring Entity carries the risks which this Contract states are Procuring Entity’s risks, and the Contractor carries the risks which this Contract states are Contractor’s risks.

12. Procuring Entity’s Risks

12.1 From the Start Date until the Defects Correction Certificate has been issued, the following are Procuring Entity’s risks:

a) The risk of personal injury, death, or loss of or damage to property (excluding the Works, Plant, Materials, and Equipment), which are due to:

   (i) Use or occupation of the Site by the Works or for the purpose of the Works, which is the unavoidable result of the Works; or
   
   (ii) Negligence, breach of statutory duty, or interference with any legal right by the Procuring Entity or by any person employed by or contracted to him except the Contractor.

b) The risk of damage to the Works, Plant, Materials, and Equipment to the extent that it is due to a fault of the Procuring Entity or in the Procuring Entity’s design, or due to war or radioactive contamination directly affecting the country where the Works are to be executed.

12.2 From the Completion Date until the Defects Correction Certificate has been issued, the risk of loss of or damage to the Works, Plant, and Materials is an Procuring Entity’s risk except loss or damage due to:

   (a) A Defect which existed on the Completion Date;

   (b) An event occurring before the Completion Date, which was not itself an Procuring Entity’s risk; or

   (c) The activities of the Contractor on the Site after the Completion Date.

13. Contractor’s Risks

13.1 From the Starting Date until the Defects Correction Certificate has been issued, the risks of personal injury, death, and loss of or damage to property (including, without limitation, the Works, Plant, Materials, and Equipment) which are not Procuring Entity’s risks are Contractor’s risks.
14. Insurance

14.1 The Contractor shall provide, in the joint names of the Procuring Entity and the Contractor, insurance cover from the Start Date to the end of the Defects Liability Period, in the amounts and deductibles stated in the Contract Data Sheet for the following events which are due to the Contractor’s risks:

(a) Loss of or damage to the Works, Plant, and Materials;

(b) Loss of or damage to Equipment;

(c) Loss of or damage to property (except the Works, Plant, Materials, and Equipment) in connection with the Contract; and

(d) Personal injury or death.

14.2 Policies and certificates for insurance shall be delivered by the Contractor to the Project Manager for the Project Manager’s approval before the Start Date. All such insurance shall provide for compensation to be payable in the types and proportions of currencies required to rectify the loss or damage incurred.

14.3 If the Contractor does not provide any of the policies and certificates required, the Procuring Entity may effect the insurance which the Contractor should have provided and recover the premiums the Procuring Entity has paid from payments otherwise due to the Contractor or, if no payment is due, the payment of the premiums shall be a debt due.

14.4 Alterations to the terms of insurance shall not be made without the approval of the Project Manager.

14.5 Both parties shall comply with any conditions of the insurance policies.

15. Site Investigation Reports

15.1 The Contractor, in preparing the Tender, shall rely on any Site Investigation Reports referred to in the Contract Data Sheet, supplemented by any information available to the Tenderers.

16. Queries about the Contract Data Sheet

16.1 The Project Manager will clarify queries on the Contract Data Sheet.

17. Contractor to Construct the Works

17.1 The Contractor shall construct and install the Works in accordance with the Specifications and Drawings.

18. Commencement and Completion

18.1 The Contractor may commence execution of the Works on the Start Date and shall carry out the Works in accordance with the Programme submitted by the Contractor, as updated with the approval of the Project Manager, and complete them by the Intended Completion Date.

19. Approval by the Project Manager

19.1 The Contractor shall submit Specifications and Drawings showing the proposed Temporary Works to the Project Manager, who is to approve them if they comply with the Specifications and Drawings.
19.2 The Contractor shall be responsible for the design of Temporary Works.

19.3 The Project Manager’s approval shall not alter the Contractor’s responsibility for design of the Temporary Works.

19.4 The Contractor shall obtain approval of third parties to the design of the Temporary Works, where required.

19.5 All Drawings prepared by the Contractor for the execution of the temporary or permanent Works, are subject to prior approval by the Project Manager before their use.

20. Protection of the Environment

20.1 The Contractors shall take all reasonable steps to protect the environment and to limit damage and nuisance to people and property resulting from pollution, noise and other results of his operations.

20.2 The Contractors shall ensure that emissions, surface discharges and effluent from his activities shall not exceed prescribed values in the environmental laws.

21. Labour Laws

21.2 The Contractor shall comply with all the relevant labour laws applicable in the Country, including laws relating to workers employment, working hours, health, safety, welfare, and immigration, and shall allow them all their legal rights.

22. Health and Safety

22.1 The Contractor shall at all times take all reasonable precautions to maintain the health and safety of his personnel.

22.2 The Contractor shall ensure that first aid facilities are available at all times at the site and that suitable arrangements are made for all necessary welfare and hygiene requirements and for the prevention of epidemics.

22.3 The Contractor shall notify the Procuring Entity 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 the property, as the Procuring Entity may reasonably require.

22.4 The Contractor shall conduct an HIV-Aids awareness programme, and shall take other such measures as specified in the Contract Data Sheet to reduce the risk of transfer of HIV virus between and among Contractor personnel, the Procuring Entity’s Staff and the surrounding community.

23. Discoveries

23.1 Anything of historical or other interest or of significant value unexpectedly discovered on the Site shall be the property of the Procuring Entity. The Contractor shall notify the Project Manager of such discoveries and carry out the Project Manager's instructions for dealing with them.
24. Possession of the Site  
24.1 The Procuring Entity shall give possession of all parts of the Site to the Contractor. If possession of a part is not given by the date stated in the **Contract Data Sheet**, the Procuring Entity will be deemed to have delayed the start of the relevant activities, and this will be a Compensation Event.

25. Access to the Site  
25.1 The Contractor shall allow the Project Manager and any person authorized by the Project Manager access to the Site and to any place where work in connection with the Contract is being carried out or is intended to be carried out.

26. Instructions, Inspections and Audits  
26.1 The Contractor shall carry out all instructions of the Project Manager which comply with the applicable laws where the Site is located.

26.2 The Contractor shall permit the Kenya Government to inspect the Contractor’s accounts and records relating to the performance of the Contractor and to have them audited by auditors appointed by the Kenya Government, if so required by the Kenya Government.

27. Disputes  
27.1 If the Contractor believes that a decision taken by the Project Manager was either outside the authority given to the Project Manager by the Contract or that the decision was wrongly taken, the decision shall be referred to the Adjudicator within 14 days of the notification of the Project Manager’s decision.

28. Procedure for Disputes  
28.1 The Adjudicator shall give a decision in writing within 28 days of receipt of a notification of a dispute.

28.2 The Adjudicator shall be paid by the hour at the rate specified in the **Tender Data Sheet** and **Contract Data Sheet**, together with reimbursable expenses of the types specified in the **Contract Data Sheet**, and the cost shall be divided equally between the Procuring Entity and the Contractor, whatever decision is reached by the Adjudicator. Either party may refer a decision of the Adjudicator to an Arbitrator within 28 days of the Adjudicator’s written decision. If neither party refers the dispute to arbitration within the above 28 days, the Adjudicator’s decision will be final and binding.

28.3 The arbitration shall be conducted in accordance with the arbitration procedure published by the institution named and in the place shown in the **Contract Data Sheet**.

29. Replacement of Adjudicator  
29.1 Should the Adjudicator resign or die, or should the Procuring Entity and the Contractor agree that the Adjudicator is not functioning in accordance with the provisions of the Contract, a new Adjudicator will be jointly appointed by the Procuring Entity and the Contractor. In case of disagreement between the Procuring Entity and the Contractor, within 30 days, the Adjudicator shall be designated by the Appointing Authority designated in the **Contract Data Sheet** at the request of either party, within 14 days of receipt of such request.
B. Time Control

30. Programme

30.1 Within the time stated in the Contract Data Sheet, the Contractor shall submit to the Project Manager for approval a Programme showing the general methods, arrangements, order, and timing for all the activities in the Works.

30.2 An update of the Programme shall be a programme showing the actual progress achieved on each activity and the effect of the progress achieved on the timing of the remaining work, including any changes to the sequence of the activities.

30.3 The Contractor shall submit to the Project Manager for approval an updated Programme at intervals no longer than the period stated in the Contract Data Sheet. If the Contractor does not submit an updated Programme within this period, the Project Manager may withhold the amount stated in the Contract Data Sheet from the next payment certificate and continue to withhold this amount until the next payment after the date on which the overdue Programme has been submitted.

30.4 The Project Manager’s approval of the Programme shall not alter the Contractor’s obligations. The Contractor may revise the Programme and submit it to the Project Manager again at any time. A revised Programme shall show the effect of Variations and Compensation Events.

31. Extension of the Intended Completion Date

31.1 The Project Manager shall extend the Intended Completion Date if a Compensation Event occurs or a Variation is issued which makes it impossible for Completion to be achieved by the Intended Completion Date without the Contractor taking steps to accelerate the remaining work, which would cause the Contractor to incur additional cost.

31.2 The Project Manager shall decide whether and by how much to extend the Intended Completion Date within 21 days of the Contractor asking the Project Manager for a decision upon the effect of a Compensation Event or Variation and submitting full supporting information. If the Contractor has failed to give early warning of a delay or has failed to cooperate in dealing with a delay, the delay by this failure shall not be considered in assessing the new Intended Completion Date.

32. Acceleration

32.1 When the Procuring Entity wants the Contractor to finish before the Intended Completion Date, the Project Manager will obtain priced proposals for achieving the necessary acceleration from the Contractor. If the Procuring Entity accepts these proposals, the Intended Completion Date will be adjusted accordingly and confirmed by both the Procuring Entity and the Contractor.

32.2 If the Contractor’s priced proposals for acceleration are accepted by the Procuring Entity, they shall be incorporated in the Contract Price and treated as a Variation.
### 33. Delays Ordered by the Project Manager

33.1 The Project Manager may instruct the Contractor to delay the start or progress of any activity within the Works.

### 34. Management Meetings

34.1 Either the Project Manager or the Contractor may require the other to attend a management meeting. The business of a management meeting shall be to review the plans for remaining work and to deal with matters raised in accordance with the early warning procedure.

34.2 The Project Manager shall record the business of management meetings and provide copies of the record to those attending the meeting and to the Procuring Entity. The responsibility of the parties for actions to be taken shall be decided by the Project Manager either at the management meeting or after the management meeting and stated in writing to all who attended the meeting.

### 35. Early Warning

35.1 The Contractor shall warn the Project Manager at the earliest opportunity of specific likely future events or circumstances that may adversely affect the quality of the work, increase the Contract Price or delay the execution of the Works. The Project Manager may require the Contractor to provide an estimate of the expected effect of the future event or circumstance on the Contract Price and Completion Date. The estimate shall be provided by the Contractor as soon as reasonably possible.

35.2 The Contractor shall cooperate with the Project Manager in making and considering proposals for how the effect of such an event or circumstance can be avoided or reduced by anyone involved in the work and in carrying out any resulting instruction of the Project Manager.

### C. Quality Control

#### 36. Identifying Defects

36.1 The Project Manager shall check the Contractor’s work and notify the Contractor of any Defects that are found. Such checking shall not affect the Contractor’s responsibilities. The Project Manager may instruct the Contractor to search for a Defect and to uncover and test any work that the Project Manager considers may have a Defect.

#### 37. Tests

37.1 If the Project Manager instructs the Contractor to carry out a test not specified in the Specification to check whether any work has a Defect and the test shows that it does, the Contractor shall pay for the test and any samples. If there is no Defect, the test shall be a Compensation Event.

#### 38. Correction of Defects

38.1 The Project Manager shall give notice to the Contractor of any Defects before the end of the Defects Liability Period, which begins at Completion, and is defined in the Contract Data Sheet. The Defects Liability Period shall be extended for as long as Defects remain to be corrected.
38.2 Every time notice of a Defect is given, the Contractor shall correct the notified Defect within the length of time specified by the Project Manager’s notice.

38.3 If the Contractor has not corrected a defect within the time specified in the Procuring Entity’s notice, a penalty for lack of performance will be paid by the Contractor. The amount to be paid will be calculated as a percentage of the cost of having the defect correct, assessed as described in Clause 39.

39. Uncorrected Defects

39.1 If the Contractor has not corrected a Defect within the time specified in the Project Manager’s notice, the Project Manager will assess the cost of having the Defect corrected, and the Contractor will pay this amount.

D. Cost Control

40. Bill of Quantities

40.1 The Bill of Quantities shall contain items for the construction, installation, testing, and commissioning work to be done by the Contractor.

40.2 The Bill of Quantities is used to calculate the Contract Price. The Contractor shall be paid for the quantity of the work done at the rate in the Bill of Quantities for each item.

41. Changes in the Quantities

41.1 If the final quantity of the work done differs from the quantity in the Bill of Quantities for the particular item by more than 25 percent, provided the change exceeds 1 percent of the Initial Contract Price, the Project Manager shall adjust the rate to allow for the change.

41.2 The Project Manager shall not adjust rates from changes in quantities if thereby the Initial Contract Price is exceeded by more than 15 percent, except with the prior approval of the Procuring Entity.

41.3 If requested by the Project Manager, the Contractor shall provide the Project Manager with a detailed cost breakdown of any rate in the Bill of Quantities.

42. Variations

42.1 All Variations shall be included in the updated Programmes produced by the Contractor.

43. Payments for Variations

43.1 The Contractor shall provide the Project Manager with a quotation for carrying out the Variation when requested to do so by the Project Manager. The Project Manager shall assess the quotation, which shall be given within seven days of the request or within any longer period stated by the Project Manager and before the Variation is ordered.

43.2 If the work in the Variation corresponds with an item description in the Bill of Quantities and if, in the opinion of the Project Manager, the quantity of work is above the limit stated in Sub-Clause 41.1 or the timing of its execution do not cause the cost per unit of quantity to change, the rate in the Bill of Quantities shall be used to calculate the value of the Variation.
If the cost per unit of quantity changes, or if the nature or timing of the work in the Variation does not correspond with items in the Bill of Quantities, the quotation by the Contractor shall be in the form of new rates for the relevant items of work.

43.3 If the Contractor’s quotation is unreasonable, the Project Manager may order the Variation and make a change to the Contract Price, which shall be based on the Project Manager’s own forecast of the effects of the Variation on the Contractor’s costs.

43.4 If the Project Manager decides that the urgency of varying the work would prevent a quotation being given and considered without delaying the work, no quotation shall be given and the Variation shall be treated as a Compensation Event.

43.5 The Contractor shall not be entitled to additional payment for costs that could have been avoided by giving early warning.

44. Cash Flow Forecasts

44.1 When the Programme is updated, the Contractor shall provide the Project Manager with an updated cash flow forecast. The cash flow forecast shall include different currencies, as defined in the Contract, converted as necessary using the Contract exchange rates.

45. Payment Certificates

45.1 The Contractor shall submit to the Project Manager monthly statements of the estimated value of the work executed less the cumulative amount certified previously.

45.2 The Project Manager shall check the Contractor’s monthly statement and certify the amount to be paid to the Contractor within twenty eight 28 days of receipt of the certificate from the contractor.

45.3 The value of work executed shall be determined by the Project Manager.

45.4 The value of work executed shall comprise the value of the quantities of the items in the Bill of Quantities completed.

45.5 The value of work executed shall include the valuation of Variations and Compensation Events.

45.6 The Project Manager may exclude any item certified in a previous certificate or reduce the proportion of any item previously certified in any certificate in the light of later information.

45.7 The Project Manager shall not be bound to certify any payment, if the net amount, after all retentions and deductions would be less than minimum amount of Interim Payment Certificate stated in the Contract Data Sheet.

46. Payments

46.1 Payments shall be adjusted for deductions for advance payments and retention. The Procuring Entity shall pay the Contractor the amounts certified by the Project Manager within 28 days of the date of each certificate. If the Procuring Entity makes a late
payment, the Contractor shall be paid interest on the late payment in the next payment. Interest shall be calculated from the date by which the payment should have been made up to the date when the late payment is made at the prevailing rate of interest for commercial borrowing for each of the currencies in which payments are made as indicated in the Contract Data Sheet.

46.2 If an amount certified is increased in a later certificate or as a result of an award by the Adjudicator or an Arbitrator, the Contractor shall be paid interest upon the delayed payment as set out in this clause. Interest shall be calculated from the date upon which the increased amount would have been certified in the absence of dispute.

46.3 Unless otherwise stated, all payments and deductions will be paid or charged in the proportions of currencies comprising the Contract Price.

46.4 Items of the Works for which no rate or price has been entered in will not be paid for by the Procuring Entity and shall be deemed covered by other rates and prices in the Contract.

47. Compensation Events

47.1 The following shall be Compensation Events:

(a) The Procuring Entity does not give access to a part of the Site by the Site Possession Date stated in the Contract Data Sheet.

(b) The Procuring Entity modifies the Schedule of Other Contractors in a way that affects the work of the Contractor under the Contract.

(c) The Project Manager orders a delay or does not issue Drawings, Specifications, or instructions required for execution of the Works on time.

(d) The Project Manager instructs the Contractor to uncover or to carry out additional tests upon work, which is then found to have no Defects.

(e) The Project Manager unreasonably does not approve a subcontract to be let.

(f) Ground conditions are substantially more adverse than could reasonably have been assumed before issuance of the Letter of Acceptance from the information issued to Tenderers (including the Site Investigation Reports), from information available publicly and from a visual inspection of the Site.

(g) The Project Manager gives an instruction for dealing with an unforeseen condition, caused by the Procuring Entity, or additional work required for safety or other reasons.

(h) Other contractors, public authorities, utilities, or the Procuring Entity does not work within the dates and other
constraints stated in the Contract, and they cause delay or extra cost to the Contractor.

(i) The advance payment is delayed.

(j) The effects on the Contractor of any of the Procuring Entity’s Risks.

(k) The Project Manager unreasonably delays issuing a Certificate of Completion.

(l) Other Compensation Events described in the Contract or determined by the Project Manager shall apply.

47.2 If a Compensation Event would cause additional cost or would prevent the work being completed before the Intended Completion Date, the Contract Price shall be increased and/or the Intended Completion Date shall be extended. The Project Manager shall decide whether and by how much the Contract Price shall be increased and whether and by how much the Intended Completion Date shall be extended.

47.3 As soon as information demonstrating the effect of each Compensation Event upon the Contractor’s forecast cost has been provided by the Contractor, it shall be assessed by the Project Manager, and the Contract Price shall be adjusted accordingly. If the Contractor’s forecast is deemed unreasonable, the Project Manager shall adjust the Contract Price based on the Project Manager’s own forecast. The Project Manager will assume that the Contractor will react competently and promptly to the event.

47.4 The Contractor shall not be entitled to compensation to the extent that the Procuring Entity’s interests are adversely affected by the Contractor’s not having given early warning or not having cooperated with the Project Manager.

48. Taxes

48.1 The Project Manager shall adjust the Contract Price if taxes, duties, and other levies are changed between the date 28 days before the submission of Tenders for the Contract and the date of the last Completion certificate. The adjustment shall be the change in the amount of tax payable by the Contractor, provided such changes are not already reflected in the Contract Price or are a result of Clause 50.

49. Currencies

49.1 Where payments are made in currencies other than the Kenya Shillings, the exchange rates used for calculating the amounts to be paid shall be the exchange rates stated in the Contractor’s Tender.

50. Price Adjustment

50.1 The amounts payable to the Contractor, in various currencies pursuant to Sub-Clause 45.1, shall be adjusted in respect of the rise or fall in the cost of labour, Contractor’s Equipment, Plant, materials, and other inputs to the Works, by applying to such amounts the formulae prescribed in this clause based on the prevailing consumer price index obtained from the Central
Bureau of Statistics or the monthly inflation rate issued by the Central Bank of Kenya.

50.2 To the extent that full compensation for any rise or fall in costs to the Contractor is not covered by the provisions of this or other clauses in the Contract, the unit rates and prices included in the Contract shall be deemed to include amounts to cover the contingency of such other rise or fall of costs.

50.3 The adjustment to be applied to amount payable to the Contractor as certified in Payment Certificates shall be determined 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 as follows:

\[ P_n = a + b \frac{L_n - L_o}{L_o} + c \frac{M_n - M_o}{M_o} + d \frac{E_n - E_o}{E_o} + \text{etc.} \]

where;

- \( P_n \) is a price adjustment factor to be applied to the amount in each specific currency for the payment of the work carried out in the subject month, where such variations and day work are not otherwise subject to adjustment;

- \( a \) is a constant, specified in the Appendix to Tender, representing the nonadjustable portion in contractual payments;

- \( b, c, d, \text{etc.} \) are weightings or coefficients representing the estimated proportion of each cost element (labour, materials, equipment usage, etc.) in the Works or sections thereof, net of Provisional Sums, as specified in the Appendix to Tender; the sum of \( a, b, c, d, \text{etc.} \) shall be one;

- \( L_n, M_n, E_n, \text{etc.} \) are the current cost indices or reference prices of the cost elements in the specific currency of origin for month “\( n \)”, determined pursuant to Sub-Clause 50.5, applicable to each cost element; and

- \( L_o, M_o, E_o, \text{etc.} \) are the base cost indices or reference prices corresponding to the above cost elements at the date specified in Sub-Clause 50.5

The value of net work done, certified by the Project Manager, in any monthly Interim or Final Certificate as payable by the Procuring Entity to the Contractor before deduction of any retention money shall be increased or decreased by an amount of ‘\( F \)’.

\[ F = P_n \times P_c \]

where;

The effective value \( P_c \) of work done which is to be subjected to increase or decrease shall be the difference between:
(i) the amount which, in the opinion of the Project Manager, is due to the Contractor under Clause 45 (before deduction of retention money and before deducting sums previously paid on account) less:

- any amount for payment or repayment of any advance payment;
- any amount for materials on site (if any);
- any amounts for nominated sub-contractors (if any)
- any amounts for any other items based on actual cost or current prices; or
- any sums for increase or decreases in the Contract Price paid under this Sub-Clause

and

(ii) the amount calculated in accordance with (i) above of this Sub-clause and included in the last preceding statement.

50.4 The sources of indices shall be those listed in the Appendix to Tender, as approved by the Engineer. Indices shall be appropriate for their purpose and shall relate to the Contractor’s proposed source of supply of inputs on the basis of which his Contract Price and expected foreign currency requirements shall have been computed. As the proposed basis for price adjustment, the Contractor shall have submitted with his Tender the tabulation of Weightings and Source of Indices in the Appendix to Tender, which shall be subject to approval by the Engineer.

50.5 The base cost indices or prices shall be those prevailing on the day 28 days prior to the latest date for submission of Tenders. Current indices or prices shall be those prevailing on the day 28 days prior to the last day of the period to which a particular Interim Payment Certificate is related. If at any time the current indices are not available, provisional indices as determined by the Engineer will be used, subject to subsequent correction of the amounts paid to the Contractor when the current indices become available.

50.6 If the Contractor fails to complete the Works within the time for completion prescribed under Clause 58 adjustment of prices thereafter until the date of completion of the Works shall be made using either the indices or prices relating to the prescribed time for completion, or the current indices or prices, whichever is more favourable to the Procuring Entity, provided that if an extension of time is granted pursuant to Clause 28, the above provision shall apply only to adjustments made after the expiry of such extension of time.

50.7 The weightings for each of the factors of cost given in the Appendix to Tender shall be adjusted if, in the opinion of the Engineer, they have been rendered unreasonable, unbalanced, or inapplicable as a result of varied or additional work already executed or instructed under Clause 43 or for any other reason.

51. Retention

51.1 The Procuring Entity shall retain from each payment due to the
Contractor the proportion stated in the Contract Data Sheet until Completion of the whole of the Works.

51.2 On completion of the whole of the Works, half the total amount retained shall be repaid to the Contractor and the other half when the Defects Liability Period has passed and the Project Manager has certified that all Defects notified by the Project Manager to the Contractor before the end of this period have been corrected.

51.3 On completion of the whole Works, the Contractor may substitute retention money with an “on demand” Bank guarantee.

52. Liquidated Damages

52.1 The Contractor shall pay liquidated damages to the Procuring Entity at the rate per day stated in the Contract Data Sheet for each day that the Completion Date is later than the Intended Completion Date. The total amount of liquidated damages shall not exceed the amount defined in the Contract Data Sheet. The Procuring Entity may deduct liquidated damages from payments due to the Contractor. Payment of liquidated damages shall not affect the Contractor’s liabilities.

52.2 If the Intended Completion Date is extended after liquidated damages have been paid, the Project Manager shall correct any overpayment of liquidated damages by the Contractor by adjusting the next payment certificate. The Contractor shall be paid interest on the overpayment, calculated from the date of payment to the date of repayment, at the rates specified in Sub-Clause 46.1.

52.3 If the Contractor has not corrected a defects within the time specified in the Procuring Entity’s notice, the Procuring Entity will assess the cost of having the defect corrected, the Contractor will pay this amount, and a penalty for lack of performance calculated as described in Clause 38.

53. Bonus

53.1 The Contractor shall be paid a Bonus calculated at the rate per calendar day stated in the Contract Data Sheet for each day (less any days for which the Contractor is paid for acceleration) that the Completion is earlier than the Intended Completion Date. The Project Manager shall certify that the Works are complete, although they may not be due to be complete.

54. Advance Payment

54.1 The Procuring Entity shall make advance payment to the Contractor of the amounts stated in the Contract Data Sheet by the date stated in the Contract Data Sheet, against provision by the Contractor of an Unconditional Bank Guarantee in a form and by a bank acceptable to the Procuring Entity in amounts and currencies equal to the advance payment. The Guarantee shall remain effective until the advance payment has been repaid, but the amount of the Guarantee shall be progressively reduced by the amounts repaid by the Contractor. Interest will not be charged on the advance payment.

54.2 The Contractor is to use the advance payment only to pay for
Equipment, Plant, Materials, and mobilization expenses required specifically for execution of the Contract. The Contractor shall demonstrate that advance payment has been used in this way by supplying copies of invoices or other documents to the Project Manager.

54.3 The advance payment shall be repaid by deducting proportionate amounts from payments otherwise due to the Contractor, following the schedule of completed percentages of the Works on a payment basis. No account shall be taken of the advance payment or its repayment in assessing valuations of work done, Variations, price adjustments, Compensation Events, Bonuses, or Liquidated Damages.

55. Performance Securities

55.1 The Performance Security shall be provided to the Procuring Entity no later than the date specified in the Letter of Acceptance and shall be issued in an amount and form and by a bank or surety acceptable to the Procuring Entity, and denominated in the types and proportions of the currencies in which the Contract Price is payable. The Performance Security shall be valid until a date 28 days from the date of issue of the Certificate of Completion in the case of a Bank Guarantee, and until one year from the date of issue of the Completion Certificate in the case of a Performance Bond.

56. Day works

57. 56.1 If applicable, the Day works rates in the Contractor’s Tender shall be used for small additional amounts of work only when the Project Manager has given written instructions in advance for additional work to be paid for in that way.

58. 56.2 All work to be paid for as Day works shall be recorded by the Contractor on forms approved by the Project Manager. Each completed form shall be verified and signed by the Project Manager within two days of the work being done.

59. 56.3 The Contractor shall be paid for Day works subject to obtaining signed Day works forms.

60. Cost of Repairs

57.1 Loss or damage to the Works or Materials to be incorporated in the Works between the Start Date and the end of the Defects Correction periods shall be remedied by the Contractor at the Contractor’s cost if the loss or damage arises from the Contractor’s acts or omissions.

E. Finishing the Contract

61. Completion Certificate

58.1 The Contractor shall request the Project Manager to issue a certificate of Completion of the Works, and the Project Manager will do so upon deciding that the work is completed.

62. Taking Over

59.1 The Procuring Entity shall take over the Site and the Works within seven days of the Project Manager’s issuing a certificate of Completion.
63. Final Account

60.1 The Contractor shall supply the Project Manager with a detailed account of the total amount that the Contractor considers payable under the Contract before the end of the Defects Liability Period. The Project Manager shall issue a Defects Liability Certificate and certify any final payment that is due to the Contractor within 56 days of receiving the Contractor’s account if it is correct and complete. If it is not, the Project Manager shall issue within 56 days a schedule that states the scope of the corrections or additions that are necessary. If the Final Account is still unsatisfactory after it has been resubmitted, the Project Manager shall decide on the amount payable to the Contractor and issue a payment certificate.

64. Operating and Maintenance Manuals

61.1 If “as built” Drawings and/or operating and maintenance manuals are required, the Contractor shall supply them by the dates stated in the Contract Data Sheet.

61.2 If the Contractor does not supply the Drawings and/or manuals by the dates stated in the Contract Data Sheet, or they do not receive the Project Manager’s approval, the Project Manager shall withhold the amount stated in the Contract Data Sheet from payments due to the Contractor.

65. Termination

62.1 The Procuring Entity or the Contractor may terminate the Contract if the other party causes a fundamental breach of the Contract.

62.2 Fundamental breaches of Contract shall include, but shall not be limited to, the following:

(a) The Contractor stops work for 28 days when no stoppage of work is shown on the current Programme and the stoppage has not been authorized by the Project Manager;

(b) The Project Manager instructs the Contractor to delay the progress of the Works, and the instruction is not withdrawn within 28 days;

(c) The Procuring Entity or the Contractor is made bankrupt or goes into liquidation other than for a reconstruction or amalgamation;

(d) A payment certified by the Project Manager is not paid by the Procuring Entity to the Contractor within 84 days of the date of the Project Manager’s certificate;

(e) The Project Manager gives Notice that failure to correct a particular Defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Project Manager;

(f) The Contractor does not maintain a Security, which is required; and

(g) The Contractor has delayed the completion of the Works by the number of days for which the maximum amount of liquidated damages can be paid, as defined in the Contract.
Data Sheet.

(h) If the Contractor, in the judgment of the Procuring Entity has engaged in corrupt or fraudulent practices in competing for or in executing the Contract.

For the purpose of this paragraph:

“corrupt practice” means the offering, giving, receiving or soliciting of anything of value to influence the action of a public official in the procurement process or in contract execution and includes inter alia, bribery and extortion or coercion which involves threats of injury to person, property or reputation, and.

“fraudulent practice” means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Procuring Entity, and includes collusive practice among Tenderers (prior to or after Tender submission) designed to establish Tender prices at artificial non-competitive levels and to deprive the Procuring Entity of the benefits of free and open competition.

62.3 When either party to the Contract gives notice of a breach of Contract to the Project Manager for a cause other than those listed under Sub-Clause 62.2 above, the Project Manager shall decide whether the breach is fundamental or not.

62.4 Notwithstanding the above, the Procuring Entity may terminate the Contract for convenience.

62.5 If the Contract is terminated, the Contractor shall stop work immediately, make the Site safe and secure, and leave the Site as soon as reasonably possible.

66. Payment upon Termination

63.1 If the Contract is terminated because of a fundamental breach of Contract by the Contractor, the Project Manager shall issue a certificate for the value of the work done and Materials ordered less advance payments received up to the date of the issue of the certificate and less the percentage to apply to the value of the work not completed, as indicated in the Contract Data Sheet. Additional Liquidated Damages shall not apply. If the total amount due to the Procuring Entity exceeds any payment due to the Contractor, the difference shall be a debt payable to the Procuring Entity.

63.2 If the Contract is terminated for the Procuring Entity’s convenience or because of a fundamental breach of Contract by the Procuring Entity, the Project Manager shall issue a certificate for the value of the work done, Materials ordered, the reasonable cost of removal of Equipment, repatriation of the Contractor’s personnel employed solely on the Works, and the Contractor’s costs of protecting and securing the Works, and less advance payments received up to the date of the certificate.
67. Property

64.1 All Materials on the Site, Plant, Equipment, Temporary Works, and Works shall be deemed to be the property of the Procuring Entity if the Contract is terminated because of the Contractor’s default.

68. Release from Performance

65.1 If the Contract is frustrated by the outbreak of war or by any other event entirely outside the control of either the Procuring Entity or the Contractor, the Project Manager shall certify that the Contract has been frustrated. The Contractor shall make the Site safe and stop work as quickly as possible after receiving this certificate and shall be paid for all work carried out before receiving it and for any work carried out afterwards to which a commitment was made.

69. Suspension of Financing

66.1 In the event that the source of financing is suspended to the Procuring Entity, from which part of the payments to the Contractor are being made:

(a) The Procuring Entity is obligated to notify the Contractor of such suspension within 7 days of having received the financing agency’s suspension notice.

(b) If the Contractor has not received sums due it within the 28 days for payment provided for in Sub-Clause 46.1, the Contractor may immediately issue a 14-day termination notice.
SECTION V: CONTRACT DATA SHEET (CDS)
## Contract Data Sheet

### Instructions for completing the Contract Data Sheet

<table>
<thead>
<tr>
<th>CDS Clause</th>
<th>GCC Clause</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.1</td>
<td>A. General</td>
</tr>
</tbody>
</table>

(Itemise Definitions to take the same numbering as per the General Conditions)

The Procuring Entity is *Rift Valley Water Services Board, P.O. Box 2451-20100, Nakuru.*

Authorised Representative: *Chief Executive Officer,*

The Adjudicator is *Person appointed by Chairman IEK*

The Defects Liability Period is *365(Three hundred and sixty five) days.***

The Project Manager is *Chief Executive Officer,* *Rift Valley Water Services Board, P.O. Box 2451-20100, Nakuru.*

The name and identification number of the Contract is

**Name:** *MilimaTatu water supply Project*

**Tender Number:** *RVWSB/MLM-TAT/EQ/2017-2018*

The Works consist of:

- Purchasing and laying of HDPE 2” Rolls pipe (100mm length)
- Purchasing, installing and testing submersible pump of 8m3/hr against a head of 115m
- Purchasing, installing and testing Genset to supply power to the submersible pump
- Purchasing, installing and testing lorentzPS7K2 controller for controlling the pumping system monitoring of the operating state and incorporates the following alarm functions, overcurrent, under voltage, over speed, over temperature, reverse polarity and low water.
- Purchasing, installing and testing solar modules:125W, 12 V Multi-crystalline PV Solar modules to provide a maximum of 900W output and a serve capacity over the rated power requirements of the pump of 7500W.
- Purchasing, installing and testing solar system accessories and installation sundries to meet the pump requirement
The objective of the contract is to improve on efficiency and reliability of the water supply in MilimaTatu area.

The Start Date shall be **22nd October, 2017**

The Intended Completion Date for the whole of the Works shall be **22nd January, 2018**

The following documents also form part of the Contract:
- **Notification of award**
- **Letter of acceptance**
- **Work programme**
- **Performance bond**
- **General conditions of contract**
- **Specifications**
- **Priced bill of quantities**

The Site is located in **MilimaTatu in Turkana North Sub-County**

| 2. | 2.2 | Indicate whether there is sectional completion: **N/A** |
| 3. | 2.3(9) | List other documents that form part of the contract if any: |
| 4. | 3.1 | The language of the Contract documents is **English**. The law that applies to the Contract is the Kenyan Law. |
| 5. | 9.1 | Include the Schedule of Other Contractors, if any. |
| 6. | 10.1 | Include the Schedule of Key Personnel: Refer to Tender Datasheet TDS Reference No. 17 |
| 7. | 14.1 | The minimum insurance covers shall be: |
| | | (a) loss of or damage to the Works, Plant, and Materials: **As per the relevant laws of the Republic of Kenya** |
| | | (b) loss of or damage to Equipment: **As per the relevant laws of the Republic of Kenya** |
| | | (c) loss of or damage to property (except the Works, Plant, Materials, and Equipment) in connection with the Contract: **As per the relevant laws of the Republic of Kenya** and |
| | | (d) personal injury or death: **As per the relevant laws of the Republic of Kenya** |
| 8. | 15.1 | Site Investigation Reports available to the Tenderers are: |
| | a) | None |
| | b) | None |
| | c) | None |
The other measures include:

a. Minimising the number of migrant workers employed on the project and household in the site camp

b. Providing access to voluntary counselling and testing (VCT)

c. Providing psychological support and health care including prevention and treatment of opportunistic infections for workers infected and affected, as well as their families

d. Providing condoms (male and female) to workers

| 10. | 24.1 & 47.1 | The Site Possession Date shall be \textit{at least} \textit{seven days after signing the contract} |

| 11. | 28.2 | Hourly rate of Fees payable to the Adjudicator is: \ldots \ldots \ldots [insert hourly fee in KShs..]

Types of reimbursable expenses to be paid to the Adjudicator include: [insert types of reimbursable expenses].

a) \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldOTS(a)\ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldOTS(b)\ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldOTS(c)\ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldOTS

12. 28.3 Arbitration will take place at \textit{Nakuru} in accordance with rules and regulations published by \ldots \ldots \ldots [state the institutions] and [insert rules and regulations]

13. 29.1 Appointing Authority for the Adjudicator: \textit{Chairman IEK}

B. Time Control

14. 30.1 The Contractor shall Submit a Programme for the Works within \textit{three} \textit{days} \textit{of} delivery of the Letter of Acceptance.

15. 30.3 The period between Programme updates is \textit{seven} \textit{days}.

16. 30.3 The amount to be withheld by the Project Manager in the case the contractor does not submit an updated programme is: \textit{Kshs. 10,000} \textit{(Ten thousand Kenya shillings)}.

C. Quality Control

17. 38.1 The Defects Liability Period is \textit{365} \textit{(Three hundred and sixty five days)}

D. Cost Control

18. 45.7 Minimum Amount of Interim Payment Certificate will be \textit{minimum} \textit{50\% of the contract sum}

19. 46.1 The interest rate shall be \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldOTS

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for commercial borrowing from the contractors bank

<p>| | | |</p>
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<thead>
<tr>
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<tbody>
<tr>
<td>20.</td>
<td>47.1(a)</td>
<td>The Site Possession Date shall be 7(seven) days after signing the contract</td>
</tr>
<tr>
<td>21.</td>
<td>50</td>
<td>The contract <em>is not</em> subject to price adjustment in accordance with Clause 50 of the General Conditions of Contract.</td>
</tr>
<tr>
<td>22.</td>
<td>51.1</td>
<td>The amount of retention is <em>10%</em> of value of works of Interim Payment Certificate’.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Limit of retention will be <em>10%</em> of contract price.</td>
</tr>
<tr>
<td>23.</td>
<td>52.1</td>
<td>The rate of liquidated damages is <em>0.15%</em> of the contract price per day</td>
</tr>
<tr>
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<td>52.1 62.2 (g)</td>
<td>The maximum amount of liquidated damages is <em>5% of the contract price</em></td>
</tr>
<tr>
<td>24.</td>
<td>53.1</td>
<td>The bonus for early completion is : <em>N/A</em>.</td>
</tr>
<tr>
<td>25.</td>
<td>54.1</td>
<td>The amount of advance payment shall be <em>10%</em> of the contract sum payable within 10 (ten) days upon the Contractor availing the Unconditional Bank Guarantee as per Clause 54 GCC.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Recovery of Advance Payment: <em>Not Applicable</em></td>
</tr>
<tr>
<td>26.</td>
<td>55.1</td>
<td>The Performance Security shall be <em>10%(Ten)percent of the contract price</em>.</td>
</tr>
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<td></td>
<td></td>
<td><strong>E. Finishing the Contract</strong></td>
</tr>
<tr>
<td>27.</td>
<td>61.1</td>
<td>As built drawings shall be supplied by the contractor by <em>N/A</em> days after handing over of the works.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operating manual shall be supplied by the contractor by: <em>The same date as any equipment is supplied by the contractor</em></td>
</tr>
<tr>
<td>28.</td>
<td>61.2</td>
<td>The amount to be withheld by the Project Manager in the case the contractor does not submit as built drawings is: <em>N/A</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The amount to be withheld by the Project Manager in the case the contractor does not submit operating manual is: <em>Kshs.50,000</em></td>
</tr>
<tr>
<td>29.</td>
<td>63.1</td>
<td>The percentage to apply to the value of the work not completed, representing the Procuring Entity's additional cost for completing the Works, is <em>10%</em>.</td>
</tr>
</tbody>
</table>
SECTION VI: TECHNICAL SPECIFICATIONS
1.0 GENERAL WORKS SPECIFICATIONS

1.1 General

All materials, equipment and testing apparatus etc. to be furnished and Works to be executed by the Contractor in this Contract shall conform to the requirements of the latest Kenya Standards, International Standards Organization (ISO) Standards, DIN, British Standards (BS) or other approved applicable Standard in Kenya, unless otherwise specifically stated.

Equipment to be purchased shall be from well recognized manufacturers whose products are standardized and controlled by any recognized Standards Organization.

All dimensions and measurement units shall be in S.I. units unless stated otherwise.

The Contractor may propose to the Engineer an alternative Standard other than specified, in which case he shall submit six (6) copies of the English translation of the proposed Standard and all other information for the materials, equipment and testing, together with written proof from a recognized Standards Organization that the proposed Standard is equivalent in all significant respects to the Standard specified.

The equipment to be employed by the Contractor shall have sufficient performance capacity and durability as to secure the completion of the Works within the construction period stipulated under the Contract. All materials and equipment shall be subject to inspections or tests by the Engineer at any time and in any state of completion both off-site and on-site as he deems necessary. The Contractor shall furnish promptly, without additional charge, all facilities, labor and materials reasonably needed for performing such inspections and tests as may be required by the Engineer.

The Contractor shall make diligent efforts to procure the specified materials, but when the materials specified are unavailable, for reasons beyond the control of the Contractor, substitutes may be used with prior written approval of the Engineer.

1.2 Office for Contractor

The Contractor shall have an office on the site to be approved by the PM REP and which shall be open and attended to at all hours during which work is in progress.

Notwithstanding anything contained in Clause 6.1 of the General Conditions of Contract, any notice to be given to or served upon the Contractor shall be deemed and taken to be efficiently given or served by the delivery thereof at such office on the site.

1.3. Protection of works

The Contractor shall carefully protect from injury by weather all work and materials which may be affected thereby.

1.4 Damage to land

Except where specified for the proper execution of the Works, the Contractor shall not interfere with any fence, hedge, tree, land or crops within, upon or forming the boundary of the site or elsewhere. In the event of such interference, the Contractor
shall make good to the satisfaction of the owner and the Engineer and shall pay to the owner such damages as the Engineer may determine.

1.5 Rivers and drains
The Contractor shall at all times maintain the free flow of rivers and drains and prevent excavated material from the Works from being deposited in them.

1.6 Services
Before commencing Works which include excavation or ground levelling by manual or mechanical excavation the Contractor shall at his own expenses ascertain in writing from Telkom Kenya, Kenya Power & Lighting Co. Ltd. and all other Public Bodies, Companies and persons who may be affected, the position and depth of their respective ducts, cables, mains, pipes, or other appurtenances. He shall thereupon search for and locate such services.

The Contractor shall at his own expense arrange to have effectually propped, protected, underpinned, altered, diverted, restored and made as may be necessary, all water courses, pipes, cables or ducts, poles or wires or their appurtenances disturbed or damaged during the progress of the Works, or in consequence thereof.

Except that such services as require to be removed or altered by virtue of the layout of the permanent work and not the manner in which the work is carried out, shall be so removed or altered at the direction and at the expense of the Employer.

The Contractor shall be liable for the cost of repairs to any services damaged as a result of carrying out the Works and execution of these Works.

1.7 Privately owned or public services
If any privately owned or public services passing through the site will be affected by the Works, the Contractor shall provide at his own expense a satisfactory alternative service in full working order to the satisfaction of the owner of the services and the PM REP, before the cutting of the existing service. Any damage to private or public services shall be made good by the Contractor at his cost.

In case the remedial work is not executed promptly by the Contractor, the PM REP may make alternative arrangements for the execution of the work and debit the costs to the Contractor.

1.8 Water supply
The Contractor shall provide for all purposes of the work, an adequate supply of water from a suitable source or sources approved by the PM REP. He must pay the water charges, if any, and make arrangements for supply, transport and distribution.

1.9 Additional land
The Contractor shall select and arrange at his own expenses for any temporary occupation of land outside the site which he requires for the efficient execution of the
Works. The Contractor must comply fully with all By-laws and Regulations currently in force in the area.

1.10 Use of heavy plant

In the event of the Contractor desiring to use heavy machinery or plant, he shall first satisfy the Engineer that they will be of such size and used in such a manner as not to cause any disturbance or damage in particular to water, electricity, Post Office or other mains, cables and connections or to sewers, culverts etc. or interfere with the line or position of any overhead wires and cables of any sort, telegraph poles, power poles etc.

The Contractor will be held liable for any such damage or disturbance and shall pay the full costs of any reinstatement, relaying, repairing or refixing as may be required, as agreed between the Engineer and the owner affected.

1.11 Provision of instruments and labour

The Contractor shall provide at his own expenses all instruments, materials, tools and other things which the Project Manager considers necessary for his proper supervision of the Works and shall maintain the same in good order. He shall also provide materials, an experienced Surveyor and labour for attendance on the PM REP and his representatives in carrying out operations connected with the supervision of the Works. All charges arising out of such services shall be deemed to be included in his rates in the Bill of Quantities.

1.12 Access to sites

The Contractor shall construct and maintain all temporary accesses required for the execution of the Works. Access roads shall be constructed and maintained. The cost of all these Works shall be deemed to be covered by rates and prices quoted by the Contractor.

1.13 Pollution

The Contractor shall ensure that during the course of his operations no pollution of the atmosphere, rivers, reservoir catchment areas or groundwater is allowed to take place.

1.14 Tree protection

Trees within the permanent and temporary easement are the property of owners. Specific trees will be identified by the Engineer, prior to construction, and the Contractor shall neither remove nor cut their roots unless otherwise directed by the PM REP. If the roots of such trees appear within the trench areas, the Contractor shall handle the roots with maximum care so that no portion of the roots will be damaged. During the excavation of the trench, the exposed roots may be removed to a position that will not damage the roots and will not interfere with the pipe laying. During the construction, the roots shall be thoroughly protected by appropriate cover and wetted.
as directed. After the pipes are laid, the moved roots shall be placed back to the original locations and backfilled carefully by selected soft soil which can support vegetation.

1.15 Watching, fencing and lighting

The Contractor shall arrange to employ watchmen to guard the Works both during the day and night from the commencement of the Works until the substantial completion of the Works.

Any excavation or other obstruction likely to cause injury or damage to any person or domestic animals must be fenced off as directed by the Engineer.

1.16 Tips

The Contractor shall be responsible for provision of all tips, at his own expense, for disposal of all spoil or other rubbish collected during the construction of the Works. Any surplus excavated material not required shall also be carted away to these tips. The site of the tips must be approved by the Engineer.

1.17 Tropicalization

In choosing materials and their finishes, due regard shall be given to the tropical conditions of the site to which they will be subjected. The Contractor shall submit details of his practices which have proven satisfactory and which he recommends for application on the parts of the Works which may be affected by the tropical conditions.

1.18 Progress meetings

Throughout the project period, progress meetings will be held to discuss the progress of the work, schedule for the ensuing month, methods of construction, procurement, transportation, labours, etc. These meetings can be called at any time intervals at the request of the Contractor or as directed by the Project Manager.

1.19 Inspection by Engineer during defects liability period

The Engineer will give the Contractor due notice of his intention to carry out inspection during the Defects Liability Period and the Contractor shall upon receipt of such notice arrange for a responsible representative to be present at the times and dates named by the PM REP. This representative shall render all necessary assistance and take notice of all matters and things to which his attention is directed by the Engineer.

1.20 Submission of samples

Before incorporating in the finished work any materials or articles which he supplies under the terms of the Contract, the Contractor shall submit to the PM’s Representative for his approval a sample of each respective material or article, and such samples shall be delivered to and kept at his office for reference. All the respective kinds of materials and articles used in and upon the Works, shall be at least equal in quality to the approved samples. Each and every sample shall be a fair
average of the bulk material or of the article which it represents. The Engineer’s Representative may decide the method by which each sample to be taken from the bulk material shall be obtained.

1.21 Responsibility for ordering materials and manufactured articles and samples for testing

The responsibility for so ordering and delivering materials and manufactured articles and samples that they may be tested sufficiently far in advance of the work as not to delay it, shall rest upon the Contractor, and he shall not be entitled to any time credit for delay occasioned by his neglect to order sufficiently well in advance or to effect payment of any costs he may incur as a result thereof.

With regard to any item in the Bill of Quantities which is the subject of a P.C. Sum, the Contractor shall notify the Engineer of his requirements as early as possible leaving ample time for the Engineer to make any necessary arrangements so that no delay occurs in the progress of the work.

1.22 Tests of materials and manufactured articles before use

Any or all of the materials and manufactured articles supplied by the Contractor for use on any of the Works throughout this Contract shall be subject in advance to tests as may be specified in the relevant Standard Specification as may from time to time be deemed necessary by the Engineer. Samples of all such materials and manufactured articles, together with all the necessary labor, materials, plant and apparatus for sampling and for carrying out of tests on the site on all such materials and manufactured articles shall be supplied by the Contractor at his own expenses. The cost of special tests ordered by the Engineer to be carried out by an independent person at a place other than the site or place of manufacture or fabrication shall be borne by the Contractor.

1.23 Rejected materials

Should any material or manufactured articles be brought on to the site of the Works which are in the judgment of the Engineer unsound or of inferior quality or in any way unsuited for the work in which it is proposed to employ them, such materials or manufactured articles shall not be used upon the Works but shall be branded if, in the opinion of the Engineer, this is necessary and shall forthwith be removed from the site of the Works, all at the Contractor’s expense and in each case as the Engineer shall direct.

1.24 Quality of materials and workmanship

The materials and workmanship shall be of the best of their respective kinds and shall be to the approval of the Engineer. In the reading of this Specification the words “to the approval of the Engineer” shall be deemed to be included in the description of all materials incorporated in the Works, whether manufactured or natural and in the description of all operations for the due execution of the Works.

1.25 Construction program
The Contractor shall submit to the PM REP for approval, a revision of the Construction Program attached in four (4) copies and after approval to the Employer in two (2) copies in the following manner:

(1) Within seven (7) days after receiving the Letter of Acceptance, the Contractor shall submit to the Engineer for approval, a detailed Program based on the key date stated hereinafter or other dates which are given in the Letter of Acceptance in the form of a Critical Path Method (hereinafter referred to as CPM Network) showing the order of procedure in which he proposes to carry out the Works including design, manufacture, delivery to the site, transport, storage, survey, construction, commissioning and maintenance. This Program shall indicate clearly all activities and its duration along with the earliest and the latest event, times and the first and last dates of the submission of the Drawings and each date of shop inspection by the Engineer for the section or portion of the Works.

The Program so prepared shall be rearranged in the form of a Time Bar-chart Schedule of which size shall be 841mm x 594mm (A-1 size). This Time Bar-chart Schedule shall be submitted to the Engineer together with the CPM Network.

(2) The CPM Network shall be in accordance with commonly accepted practices and shall show graphically the chain of activities/sub-activities and their sequential relationship with each other from the start of construction to the completion of the Contract. The Time Bar-chart Schedule shown in weeks shall list all main activities and its applicable sub-activities.

(3) In preparing the CPM Network and the Time Bar-chart Schedule the Contractor shall make due allowances for possible delays. Under no circumstances shall the CPM Network or the Time Bar-chart Schedule show a completion in excess of the “Time for Completion” stated in the Form of Tender.

(4) The Program once approved by the Engineer shall thereafter be referred to as the Contractual Program. The Engineer’s approval of such Program shall not relieve the Contractor of any of his duties or responsibilities under the Contract.

1.26 Possession and use of the Site

The Contractor shall request possession of the Site from the Project Manager’s Rep when required and in accordance with his program of Works. The CLIENT shall grant possession in accordance with Sub-Clause 2.1 of the Conditions of Contract.

When the Contractor is given possession of the Site he shall be given authority to carry out the Works instructed by the Project Manager’s Rep under the Contract.

The Contractor shall not enter the Site for additional investigations or to execute the Works until he has been granted possession. If the Contractor requires to enter the Site prior to being granted possession for other reasons and the Project Manager’s Rep agrees, he shall demonstrate that he has the necessary insurances and has arranged appropriate safety measures.

During possession of the Site, or portion of the Site, the Contractor shall be responsible for providing lighting, protection and other measures to make the
temporary works, material storage, excavations, partially finished works, etc. safe for
the public and road use.

The CLIENT will arrange for the above and shall make the Site available to the
Contractor upon request.

1.27 Site Tidiness

The Contractor shall be responsible for the proper tidiness of the Site and Works and
remove rubbish and waste promptly from the Site. All materials, plant and equipment
shall also be stored or positioned in a tidy manner.

1.28 Entry on to the Site

Prior to the commencement of operations, the Project Manager’s Rep shall supply to
the Contractor the names and addresses of relevant owners and occupiers. The
Contractor shall notify the Project Manager’s Rep in writing 56 days in advance of his
intention to start work within each area of ownership or occupation.

The Contractor shall keep records of the dates of his entry on to and departure from
all property and lands of each owner and occupier, together with the dates of the
erection and removal of all enclosures, and shall furnish copies of these records when
required by the Project Manager’s Rep. He shall keep, and furnish, copies of similar
records in respect of roads, footpaths and thoroughfares.

The Contractor shall not enter or use any part of the Site for any purpose not
connected with the Works. Where the Contractor requires any facilities or temporary
occupation of land (such as changes to site boundaries or access routes) he shall make
his own arrangements with the land owners/occupiers or local authority as
appropriate.

Any special conditions concerning entry to the Site are given elsewhere in the
Contract.

1.29 Site Compound

The Contractor shall find his own site or sites for setting up one or more compounds
in which to locate his offices, workshops, stores, plant etc. The sites shall be close to
the Project Manager’s Rep’s office and the Site laboratory.

On completion of the relevant section of the Works the Contractor shall remove all his
offices, workshops, stores, plant, fencing, hard standing etc., clean up the site and
carry out other works to return the site to its original condition.

The Contractor shall also locate his own areas for collection and disposal of waste and
unwanted materials, complying with local regulations and procedures for transport
and disposal.

The Contractor shall obtain all necessary approvals of local authorities and others for
its site compound at its own cost.

1.30 Documents to be submitted to the Project Manager’s Rep
Prior to commencement of the Works the Contractor shall supply a Works Program to the Project Manager’s Rep for approval.

The Works Program to be provided under the Conditions of Contract shall be submitted in the form of a Time – Location Chart clearly indicating the phasing of all work. Plant and labor resource teams shall be listed for all operations.

The program shall be updated following any major variations or extension of time given, and when any critical operation has fallen behind its planned program by more than 10 per cent, and in any case at 91 day intervals. On a regular base, the Contractor shall supply the following documents to the Project Manager’s Rep:

Cash Flow (monthly); List of Labor and Plant (monthly).

The submission will show cash flow up to the end of the Contract. The Contractor shall also submit to the Project Manager’s Rep at the end of each calendar month, or at such other times as may be agreed, detailed schedules and reports on plant and labor on Site, divided into categories, and show separately the Contractor’s and each sub-contractor’s labor and plant. As far as the plant is concerned, the condition of each item shall be indicated in the schedules.

Construction method statements shall be prepared for the principal elements of the Works and shall be submitted to the Project Manager’s Rep for review at least 28 days prior to the programmed activity commencement.

Construction method statements shall make due allowance for all requirements and restrictions imposed by the Contract. Each method statement shall comprise a step by step schedule of specific operations or activities with description, date, times and duration of each step. The statements shall be supported by sketches, diagrams or other supportive detail as necessary to enable a clear understanding of the method and significance of each step of work or operation.

Construction method statements shall include, but not be limited to, the following topics as relevant to the particular operation:

- the method of working;
- temporary works details;
- labour resources to be used;
- construction equipment to be used;
- safety measures; and
- pedestrian, light vehicular and emergency access.

The Contractor shall prepare and submit for the Project Manager’s Rep’s approval all bar bending schedules and all drawings of temporary work.

1.31 Survey

1.31.1 Survey of roads, properties, lands and crops

Where appropriate, the Project Manager’s Rep shall arrange for surveys to be carried out, in conjunction with the Contractor and the Road Authority, owners or occupiers,
of the condition of roads, drainage structures, properties, lands and crops which may be affected by the Works.

1.31.2 Level Datum and Dimensions

All levels shall be referred to the National Datum and the Contractor shall obtain in writing from the Project Manager’s Rep the location and value of the permanent benchmarks to be used to control the works. Before the commencement of construction work the Contractor shall establish at each site in a position to the approval of the Manager’s Rep, a steel datum peg that shall be securely concreted in. The level of this peg shall be established and agreed with the Project Manager’s Rep and all levels used in the construction of the Works shall be referred to this established datum. The correctness of this established datum shall be checked at regular intervals during the construction period and agreed with the Engineer.

The levels of the ground and the levels and dimensions of existing features shown on the Drawings are believed, but are not guaranteed, to be correct. Wherever dimensions or levels are marked on the Drawings such dimensions or levels shall take precedence over dimensions scaled from the Drawings. Where no dimensions or levels are shown on the Drawings, instructions shall be obtained from the Project Manager’s Rep.

In the event of discrepancies between the Drawings and the Specification, the Drawings shall take precedence over the Specification.

1.31.3 Levels and reference points

The Contractor shall supply to the Project Manager’s Rep details of the value and location of the temporary datum and reference points which he proposes to use.

The Contractor shall satisfy himself that the existing ground levels and the levels and locations of structures as indicated in the Contract are correct. Should the Contractor wish to dispute any levels he shall submit to the Project Manager’s Rep a schedule of the position of the levels considered to be in error and a set of revised levels.

1.31.4 Setting Out of the Works

It shall be the Contractor’s responsibility to obtain from the Project Manager’s Rep before commencing the work co-ordinates and levels of setting out points, which have already been established by the Project Manager’s Rep. The Contractor shall use these to establish additional temporary bench marks as necessary throughout the project area. These shall be of a form approved by the Project Manager’s Rep and shall be maintained until the completion of works.

The Contractor shall be responsible for the setting out of the works, in accordance with the Conditions of Contract. All dimensions and levels shown on the drawings referred to in any document forming part of the Contract shall be verified by the Contractor on site. He shall be responsible for pointing out promptly any discrepancies or error in such dimensions or levels. The Contractor shall prepare detailed setting out drawings and data sheets as necessary and submit them to the Project Manager’s Rep for approval. Any modification of these drawings or data
sheets required by the Project Manager’s Rep shall be made by the Contractor and resubmitted for final approval.

1.32 Temporary fencing/ security of site

The Contractor shall be responsible for ensuring that the Site is adequately fenced. The Contractor shall do this work prior to starting work on the relevant portion of the Site. The Contractor shall regularly inspect and maintain all such fencing, any defects being made good without delay.

Access shall be provided in temporary/Site fencing as necessary for the use of the occupiers of adjacent lands. Temporary site fencing shall remain in position until either it is replaced by permanent fencing or the Works are sufficiently completed to enable that portion of the Site to be brought into use. The type and height of temporary fencing shall be to the Project Manager’s Rep’s satisfaction where not stated elsewhere in the Contract.

Where required by the Contract the Contractor shall be responsible for making the Site secure with lockable access gates and security lighting to suit local conditions.

1.33 Interference with land interests

The Contractor shall confine his constructional operations within the Site, or such other areas of land as may be negotiated, and shall instruct his employees, and those of his sub-contractors, not to trespass.

Subject to any unavoidable disturbance that may be necessitated by the execution of the Contract, the Contractor shall not interfere with any sporting, fishing or other rights that may be enjoyed on or near the site.

Before exercising any right negotiated by him in connection with way leaves or accommodation outside the site, the Contractor shall notify the Project Manager’s Rep in writing of such arrangements.

Normally on site living accommodation will not be permitted but where it is unavoidable, this will be detailed in the Contract.

1.34 Interference with access to properties and apparatus

Before interfering with access to any property, the Contractor shall provide alternative arrangements. The Contractor shall notify the Project Manager’s Rep and the relevant occupiers in writing 14 days in advance of any such interference and shall confirm to the Project Manager’s Rep that alternative arrangements have been agreed.

The Contractor shall take particular account the access and service requirements of those with special needs. Special needs are defined as those needs related to health and mobility of individuals affected and individuals concerned with the health of others.

The Contractor shall not unreasonably obstruct access to any manhole or other surface cover outside normal working hours.

1.35 Procedure for complaints and claims for damage
The Contractor shall notify the Project Manager’s Rep in writing immediately following any damage or injury arising out of the execution of the Works.

Details of all claims or warnings of intended claims which the Contractor may receive from third parties shall be notified without delay to the Project Manager’s Rep, who shall likewise pass to the Contractor any such claims or warnings which may be submitted directly to the Project Manager's Rep or CLIENT.

The Contractor shall deal promptly with any complaints, claims, damage or injury by owners or occupiers.

1.36 Protection against damage

The Contractor shall take all necessary precautions to avoid causing any unwarranted damage to roads, lands, properties, trees and other features during the currency of the Contract.

Where any portion of the Works is close to, across, or under any existing apparatus of Utility Companies, the Road Authority or other parties, the Contractor shall temporarily support and work round, under or adjacent to all apparatus in a manner designed to avoid damage, leakage or danger, and to ensure uninterrupted operation.

Should any leakages or damage be discovered, the Contractor shall at once notify the Project Manager’s Rep and the Utility Company, Road Authority or owner concerned, as appropriate, and the Contractor shall afford every facility for the immediate repair or replacement of the apparatus affected. The Contractor shall fully reinstate at his expense and to the Project Manager’s Rep’s satisfaction any damage caused by any of his operations.

Damage includes all actions that would lead to environmental damage such as tipping of waste, fuel or oil and destruction by plant and equipment.

The Contractor shall protect all underground and above ground existing structures from damage, whether or not they lie within the limits of the easements obtained by the CLIENT. Where such existing walls, fences, gates, sheds, buildings, or any other structures must be removed in order to carry out the construction properly, they shall be restored to their original condition to the satisfaction of the property owner, occupier and Project Manager’s Rep. The Project Manager’s Rep shall be notified of any damage made to structures and repairs or replacements shall be made before backfilling takes place. The Contractor shall remove and replace such small miscellaneous structures as fences, mailboxes, and signposts without additional compensation from the CLIENT. These structures shall be replaced in a condition as good as their original condition.

If existing structures are encountered which will prevent the construction of the Works as designed, the Contractor shall notify the Project Manager’s Rep of his proposed changes and make such reasonable modifications as are necessary to the satisfaction of the Project Manager’s Rep.

1.37 Protection of agricultural land
The Contractor shall submit details to the Project Manager’s Rep of all herbicides and pesticides proposed for approval. Specific requirements to prevent the spread of animal and plant diseases (if any) are given in the Contract.

**1.38 Works affecting watercourses**

The Contractor shall notify the Project Manager’s Rep in writing 14 days in advance of his intention to start any part of the Works affecting a watercourse (whether running with water or not), canal, lake, reservoir, borehole or aquifer.

The Contractor shall be responsible for maintaining watercourses within the Site in effective working condition at all times.

The Contractor shall take all practicable measures to prevent the deposition of silt or other material in, and the pollution of, or damage to, any existing watercourse, canal, lake, reservoir, borehole or aquifer, arising from his operations and acts of vandalism.

The Contractor shall obtain approval for all temporary discharges, crossings or diversions to watercourses. National legal requirements (if any) and those specific to the Project and are detailed in the Contract.

Generally all liquid/fuel storage tanks shall be located in a sealed protective retaining bund capable of holding at least 110% of the tank volume with a freeboard of 200mm. Filling/discharge pipe work shall be positioned to contain spillage in the bund and all valves shall be lockable.

**1.39 Dealing with water**

The Contractor shall bear all risks associated with water, whether from the main river, local water courses, irrigation channels, underground springs, rainfall or any other sources or cause. The Contractor shall take measures, carry out any operation and provide and use all necessary plant, appliances, pumps, and the like for dealing with flowing or standing water within the Site. The Contractor shall be responsible for pumping all water from excavations.

**1.40 Hygiene**

Before any person is engaged on work involving possible contact with potable water, he shall be notified of the need for personal hygiene and the dangers of contamination, shall complete a medical questionnaire provided by the CLIENT and, where there is a need, shall be tested to indicate that he is not a carrier of any waterborne disease. The Contractor shall notify the Project Manager’s Rep of any person who has been certified by a doctor as suffering from an illness associated with looseness of the bowels and no such person shall be employed on such work until the CLIENT's medical adviser is satisfied that it is safe for him to be employed.

Where there is a doubt concerning a person's suitability to be employed on the Works, that person will be required to complete a medical examination certifying that he is clear of illness associated with any waterborne disease.

Where the Works are intended for the purpose of supplying potable water to the public, every precaution must be taken to avoid contamination of the Works. For this
reason, any workman fouling any site or its vicinity shall be removed from the Works and shall not thereafter be employed upon the Works without the permission of the Project Manager’s Rep.

The Contractor shall provide sufficient chemical-type toilets at each working location, of suitable type, and maintain the facility in a sanitary condition at all times. Chemical-type toilets shall be of adequate construction so that no unsanitary contamination of the area can result from their use. Upon completion of that part of the Works, sanitary facilities shall be removed and the areas restored to their original condition.

1.41 Utilities relocation and protection

The Contractor shall be responsible for identifying the location and nature of all services on the Site, liaising with utilities and other organizations or bodies whose services may be affected by the Works and obtaining the necessary permits and approvals for design and construction of the Works. The necessary approval periods shall be allowed for in the Contractor’s scheduling program.

Notwithstanding any approvals, before excavation commences the Contractor shall ascertain the accurate location of existing services using safe methods of pipe location, cable detection or hand digging of trial holes as appropriate. If any underground service is encountered unexpectedly the Contractor shall notify the Project Manager’s Rep and owner of the service without delay. Notwithstanding any services information supplied to the Contractor the responsibility to locate all services and prevent any damage to existing services shall rest with the Contractor.

The Contractor shall be responsible for all works as may be required in the inter-relation with existing utilities and services, such as the realignment, adjustment, disconnection, relaying and reconnection, for all and any delay occasioned thereby and making payment to the relevant statutory bodies for utility services.

The Contractor shall ensure that all utility service providers, including the CLIENT, whose equipment already traverses the Site can gain access to that equipment to inspect, repair and renew the same without restriction.

The Contractor shall record the position of all located existing services on the general arrangement drawings a copy of which shall be made available by the Contractor to the Project Manager’s Rep. If any service is found to exist but is not as indicated in the Contract then the Contractor shall at once give written notification to the Project Manager’s Rep. No warranty is given as to the accuracy or completeness of the information on existing services included in the Contract.

It shall be the Contractor's responsibility to ensure proper backfilling, appropriate to the section of the site, of any excavation made in the work area by any Utility Company, made necessary by the Contractor's operations.

The Contractor shall possess sufficient serviceable pipe/cable detectors for locating buried pipes and cables and appropriate staff competent in their use. Each detector shall be operated in accordance with the manufacturer's instructions.
Paint used for temporary marking of services shall be non-permanent and shall either weather away naturally or be capable of being washed away using water and a stiff brush.

The Contractor shall comply with any relevant local or National Utility regulations indicated in the Contract.

1.42 Traffic management

Throughout the execution of the Works and the remedying of any defects therein, the Contractor shall:

have full regard for the safety of all persons on the Site and shall keep the Site (so far as the same is under his control) as well as the Works (so far as the same are not completed or occupied by the CLIENT) in an appropriate state to avoid any danger to all persons whether or not they are authorized to be on the Site; and provide and maintain, at his own cost, all lights, barriers and warning signs, when and where necessary or when required by the Project Manager’s Rep for the protection of the Works or for the safety and convenience of the public or others.

The Contractor shall not commence any work that affects the public roads until all traffic safety measures necessitated by the work are fully operational.

The traffic signs, road markings, lamps, barriers and traffic control signals shall be in accordance with the requirements current at the date of the execution of the work.

The Contractor shall keep clean and readable at all times all traffic signs, road markings, lamps, barriers and traffic control signals and he shall position, re-position, cover or remove them as necessitated by the progress of the Works.

Roads, accesses, rights of way, etc. which are being used by construction traffic shall at all times be kept clean of all dirt, mud and material dropped from vehicles or from tyres arising from such use. The Contractor shall provide, maintain and use suitable equipment for this purpose.

In carrying out the Works the Contractor shall ensure that all road drains, ditches and channels are kept clear of any spoil, mud, slurry, or other materials likely to impede the free flow of water.

Where work is carried out on, or adjacent to a highway open to traffic, the Contractor shall ensure that vehicles and mobile plant under his control operating frequently or regularly on or adjacent to that highway in the execution of the Works shall be painted in a conspicuous color.

The Contractor shall provide, and suitably sign, points of entry to and exit from the Site, for vehicles and plant engaged on the Works. The Contractor shall ensure that when any vehicle or item of plant is reversing within the Site on or adjacent to a highway open to traffic, it does so only under the supervision of a person designated for the purpose of regulating traffic within the Site who shall be readily distinguishable from the remainder of the work force.
Where work is carried out on or adjacent to a highway open to traffic, the Contractor shall ensure that the work force and the site supervisory staff at all times wear high visibility warning clothing.

1.43 Emergency arrangements

The Contractor shall maintain arrangements whereby he can quickly call out labour outside normal working hours to carry out any work needed for an emergency associated with the Works. The Project Manager’s Rep shall be provided at all times with a list of addresses and telephone numbers of the Contractor’s staff who are currently responsible for organizing emergency work.

The Contractor shall acquaint himself and his employees with any relevant local arrangements that are in existence for dealing with emergencies.

1.44 Hazardous substances

No hazardous substances shall be brought on to the Site or used for any purpose unless the Contractor has previously obtained the written approval of the Project Manager’s Rep and has obtained the necessary permits. The Contractor shall obtain the Project Manager’s Rep’s approval in writing prior to storing and locations of any hazardous substance on the Site.

The Contractor shall comply with Specific local or National codes and laws, for example, those concerning storage of fuel and flammable substances and explosives.

1.45 Existing structures and underground services

Where, in the course of construction of the Works, any existing foundations, walls, sewers, drains, pipes, wires, cables, and other structures, places and things are exposed, or otherwise are affected by the execution of the Contract, they shall be properly maintained, adequately supported and protected. Expedients to the approval of the Project Manager’s Rep shall be adopted, which will prevent inconvenience, interruption and which will ensure safety and continuity of use, of the above.

1.46 Fire prevention and protection

The Contractor shall perform all work in a fire-safe manner. He shall supply and maintain on the site adequate fire-fighting equipment. The Contractor shall comply with all current applicable fire regulations.

1.47 Access by officials and visitors

Authorized clients; or Government; financiers and municipal officials shall at all times have access to the work wherever it is in preparation or progress, and the Contractor shall provide proper facilities for such access and for inspection.

Where the Site has conditions requiring access by archaeologists, environmental or conservation officials, this will be detailed in the Contract.
Where visitor access is required to the site offices, particular care shall be taken to ensure that this access is safe and adequately signposted.

1.48 Public safety and convenience

The Contractor shall mark all open trenches and other obstructions by approved signs, fences, barricades, and lights for the safety of the public.

1.49 Street clean-up during construction

The Contractor shall clean all spilled dirt, gravel, or other foreign material caused by the construction operations from all streets and roads at the conclusion of each day's operation. Cleaning shall include washing with water, power brushing, and use of manual labor as necessary to achieve the standard comparable with adjacent streets unaffected by the works.

The Contractor shall take all reasonable steps to prevent vehicles entering and leaving the Site depositing mud or other debris on the surface of adjacent roads or footways, and shall remove expeditiously any materials so deposited. The Contractor shall not without the agreement of the Project Manager’s Rep obstruct more than a 100 meter length of any part of the highway at any one time.

1.50 Access for emergency services

The Contractor shall notify the Fire and Police Services before closing any street or portion thereof and no closing shall be made without the Project Manager’s Rep’s approval. The Fire and Police Services shall be notified when the streets are again passable for emergency vehicles. The method adopted for construction of the Works shall minimize interference with Fire and Police Service access and at no time prevent such access.

The Contractor shall leave his night contact telephone number with the local Police office whenever construction operations are in progress.

1.51 Tipping facilities and waste materials

No tipping facilities are to be provided by the CLIENT (unless otherwise indicated in the Contract) and he shall make all arrangements and bear all costs for the disposal of all surplus excavated material. Unauthorized tipping shall not be permitted.

The removal of waste material from the site must comply with local and National regulations in respect of carrying and disposal.

1.52 Testing

If the Contractor provides his own testing facilities, the equipment, staff and method of operation shall be acceptable to the Project Manager’s Rep, and up to 25% of all tests conducted by the Contractor shall simultaneously be carried out, on samples of the same material, by an approved independent testing laboratory. The Project Manager’s Rep shall have access to the Contractor's laboratory or the independent laboratory at all reasonable times.
The Contractor submits all test results without delay. Test results from independent laboratories shall be copied and sent directly to the Project Manager’s Rep by the laboratory.

1.53 Works off-site

When major components of the Works are manufactured off-Site, the Contractor shall make arrangements to provide an adequate and secure office at or adjacent to the place of, and during the period of, manufacture and testing. The Contractor shall give written notice to the Project Manager’s Rep of the workshops and places where work is being, or is about to be, carried out from which materials of manufactured articles are about to be or are being supplied. He shall also give such notice and keep the Project Manager’s Rep advised of the times when such materials will be ready to be inspected, so that such inspection may take place without delaying the delivery of the materials to the site. Such notices shall be given at such times as will permit the inspection of the whole of the work at all stages of the processes of manufacture and not simply when the goods are completed ready for delivery.

At least four weeks prior to the placing of any orders for major components of the Works the Contractor shall forward to the Project Manager’s Rep for approval full and detailed particulars and samples when requested of the materials/components that he intends to procure for the Works. All these items shall comply with the Specification and shall bear necessary approvals for use in Kenya.

1.54 Other contractors

The Contractor is advised that other contractors employed by the CLIENT and employees of the CLIENT may be working on and around the Site. The Contractor shall grant access to the Site to any such persons. The Contractor shall liaise with the CLIENT and shall plan and execute the Works for mutual convenience and ensure satisfactory progress of the project.

The Contractor shall not interfere in any way with any works, whether the property of the CLIENT or of a third party and whether or not the position of such works is indicated to the Contractor, by the Project Manager’s Rep, except where such interference is specifically described as part of the Works either in the Contract or by the Project Manager’s Rep’s instruction. The Contractor shall respect and shall ensure that his employees and his subcontractors respect the construction and finish of works and articles supplied or installed by others and will be held responsible for any loss or damage thereto if caused by him.

1.55 Safeguarding the environment

The Contractor shall execute all works and take any measures for environmental protection and impact mitigation in accordance with the laws in force in Kenya. He shall obtain all the necessary updated information concerning the NEMA regulations and obtain all the necessary authorizations and carry out complementary studies.
whenever necessary. He shall obtain environmental approvals for all temporary works.

During the works, including site mobilization and the maintenance period, the Contractor and his sub-contractors, in compliance with the norms and regulations in force, shall implement the following mitigation measures:

Reduction of Equipment and Plant noise when working in urban areas and in proximity to occupied buildings. Control of vibration from plant and equipment in urban areas and in proximity to buildings and other structures. Optimum location for crushers, bitumen plants, batching plants and other similar plants, in order to minimize their adverse impact on the natural and human environments. Enforcement of an adequate traffic management plan to minimize the disturbance caused by the site traffic and to safeguard the public and the Contractor’s labor. Protection of rivers, lakes, lands in crop and any areas surrounding the Site, against any pollution, which may originate either from the permanent road works or from other activities related to the Contractor’s organization. Control of the method of storage of materials, with strict observance of the standards and specifications regarding the most sensitive items such as fuel, bitumen, lubricants, cement, explosive, etc. Protection and accurate reinstatement at the end of the works of borrow pits, quarries, services and diversion roads and any other temporary or preparatory work.

Provision and installation of specific equipment and the relevant monitoring of noise, gas, dust, liquids and other pollutants derived from Site activities. Reduction of the emission of pollutants when they reach maximum admissible levels, in accordance with the Kenyan current legislation and norms. Biodegradable materials shall be carefully buried in locations approved by the Project Manager’s Rep and the local environmental Agency in order to prevent any pollution of underground water. Any other action which might be necessary in accordance with the Project Manager’s Rep’s instructions and, as required by the current Kenyan legislation. (Law No. 137, dated 30.12.1995 refers particularly). The Contractor shall, at the request of the Project Manager’s Rep, carry out whatever environmental measurements are required to demonstrate that the requirements of this Clause are being respected. The tests shall be carried out at the locations and times required by the Project Manager’s Rep, and the Contractor shall carry out such tests at his own expense with instruments supplied by him.

1.56 Contractor’s equipment

Details of all Contractor’s equipment to be used by the Contractor in the execution of the Works shall be submitted to the Project Manager’s Rep prior to its use. If in the Project Manager’s Rep’s opinion circumstances arise where it is reasonable that the use of the Contractor’s equipment should be suspended either temporarily or permanently, the Contractor shall change the method of performing the work affected. In particular, this will apply where it is impossible or unsafe to excavate except by hand methods, due to the proximity of, and danger to, existing roads, structures, or services.
The Contractor shall be deemed to have no cause for claims against the CLIENT on account of having to carry out the work by another method, nor shall he be deemed to have cause for claim if any order issued by the Project Manager’s Rep results in the Contractor’s equipment having to stand idle for a period of any duration whatsoever or having to be removed.

1.57 Accommodation for the contractor

The Contractor shall provide, erect, service and maintain all necessary buildings as offices, housing or plant/yard/stores for himself, his staff and his employees.

The Contractor shall arrange the supply of electricity, fresh water, telephone, compressed air and other services as are necessary to his Site establishment and shall provide, maintain and remove on completion all pipes, cables and fittings which carry such services to his operations. The Contractor shall provide an adequate supply of safe drinking water on the Site. All electrical installations forming part of the Temporary Works shall comply with the current National Regulations.

The Contractor shall make all necessary arrangements for the purchase or rental of land, for his offices, housing, plant yard, stores, and with the supply of electricity and water and sewage and waste disposal (including the construction of septic tanks).

All buildings shall comply with the appropriate local or National regulations and the Contractor shall provide the appropriate Authority with sufficient details of the establishment so that approval of that Authority can be obtained by the Contractor prior to construction. The Contractor shall also construct and maintain adequate roads or paths to all buildings.

All huts, buildings, fixtures and fittings provided under this Clause shall be removed and the site reinstated at the end of the Contract.

1.58 Clearance of site on completion

A Completion Certificate will not be issued before the Contractor has removed all his machinery, equipment, plant, waste material from the Site and the Site reinstated to the satisfaction of the Project Manager’s Rep. Issuance of Substantial Completion Certificate is not considered a completion certificate for discharge of contractor duties until the former is attained.

1.59 Construction permits

The Contractor shall obtain all permits necessary for the construction, occupation and use of the Works. The Project Manager’s Rep has no role in assisting the Contractor in obtaining the necessary permits. The Contractor shall assist the Project Manager’s Rep and the CLIENT in obtaining permits that only the CLIENT may obtain.

The Contractor shall allow a realistic timescale for dealing with the third parties responsible, for permits etc., in his planning and programming of the work.

The Contractor shall comply with all conditions stipulated in any permits granted by third parties, including conditions stipulated in those permits obtained by the CLIENT.
1.60 Working hours

Working hour restrictions will apply to the Site including the delivery of materials and equipment. Details are given in the Contract. Overtime works will be approved first by the Project Manager’s Rep.

1.61 Temporary works

The Contractor shall design, arrange, provide and remove at his own cost all temporary works needed to carry out the Permanent Works. The temporary works shall include the provision of road diversions where considered necessary. All temporary works shall be approved by the Project Manager’s Rep, but this shall not relieve the Contractor of his responsibility for their design and adequacy. The Contractor shall obtain all the necessary approvals from the relevant authorities, service (utility owners), local municipalities and other third parties for his design of the temporary works where required.

The Contractor shall be responsible for obtaining all approvals and permits for organizing all necessary land hire for any temporary works such as access roads, diversion roads, borrow pits, site compounds, material and equipment storage areas, laboratory facilities and so on. He shall restore the areas affected by these temporary works either to their original condition or to a condition agreeable to the Project Manager’s Rep, or stipulated in approvals.

The Contractor shall design and construct any form of temporary road diversion and rail or river crossing and shall be responsible for obtaining approvals and clearances from all land owners and other relevant organizations affected by these temporary works.

The temporary road diversions shall be designed and constructed using materials and workmanship that prevent settlement, rutting or distortion of the running surface. The design of the diversion shall be submitted, to the Project Manager’s Rep for approval. The Contractor shall submit details of his scheme to the landowners, river authority etc. When submitting the design of the diversion to the Project Manager’s Rep, the Contractor shall also submit his proposals for traffic management and safety whilst the diversion is in use and shall obtain approval of such from local authorities.

On completion of the relevant section of the Works for which temporary works have been provided, the Contractor shall remove such roads, structures and the like and reinstate the ground on which they had been constructed to its original or to a similar condition to the satisfaction of the Project Manager’s Rep.

1.62 Drawings and documents

Subject to the requirements of the Particular Specifications the Contractor shall prepare shop and Working Drawings necessary to execute the works. The calculations and Working Drawings shall be submitted to the Project Manager’s Rep for approval.
14 days, or as otherwise specified, prior to commencement of the relevant sections of the works on site. Should the submission not be acceptable to the Project Manager’s Rep, the contractor shall re-submit with such further details and information that the Project Manager’s Rep may require until the Project Manager’s Rep is satisfied. The relevant section of work cannot be commenced prior to approval. The Contractor’s submission for approval shall be sufficient for the Project Manager’s Rep to be able to confirm that his proposals conform to the Specification and any relevant Codes and standards. The submission shall be legible and in English, or with an English translation. As a minimum it shall include,

- Calculations, detailing the applicable recognized Codes or Standards.
- Drawings and sketches to clarify the submission.
- Details of proprietary materials.
- Details of any deviation from the Specification, with explanation.
- Confirmation from a suitably qualified person that the submission has been checked for conformity with the Specification.

Any deviation from the approved submission will require the prior approval of the Project Manager’s Rep.

If within 14 days, or otherwise specified period, such approval has not been granted, other than due to rejection of the submission by the Project Manager’s Rep, then approval will be deemed to have been granted. Any such approval, deemed or otherwise, will not relieve the Contractor of any of his obligations under the Contract.

All dimensions in drawings, calculations and information furnished in connection with the Contract shall be expressed in metric SI units (Metric SI units: m, kg, N, kg/cm², °C, watt, bar, etc.).

All drawings shall be sized to designations A1, A2, A3, and A4. Sizes AO and above shall not be used. Each drawing shall carry the project title, the name of the Project Manager’s Rep, the Contractor and the Employer together with the drawing title and number and other relevant data, in the lower right-hand corner. The Project Manager’s Rep’s approval of the Working Drawings, Contract Records etc. and of the Workshop test records etc., shall not relieve the Contractor of the obligation to meet the terms of the Specification and any of the plant which upon delivery to site is found to be incorrect or unsatisfactory, or which fails to perform its duty satisfactorily during commissioning or during the Defects Notice Period shall be replaced to the Project Manager’s Rep’s satisfaction.

The Contractor shall be responsible for any discrepancies, errors, or omissions in the drawings and other particulars supplied by him, whether such drawings and particulars have been approved by the Project Manager’s Rep or not, provided that such discrepancies, errors, or omissions are not due to inaccurate information or particulars furnished in writing to the Contractor by the Employer or the Project Manager’s Rep. The Employer shall be responsible for drawings and information supplied in writing by the Employer or the Project Manager’s Rep and for the details of special work specified by either of them. The Employer shall pay any extra cost
reasonably incurred by the Contractor due to any alterations of the work necessitated by reason of inaccurate information so supplied to the Contractor.

1.63 Record drawings

Concurrently with the progress of work on Site the Contractor shall prepare all necessary drawings and diagrams of the "as-fitted" / "as-built" Works as may be required for record and for care, maintenance, repair, etc. purposes and these shall include:

Arrangement drawings of each complete installation to a scale of not less than 1:20. Outline dimensioned drawings of each of the principal items of plant. Each shall carry or be accompanied by a schedule of fittings, instruments and components which shall include the maker's name, reference numbers, ratings and full particulars of all the component parts. Sectional drawings of each of the major items of plant with the parts named and numbered to facilitate maintenance and overhaul. These drawings shall also show the type of fit and running clearance for fitted and running parts and with them shall be included such detailed workshop drawings as may be necessary for the manufacture of replacement components during the working lifetime of the plant. Such electrical and operational diagrams as may be necessary. Cable schedules, diagrams and route sections for cable installations. Cable route plan of the Site and of each of the principal installations showing sections through the cable groups and trenches so that each cable etc. in a group or trench may be readily identified. This information shall preferably be shown on a number of large scale drawings which shall be correlated by means of a small scale master plan.

The foregoing drawings may include those submitted and approved as Working Drawings and all shall be sized and set out according to the requirements for the Working Drawings.

The plant shall not be deemed to be ready for issue of the Completion Certificate until the Record Drawings have been furnished. The title block shall be that of the Project Manager’s Rep responsible for the supervision of the Works.

1.64 Operation and maintenance manual

1.64.1 General

The Contractor shall provide suitably bound operating and maintenance manuals for all plant installed and rehabilitated within the works. The introduction shall include a general description of each works and its operation.

The instructions shall be clearly written in the English language and shall be suitable for all staff categories that will need to use them. The manuals shall form the basis for training of the Employer’s personnel and therefore the greatest importance will be attached to completeness and clarity of presentation.

It is emphasized that a collection of standard pamphlets of a general nature accompanied by drawings and descriptive matters relating to the Plant as installed, will not be acceptable. In particular, information supplied by sub-Contractors and manufacturers employed by the Contractor, shall be coordinated into the
comprehensive manual. Cross-referencing of descriptive matter, drawings and spare part lists must be complete.

The Contractor shall submit for approval, duplicate draft copies of the operation and maintenance manuals.

1.64.2 Operating instructions

Operating instructions shall give a detailed description for all operations likely to be carried out during the life of the plant. The instructions shall cover the installation, refurbishing, commissioning, testing, operation and trouble shooting of the entire plant.

The instruction manuals shall describe the installation as a whole and shall give a step-by-step procedure for any operation likely to be carried out daily, weekly, and monthly and at longer intervals to ensure trouble-free operation. Where applicable, fault location charts shall be included to facilitate tracing the cause of malfunctions or breakdown and correcting faults.

A separate section shall be allocated for each type of equipment which shall contain all relevant information concerning the construction and operating principles of that item.

1.64.3 Maintenance Instructions

Maintenance instructions shall include a list of all serviceable and replaceable parts, checking, and testing and replacement procedures to be carried out at routine intervals to ensure trouble free operations.

Detailed instructions shall be provided to cover the procedures for disassembly, remedial repairs and assembly of individual items of plant.

A spares schedule shall be included consisting of a complete list of itemized spare parts for all mechanical and electrical plant with ordering references and part numbers. Parts shall be identified on equipment sectional drawings.

Any special maintenance tools shall be listed and detailed.

A separate section of the manual shall be devoted to standard schedule sheets that can be used by the Employer's staff for recording routine maintenance tasks for all items of plant requiring servicing.

1.64.4 Minimum Inclusions

Concurrently with the progress of work on Site the Contractor shall prepare the Operating and Maintenance.

Instruction Manuals which shall include where applicable:

1.65 Schedule of approved Record Drawings and documents.
Detailed description of the plant and its method of operation, control and protection. Recommended operation and routine check procedures.

Recommended care and maintenance routines together with the procedures for the repair and re-commissioning of major items of plant.

1.66 Recommended emergency control procedures.

Maker's descriptive literature and technical data sheets in respect of each item of the plant including the recommended installation, care, maintenance and overhaul instructions, parts lists etc, whereby the plant may be maintained correctly and whereby replacement spare parts, may be ordered without difficulty.

Exploded views of all items of plant with each component and reference number cross referenced to the appropriate data sheet and spares schedule.

Schedule of the principal items of plant and components showing the title, maker, maker's type reference, serial number, rating etc. whereby reference to each is simplified.

1.67 Test results and curves, including all electrical test data and reports.

Particular reference is to be made in the operating and maintenance instructions to the:

Safety precautions and instructions to be taken when operating the plant; Pre-start check list; Bearings and moving parts which require special attention; Type of lubricants to be used, and lubrication intervals; Routine tests which are recommended to confirm that the plant is in good working order. Fault finding guide. Two draft copies of the manuals shall be submitted to the Project Manager’s Rep for his approval 2 weeks, or as otherwise specified, prior to the Tests on Completion. The Manuals shall be used for commissioning and test running under the Project Manager’s Rep’s supervision when their content and accuracy will be checked.

The final 3 copies of the Manuals, incorporating amendments and additions as instructed by the Project Manager’s Rep, shall be provided upon the satisfactory completion of the installation and testing of the Works, within 6 weeks of the issue of the Certificate of Completion, or other specified time.

1.68 Contractor's Responsibility for Design

Where indicated in the Particular Specification, the Contractor shall be responsible for the general and detailed design of the complete equipment and structures to be provided and for the dimensions and arrangements of the various parts. The Contractor shall be responsible for checking the dimensions and installation conditions of the existing plant and for the design of any modifications required.

The design, construction and finish of the complete equipment and other items supplied under this Contract shall be according to first class treatment works practice and each item of equipment shall be in every way suitable for continuous operation over the full range of duties. The plant shall be as simple and maintenance free as possible.
1.69 Approval of contractor's proposals

The Contractor shall supply 4 copies of the following documentation, giving details of his proposals for approval, to the Project Manager’s Rep within 4 weeks of the Contract Start Date, or other specified time.

Two copies of design and working and construction drawings and data including calculation (in case of proposed change in the approved methodology) and erection information.

Two copies of all technical specifications of all plant and equipment proposed for the works.

Details of dead and live loads imposed by each item of plant on its foundations and any specific fixing arrangements required.

General arrangement drawings showing the layout of the site, buildings, roads, pipelines, existing and new installations;

Method Statement, including process aspects, sequence, plant and materials, and planning of the Works.

1.70 Photographs

The Contractor shall supply negatives and four copies of progress photographs, suitably inscribed, of a size not less than 250 mm by 200 mm of such portions of the Works, in progress and completed, as may be directed by the Project Manager’s Rep. The negatives and prints shall not be retouched. The negatives of the photographs shall be the property of the Employer and no prints from these negatives may be supplied to any person or persons without the authority of the Employer or the Project Manager’s Rep. The Contractor shall also provide photograph albums and mounts for mounting photographs.

Alternatively, suitable digital photographs may be taken in JPEG format, and given to the Project Manager’s Rep on a Data CD at suitable intervals during the project. These photographs will also form part of the requirements of the “as built”.

1.71 Purchase of materials

Unless specified otherwise, at least thirty (30) days prior to purchase of each batch of material to be used in the Works the Contractor shall furnish the Project Manager’s Rep with the manufacturer's specifications and recommendations of the material he intends to use, including present full manufacturers address, for approval by the Project Manager’s Rep.

1.72 Operation of unsatisfactory equipment

If the operation or use of the materials or equipment proves to be unsatisfactory to the Project Manager’s Rep, the Employer shall have the right to operate and use such materials or equipment until they can be taken out of service for correction by the Contractor of such latent defects, errors, or omissions and for replacement in whole or in part, if correction is unsuccessful or not feasible.
1.73 Disruption of production

The Contractor shall plan his work in such way as to minimize disruption of the operation of any existing plant, and in agreement with the appropriate Employer’s program requirements. This shall reflect in his "Program of Works". In order to ensure the minimum disruption to production at the plant, the Contractor shall co-ordinate his work with the Employer’s operational staff.

1.74 Instructions of employer’s staff

The Contractor shall adhere to instructions of the Employer’s staff in operation and maintenance of the existing plant during the period of installation commissioning and testing. In all other cases, unless work is unavoidable or absolutely necessary for the saving of life or property or for the safety of the Works, the Contractor shall only accept instructions from the Project Manager’s Rep.

1.75 Training

1.75.1 General

The Contractor shall provide on-the-job training to the Employer's Supervisory personnel where new workshop equipment or laboratory equipment were procured and physical rehabilitation was effected to the works. The on-the-job training (O.J.T.) activities shall be based on the comprehensive operation and maintenance Manuals.

1.75.2 Training Methodology

The on-the-job training activity shall follow the step-by-step procedure of how to perform and accomplish a certain task in the most efficient and effective way. The Contractor shall organize the demonstration of how the task is to be done pointing out at each step the safety factors and possible hazards. The training process should be planned maintained and controlled in such a way that the Contractor will be able to assess the learning progress being made by the trainee. The trainees should be given enough time to practice by actually performing the tasks under the scrutiny of the Contractor. This practical component of O.J.T. where the trainees actually perform the task should take not less than 50% of the training time. The Contractor shall coach and guide the trainee until the task and skill have been learned and mastered.

1.75.3 Training Areas

The Contractor shall perform On-the-job training in the following areas whenever applicable:

Operation and maintenance of plant utility (works) equipment such as water collection, distribution and supply systems;

Operation and maintenance of process equipment such as piping, pumps, motors, stills and instruments; Operation and maintenance of safety equipment such as pressure-relief valves, emergency relief equipment and fire extinguishers;
Operation and maintenance of auxiliary equipment such as pipelines, drains, gauges and measuring instruments.

1.76 Climatic data

The climatic conditions for the area are to be taken into account by the Contractor during the design and the construction of the Works.

2.0 INSPECTION AND TESTING OF MATERIALS

2.1 Apparatus required for testing on site

Apparatus for testing shall be, if directed by the Engineer, made available on site of the works, for as long a period as required by the Engineer, and regarded as constructional plant. The Contractor to allow for this provision in his rates. The following may be required:

a) A set of sieves complying with British Standard 410: Test Sieves, or the following nominal sizes:

Fine mesh wire cloth 200, 100, 72, 52, 36, 25, 18, 14, 10 and 7.

Medium mesh wire cloth 3mm.

Perforated plate 5mm, 6mm, 9mm, 12mm, 20mm, 38mm, 50mm, 65mm and 75mm.

b) A suitable balance, a pycnometer and a stove or other approved apparatus for determining the moisture content of the aggregate. The methods of test shall be as described in Part Four of British Standard 812: Sampling and Testing of Mineral Aggregates, Sands and Fillers.

c) A 200 ml. graduated cylinder in accordance with British Standard 604: Graduate Measuring Cylinders, for the use in the field settling test for clay and fine silt in aggregates.

d) Two 0.34 kg. graduated clear glass medicine bottles for use in the test of organic impurities in sand.

e) Apparatus required for testing soils in accordance with British Standard 1377: Methods of Test for Soil Classification and Compaction, and British Standard 1924: Methods of Test for Stabilised Soils.

f) Apparatus for testing concrete in accordance with British Standard 1881: Methods of Testing Concrete, Parts 1 to 7.

g) A straight edge 3 meters long and measuring wedge or other approved apparatus for testing the accuracy of surfaces.

Additional testing equipment as stated in the Bill of Quantities or as required by the Engineer.

2.2 Load testing of pipes
The Engineer may instruct the Contractor to make a Loading Test (Three-Edge Bearing or Sand Bearing) on pipes to be used to construct the water pipes. Payment for Load Tests will be entirely in accordance with the General Conditions of Contract.

2.2.1 Testing Plan

The Contractor shall prepare a plan of the proposed tests. The plan shall consist of a logical step by-step schedule indicating step, action and reaction. The plan shall be cross referenced to relevant sections of the Specification, Bill of Quantities, and ISO/DIN and British Standards (or equivalent where applicable), and shall state clearly the test method to be employed, the equipment to be used, the parameters to be measured, and the expected results. On satisfactory completion of the tests etc. the plan shall be completed with the results achieved and shall be retained for record purposes.

The test plan may be divided into sections to suit the plant purchase and manufacturing arrangements, and program. Each section of the plan shall be issued in draft at least 28 days before any testing, inspecting or commissioning takes place. The Project Manager’s Rep will notify his approval or otherwise of the plan. Any portions of the plan which the Project Manager’s Rep disapproves shall be suitably modified before implementation of that portion of the plan. Final copies of the approved plan shall be available for the testing, inspections or commissioning.

2.2.2 Testing of plant

The Contractor shall carry out during manufacture all tests specified in the relevant Standards amplified as may be called for in the Specification and Bill of Quantities, and shall forward to the Project Manager’s Rep in triplicate duly certified copies of the test results and certification that the equipment and materials comply with the relevant Standards.

Testing of electrical panels shall include the panels being tested fully assembled.

Full witness testing to the relevant standards and to prove guarantees given will be required for the following items:

- All Control/Switchgear Panels
- All High Voltage Power Factor Correction Capacitors
- All Programmable Logical Controllers (PLC) when integrated into panels

In addition, all other items of equipment not subject to witness testing shall be temporarily erected at the manufacturer's works, tested for satisfactory operation and offered for inspection.

Certified copies of the manufacturer's test readings shall be submitted to the Project Manager’s Rep prior to packing for shipment.

Such inspection, examination, or testing, shall not release the Contractor, manufacturer or supplier of any item from any obligation. Whilst the Project Manager’s Rep shall be provided with facilities for witness testing and/or inspection of all items of equipment at the manufacturer's works, at the contractor’s cost, he may at his discretion advise that the tests shall proceed in his absence, the tests shall be
made as if in his presence, and duly certified copies of test readings shall be submitted. Nevertheless, the witness test must be carried out by a suitably qualified Project Manager’s Rep, and in the case of boilers and pressure vessel, by a Lloyds or similarly qualified insurance assessor. Two copies of all test certificates and graphs shall be supplied to the Project Manager’s Rep for his approval within seven (7) days of the completion of the tests. At least (fourteen) 14 days' notice in writing shall be afforded to the Project Manager’s Rep, or his representative, to enable attendance at the Works Tests. Where tests and inspection have been completed to the Project Manager’s Rep’s satisfaction and when the test certificates, curves, etc. have been checked, the Project Manager’s Rep shall confirm acceptance in writing and the plant shall not be incorporated in the Works or delivered until this acceptance has been received.

Where witness tests are not required, the test certificate and performance curves shall be forwarded to the Project Manager’s Rep within two weeks after instructions to waive witness tests have been received. On each test certificate, sufficient information to enable the Project Manager’s Rep to issue a release certificate, including the Specification Contract number and details, shall be given for ready identification of the material or equipment to which the certificate refers. No inspection or passing by the Project Manager’s Rep of the Work, Plant or materials covered by the Contract, whether carried out or supplied by the Contractor, shall release the Contractor from any of his obligations under the Contract. The Project Manager’s Rep reserves the right to require the Contractor to meet any extra costs which are occasioned by failure of the Contractor to comply with the above testing and inspection requirements including the provision of test certificates, curves, sub-orders, etc., or which in the opinion of the Project Manager’s Rep are due to insufficient care having been taken by the Contractor or his Sub-Contractor before presenting the Plant for inspection or test. If unauthorized delivery has taken place, the Contractor may be required to arrange for the plant to be returned to the manufacturer for inspection and/or witness testing at the Contractor's expense.

2.2.3 Performance testing and commissioning

When the plant is completely erected and ready for service, the Works shall be tested and commissioned under the Project Manager’s Rep’s supervision. At least 7 (seven) days' notice in writing shall be afforded to the Project Manager’s Rep prior to commencement of the testing period.

Tests will include, but will not be limited to:

1. Testing of Electrical Works - The complete installation shall be tested, firstly for compliance with the Public Company and Kenyan Electrical regulations where mains supplies and earthing are involved and secondly for control cable interconnections and earthing.

Tests are required for:

- insulation resistance;
- polarity;
- continuity;
• earth electrode resistance;
• effectiveness of earthing;

A detailed schedule of cable numbers and all test results shall be prepared and submitted to the Project Manager’s Rep for approval.

The testing and setting to work of the main electrical systems shall be carried out in the presence of the Project Manager’s Rep or his representative.

2. Testing of Pipework and Fittings - Pressure pipelines and valves shall be pressure tested in accordance with BS 8010, or equivalent Kenyan Standards. Testing shall be done under supervision of the Project Manager’s Rep. The Contractor shall notify the Project Manager’s Rep at least one clear working day beforehand of his intention to test a section of pipeline.

On satisfactory completion of the Performance tests the Contractor shall provide copies of the completed schedules for record purposes.

2.2.4 Tests on Completion

Upon completion of testing and commissioning the complete installed plant for the whole works shall be operated for 7 (seven) days and subjected to the prescribed Tests on Completion under the Project Manager’s Rep’s supervision and in the presence of the Employer’s staff to demonstrate that it is able to perform its specified duties satisfactorily under the approved system of operation and control and that the whole conforms with the Specification.

Before the commencement of any site testing the Contractor shall submit to the Project Manager’s Rep for approval schedules detailing the tests to be carried out in satisfaction of the Tests on Completion. On satisfactory completion of the Tests on Completion the Contractor shall provide copies of the completed schedules for record purposes. At least 7 (seven) days' notice in writing shall be afforded to the Project Manager’s Rep prior to commencement of the Tests on Completion period.

Except where otherwise specified, each item of plant shall be subjected to a continuous 7-day trial under normal working conditions, at varying heads, quantities, loads and speeds where applicable to establish correct and reliable functioning of the plant. The performance of each item of plant at its guarantee point shall be determined using pressure gauges, flow meter and electrical gauges. Electrical plant shall be tested in accordance with the Public Company Regulations, for earth continuity, polarity and insulation resistance, and the Contractor shall supply the Project Manager’s Rep with three copies of the schedule of test results. The installation will not be accepted until such tests have been approved.

Power consumption, discharge and suction and delivery pressures shall be measured where applicable.

The Contractor shall supply all necessary instruments, gauges, meters and suitably qualified personnel to carry out the tests and the cost of these shall be deemed to be included in his tendered prices.
Should any item of plant or process fail to comply with the performance guarantee, or fail to function correctly the Contractor shall modify or replace at his own expense such items as are necessary and resume the seven day testing period until the plant does meet the performance guarantees to the satisfaction of the Project Manager’s Rep.

Four copies of all inspection and test certificates and records, shall be furnished to the Project Manager’s Rep immediately after each inspection or test.

The Contractor shall instruct the Employer's operating staff and shall stand by the plant on a continuous basis whilst the trials are in progress. Training for the various elements of this contract shall be to the satisfaction of the Project Manager’s Rep. The timing of this training shall be immediately prior to the start of final tests.

2.3 Transport and storage, care of works

The Contractor shall be responsible for the offloading, storage and security of all material and equipment delivered to site and installed and for all works executed until the Issue of the Certificate of Completion.

Each item of plant or batch of material shall be securely packed and adequately protected and marked to avoid loss or damage in transit. All equipment shall be handled and stored in accordance with the manufacturers recommendations.

2.4 Joint measurement of extras

In the event of the Contractor having to execute any work or provide any material with regard to which he intends to claim extras, he shall make arrangements to take measurements of the said works or material and inform the Project Manager’s Rep accordingly, who will join the Contractor for a joint survey. If these measurements are not taken jointly and recorded before the work will be executed, the Contractor's measurement will not be recognized by the Project Manager’s Rep. The fact of such joint measurement having been made will in no way bind the Project Manager’s Rep to recognize the claim. The Project Manager’s Rep shall at all times have access to the Contractor's diary and may daily check the progress of relevant works, but this shall in no way bind the Project Manager’s Rep to accept the claim nor the value of the work other than by joint measurement nor shall it confirm the Project Manager’s Rep’s agreement to any statement in the diary.

3.0 MATERIAL AND WORKMANSHIP - GENERAL

3.1 Published standards

Except where otherwise specified plant, materials and workmanship shall comply with the relevant Kenyan Standards and Codes of Practice issued by the Kenya Bureau of Standards (KEBS).

Generally, the materials and workmanship of the goods to be supplied in Bills including materials and equipment which will be purchased from outside Kenya shall comply with the appropriate International Standard (ISO) or in specific cases the German (DIN) or British Standard (BS) or Code of Practice (CP) or Euronorm (EN).
All suppliers of goods and materials that are referred to above shall be certified to ISO 9001 or EN 29001.

Other authoritative standards which ensure an equal or higher quality than the standards and code specified will be subject to the Project Manager’s Rep’s prior review and written approval. Differences between the standards specified and the proposed alternative standards must be fully described in writing by the Contractor and submitted to the Project Manager’s Rep at least 28 days prior to the date when the Contractor requires the Project Manager’s Rep’s approval.

The Contractor shall obtain and keep on site at least one copy of the standards and codes of practice that are referred to in the specifications, or approved above, and of each other standard which applies to materials which are being supplied to, or workmanship which is executed on the Works. Copies of these codes and standards shall at all times be available for inspection by the Project Manager’s Rep.

All standards used will be the current version as available at the date of signing of the Contract. A Contractor proposing to use alternative versions of specified codes and standards shall submit the alternative version to the Project Manager’s Rep for approval in accordance with the requirements outlined in the above paragraph.

All materials and workmanship not fully specified herein or covered by an approved standard shall be of such kind as is used in first class work and suitable to the climate in the project area.

Where the requirements of any such standard specification or regulation conflict with the requirements of this specification or any item on the drawings, then the Contractor should refer to the Project Manager’s Rep for clarification before proceeding with that section of the works.

**Codes and Standards**

ISO, BS, ANSI, or ASTM codes and standards of the latest edition shall be part of this specification.

In all cases KS standards will be acceptable. Standards of other nationalities will be acceptable subject to the approval of the Employer where they can be demonstrated by the Contractor to be at least equal to, or more stringent than the equivalent specified standards.

**Electric Regulations**

The whole of the work shall be carried out in accordance with the latest edition of the Regulations issued by the Institution of Electrical Project Manager’s Rep, London, and the Kenyan Electricity Regulations.

Where the latter conflict or are inconsistent with the former then the latter shall take precedence.

The Contractor shall also comply with any regulations necessary to enable full insurance cover to be effected and with any local conditions or by-laws.
3.2 General requirements for plant and components

All components parts of the plant shall be new, unused, in current production and shall comply with the latest relevant Standard. All component parts shall be manufactured to strict systems of limits and complete interchangeability of similar parts shall be achieved. Where there is no Standards Specification or other the materials and workmanship used shall be entirely adequate for the purpose and shall not be installed without the written approval of the Project Manager’s Rep. Uniformity and interchangeability of mechanical and electrical components and accessories which are common to different parts of the Works shall also be achieved as far as practicable.

3.3 Wearing parts

Parts subject to wear shall be indelibly marked with their part number and maker’s name and address and be easily accessible. Provision shall be made for taking-up wear in bearings and other wearing parts and for easy replacement if adjustment is not practicable. If during the Defects Liability Period any parts show, in the opinion of the Project Manager’s Rep, signs of undue wear, corrosion or erosion they shall be replaced at the Contractor's expense notwithstanding that they may be working otherwise in a satisfactory manner.

3.4 Fixings

With the plant shall be provided all necessary supporting steelwork, holding down bolts, cleats, fixings, etc. whereby it shall be secured to the structures, the cost of them being included in the prices of the items with which they are associated.

3.5 Special tools

Any special tools required for adjustment and maintenance of plant shall be provided. These tools shall be used during the erection period only for the express purpose for which they are intended.

3.6 Identification labels

Each item of plant and each sub-assembly for which spare parts may be required, shall have attached to it an untarnishable metal or equal approved form of plate showing clearly the manufacture's name, serial number and basic information as to rating, speed etc., in sufficient detail to allow the component or assembly to be readily identified in correspondence and when ordering spare parts. The foregoing information shall be secured by threaded screws and nuts or equal approved method. Self-tapping screws or soft threaded rivets will not be accepted.

Switchboards and control panels shall bear a title at the top and each component shall bear a smaller circuit title. Components on the doors shall be grouped as far as possible and each group or single component labelled to identify its purpose. Internal components and sub-components shall bear labels to identify them relative to numbers or letters shown on their circuit diagrams. All terminals shall be numbered with the terminal number or conductor ferrule number as appropriate to the wiring
system adopted so that wires may be correctly reconnected without reference to drawings.

Externals labels shall be engraved on black plastic with light infill and shall be secured by nonferrous screws. Internal labels may be similar to external labels or may be painted and varnished. Adhesive labels shall not be used.

3.7 Resistance to corrosion and abrasion

Where corrosion or abrasion of materials may be expected from contact with water or sediment or from any other cause, the Contractor shall supply suitably resistant materials. Any material showing signs of corrosion, or pitting before the expiry of the Defects Notice Period shall be replaced by the Contractor at his own expense with material to the Project Manager’s Rep’s approval.

3.8 Noise and vibration

The Contractor shall make all reasonable efforts to reduce noise and vibration to a minimum. All rotating parts of the plant shall be statically and dynamically balanced so that they operate over all specified conditions without undue vibration.

3.9 Approval of materials

Before ordering any Materials of any description intended for the Works, the Contractor shall submit for the approval of the Project Manager’s Rep the names of the supplier or manufacturer proposed, a specification of the Materials and details of the place of origin or manufacture.

All Materials used in the Works must be new, unless the use of old or refurbished material is expressly permitted by the Project Manager’s Rep.

The Contractor shall ensure that the provisions of the Technical Consent are strictly adhered to.

3.10 Samples

The Contractor shall provide the Project Manager’s Rep with samples of Material necessary for testing in accordance with the Contract. Unless expressly excused, the Contractor shall also provide samples of all manufactured items required for the Works. Alternatively the Contractor shall submit trade literature where the provision of samples, in the first instance and as agreed by the Project Manager’s Rep, is impracticable. All samples rejected by the Project Manager’s Rep shall be removed from the Site. All approved samples shall be stored on Site by the Contractor for the duration of the Contract, and any materials or manufactured items subsequently delivered to the Site for incorporation in the Works shall be of a quality at least equal to the approved sample.

3.11 Materials in contact with water

Materials used in the Works which are, or can be in contact with the untreated or treated water shall not contain any matter which could impart taste, odor or toxicity or otherwise be harmful to health or adversely affect the water conveyed.
Materials or equipment shall be according to the specifications from this Project, and when they are others, prior must be obtained the Project Manager’s Rep’s approval.

**3.12 Resistance to vermin**

All plant and equipment supplied under Contract shall be suitably resistant to or protected against vermin. All seals, grommets, etc. shall be made of neoprene or alternative suitable material.

**4 EARTHWORKS**

**4.1 General**

The Contractor shall be responsible for all excavations and embankments, and the disposal of excavated materials as required for the construction of the Works and referred to herein as earthworks.

No earthworks shall commence until the Contractor has arranged all safety measures, including the provision of barriers and traffic management measures.

**4.2 Clearing site**

The Contractor shall demolish, break up and remove buildings, walls, gates, fences, advertisements and other structures and obstructions, grub up and remove trees, hedges, bushes and shrubs and clear the site of the works at such time and to the extent required by the Engineer but not otherwise, subject to the provisions of Clause 27 of the Conditions of Contract: the materials so obtained shall so far as suitable be reserved and stacked for further use; all rubbish and materials for use shall be destroyed or removed from the site, as directed by the Engineer.

Where top soil has to be excavated this shall be removed and stacked on site. After completion of construction, it shall be spread over the disturbed ground, any surplus being disposed of as directed by the Engineer.

Underground structures and chambers where required to be demolished, shall be demolished to depths shown on drawings or as directed. They shall be properly cleaned out and backfilled and compacted with suitable material to the direction and approval of the Engineer.

**4.3 Vegetation**

No allowance will be made for the cutting and removal of crops, grass, weeds and similar vegetation. The cost of all such work will be held to be included in the rates entered in the Bill of Quantities.

**4.4 Bushes and small trees**

All bushes and small trees, the main stem of which is less than 500mm girth at 1 metre above ground level shall be uprooted (unless otherwise directed by the Engineer) and burnt or otherwise disposed off as directed by the Engineer.

**4.5 Grubbing-up roots**
Stumps and tree roots shall, unless otherwise directed, be grubbed up, blasted, burnt or removed and disposed of in approved dumps to be provided by the Contractor. Where directed by the Engineer, the holes resulting from grubbing up shall be filled with approved materials, which shall be deposited and compacted in layers not exceeding 225mm loose depth, to the same dry density as that of the adjoining soil. For the purpose of measurement, tree roots shall be classified according to the mean diameter of the stump measured across the cut.

4.6 Notice to be given before commencing earthworks

The Contractor shall give to the Project Manager’s Rep at least seven days written notice of his intention to commence earthworks on any part of the Site so as to enable the Project Manager’s Rep to be furnished with all ground levels and other particulars he may require for the purpose of measurement. The earthworks shall not be commenced until written approval has been received by the Contractor from the Project Manager’s Rep.

4.7 Earthworks to lines and levels

The whole of the earthworks for the several parts of the Works shall be carried out to the dimensions and levels shown on the Drawings, or to such other dimensions and levels as may be ordered by the Project Manager’s Rep. Dimensions which are based on, or relate to, ground levels or chainages shall be referred to the Project Manager’s Rep before commencing earthworks at any location.

For the purpose of the Specification the term ground level shall refer to the ground surface before the start of earthwork operations, but after the general clearance of the Site in accordance with Clause “Clearing”.

4.8 Clearing

Clearing shall consist of clearing and grubbing including the disposal of materials, of all areas within the limits designated on the Drawings or as directed by the Project Manager’s Rep. Such clearing and grubbing shall be to the approval of the Project Manager’s Rep.

In areas designated to be cleared and grubbed the surface of the ground shall be cleared of all trees, stumps, down timber, logs, brush, under growth, heavy growth of grass or weeds, fences, minor structures, debris, and rubbish of any nature, natural obstruction or such materials which in the opinion of the Project Manager’s Rep are unsuitable for the foundation of embankments or other required structures including the grubbing of stumps roots and matted roots.

All unsuitable materials shall become property of the Contractor and shall be disposed of satisfactorily as approved by the Project Manager’s Rep.

At the locations of future embankments and foundations of structures roots shall be removed to a depth not less than 0.5 m below finished ground level.

Holes resulting from clearing shall be filled with acceptable materials, moistened and properly compacted to conform to Clause "Compacted Fill".
4.9 Demolition and dismantling

The Contractor shall demolish, dismantle and/or remove any miscellaneous existing structures, buildings or parts thereof which occupy or obstruct the Permanent Works, all as shown on the Drawings, described in the “Detailed Description of Works” or as directed by the Project Manager’s Rep. Unsuitable materials from demolishing and dismantling remain the property of the Contractor and shall be disposed of in a manner and at a location to the approval of the Project Manager’s Rep.

Where partial demolition of structures is required the Contractor shall take the outmost care not to damage any part of the structure which is to remain in place. If any such damage may occur the Contractor shall repair and make good the damage at his own expense. Unless otherwise directed by the Project Manager’s Rep holes or openings shall be backfilled and compacted to conform to Clause "Backfill for Structures".

4.10 Stripping of topsoil

Unless otherwise directed by the Project Manager’s Rep, this item shall consist of stripping the soil at the top of the original surface over a full depth of 0.15 m. Stripping shall be carried out, if deemed necessary by the Project Manager’s Rep, in the immediate areas to be occupied by the Works, including areas of excavation where material from excavation may be used in fill, areas to be occupied by Temporary Works, or any other areas as directed by the Project Manager’s Rep. Stripped topsoil shall be dumped in approved dump areas not exceeding 2 m high. Stored topsoil shall be kept free of weeds and grasses. Should the Project Manager’s Rep require the Contractor to perform stripping in excess of the required full depth of 0.15m, then such excess stripping shall be measured for payment and be paid for under "Excavation".

4.11 Relocation of utilities

The Contractor shall take at his own expense, any steps necessary to protect and safeguard any drains, pipes, cables and similar services encountered, already installed or to be installed, for the duration of the Contract in order to keep them in good working condition. Should the services become damaged during the course of the Works, then the Contractor shall be responsible for liaising with the responsible utility companies or organizations and arranging for the repair of that service. The Contractor shall bear all costs associated with the repair of the service.

Information as may be given in the Contract in relation to the present condition and character of the existing structures, roadways, embankments and the like and in relation to the dimensions of various parts of the existing structures, the position, extent and particulars of drains, pipes, cables and the like, is given without guarantee of accuracy and neither the Employer nor the Project Manager’s Rep will be liable for any discrepancy there in.

The absence of such information shall not relieve the Contractor of this liability for the cost of any repair work necessitated by damage caused by him to such mains and
services in the course of his work and for the cost of all losses arising from their disruption.

The Contractor shall obtain all available information, assistance, full permission and approval of all relevant utility companies or organizations regarding the positions and/or relocation of mains and services, serving notices of intent to start work as may be necessary in accordance with all the local Laws and Regulations. He shall make this information available to the Project Manager’s Rep as soon as he obtains it. He shall agree with the Project Manager’s Rep any trial excavations which may be necessary to confirm or establish these locations. All costs for executing trial holes shall be deemed to be included in the Contractor's rates for excavation. All locating work shall be carried out four weeks in advance of execution of the relevant work.

Any temporary or permanent diversion and/or relocation of mains and services will only be permitted after agreement with the appropriate utility companies or organizations and the approval of the Project Manager’s Rep.

Where a service, or obstruction is encountered along the route of a pipeline or in other excavation works which prevents the Contractor from carrying out his work, the Contractor is to inform the Project Manager’s Rep immediately of its presence and shall submit details, including the type of service, or obstruction, its dimensions, depth below ground level and his proposed method of overcoming the obstruction or service. Unless already detailed in the contract documents, the Project Manager’s Rep will then advise on the action to be taken.

4.12 Excavation

4.12.1 General

Excavation shall consist of excavating, removing and disposing of satisfactorily any material, regardless of the material encountered, for the several parts of the works. The Contractor's method of excavation shall be subject to the approval of the Project Manager’s Rep.

All materials from excavation remain the property of the Employer. The Contractor shall remove it from the Site and dispose of it in a manner and at a location to the approval of the Project Manager’s Rep.

For the purpose of these Specifications, excavation is distinguished in:

- Earth Excavation
- Rock Excavation

"Earth excavation" is defined as excavation of any naturally occurring or man-made or placed material that can be removed manually or by mechanical shovel, bulldozer or ripper.

"Rock excavation" is defined as excavation of any naturally occurring or man-made or placed material that cannot be removed by other means than by systematic blasting or by barring or by wedging or by the use of pneumatic tools or impact breakers. Materials, including mass concrete, shall not be classified as rock unless the Project Manager’s Rep has agreed to such classification before excavation by the Contractor.
demonstrating to the satisfaction of the Project Manager’s Rep his inability to excavate without having to resort to heavy percussion tools complete with rock bits, hydraulic wedges or blasting. In order to assess the quantities of rock excavation the Contractor will inform the Project Manager’s Rep about his intentions to execute any rock excavation and the Contractor will not execute these excavations without the approval of the Project Manager’s Rep. The Contractor shall keep records of quantities of rock excavations, to be approved by the Project Manager’s Rep.

If areas of excavation are not accessible for earthmoving equipment due to limited working space, traffic or any other reason, excavation shall be carried out manually.

The Contractor shall make records of the position and extent in excavations of every type of service and obstruction encountered during the construction of the works, and samples taken and the results of tests on such samples.

The Contractor shall make records of the position and extent in excavations of every type of service and obstruction encountered during the construction of the works, and samples taken and the results of tests on such samples. Where a service, or obstruction is encountered along the route of a pipeline, the Contractor is to inform the Project Manager’s Rep immediately of its presence and shall submit details, including the type of service, or obstruction, its dimensions, depth below ground level. The Project Manager’s Rep will then advise on the action to be taken. The extent of excavations shall be the minimum practicable in the opinion of the Project Manager’s Rep for construction of the Works. All over excavation shall be filled with suitable material at the Contractor’s expense and to the approval of the Project Manager’s Rep.

4.12.2 Definition and classification of excavated materials

Excavation in the Bills of Quantities shall be excavation in any material which in the opinion of the Engineer can be excavated by use of pick axes and hand levers. Waterlogged material shall be included in this class. Murram in any form shall also be included.

4.12.3 Compaction of fill

All materials used in fill shall be compacted to specification by plant approved by the Engineer for that purpose. Maximum compacted thickness of such layers shall not be more than 200mm.

Work on the compaction of plastic materials for fill shall proceed as soon as practicable after excavation and shall be carried out only when the moisture content is not greater than 2 per cent above the plastic limit for that material. Where the moisture content of plastic material as excavated is higher than this value the material shall be run to spoil and an equal volume of material suitable for filling shall be replaced, unless the Contractor prefers, at his own expense, to wait until the material has dried sufficiently for acceptance again as suitable material.

4.12.4 Stone revetments (stone pitching)

Where shown on the drawings, the slopes of embankments, rivers, streams, watercourses and other surfaces shall be protected against water or other action by
hand-set stone facing set on end. The larger stones shall be roughly dressed on the bed and face, and roughly square to the full depth of the joints. No rounded boulder shall be used, or stones less than 225mm in depth of 0.05 cubic metre in volume. The stones shall be laid to break bond, and shall be well bedded on to a 75mm layer of gravel or fine rubble rammed to a uniform surface and the whole work finished to the satisfaction of the Engineer. Where required, a trench shall be excavated at the bottom of the slope to such a depth as will ensure a safe foundation for the revetment.

4.12.5 Trenches of greater width and depth than necessary

The Contractor shall not be entitled to payment in respect of excavation to any greater extent, whether horizontally or vertically, than is necessary to receive any structure for which the excavation is intended, except where a separate item is provided for additional excavation for working space, timbering, or other temporary work. Excavation to a greater depth or width than directed shall be made good with suitable materials to the satisfaction of the Engineer and at the Contractor’s cost.

4.12.6 Supports for trenches

The sides of trenches shall where necessary be adequately supported to the satisfaction of the Engineer by timber or other approved means.

4.12.7 Provision of spoil heaps

The Contractor shall provide spoil heaps at his own expense for the disposal of surplus material and all rubbish collected when clearing the site and during the construction of the works. The sites for these shall be approved by the Engineer.

4.12.8 Water in excavations

All excavations shall be kept free from water, from whatever source, at all times during construction of works until in the opinion of the Engineer, any concrete or other works therein are sufficiently set. The Contractor’s rates are deemed to cover compliance with this requirement.

The Contractor shall construct any sumps or temporary drains that the Engineer may deem necessary and 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 Engineer so as to ensure that excavations are kept dry.

The Contractor shall provide all plant, labor and materials required for such work and all costs incurred shall be deemed to be included in his rates for excavation.

Excavation for structures includes removal and disposal of material, for all structural excavation.

Should the surface of excavations at foundation level become deteriorated through any cause whatsoever, then the Contractor shall further excavate all material which has in the opinion of the Project Manager’s Rep become unsuitable and he shall replace it at his own expense with such material and in such manner as the Project Manager’s Rep shall direct.
4.12.9 Tolerances for excavation

Unless otherwise specified hereinafter or elsewhere no point on the surface of the complete earthwork shall be more than +0.05 m and less than -0.05 m in distance from the designated surface.

Within the above tolerances the surface shall have a smooth regular face. All to the satisfaction of the Project Manager’s Rep.

Bed levels of drains shall not be higher, (tolerance 0), or more than 0.20 m lower than the correct level. Any over-excavation shall be filled with sand.

4.12.10 Slips, falls and excess excavations

The Contractor shall prevent slips and falls of material from the sides of the excavations and embankments.

In the event of slips, or falls occurring in the excavations and where excavations are made in excess of the specified dimensions, then any unsuitable material that has entered into the excavation is to be removed from the excavation and the additional backfilling that may be required is to be carried out with selected excavated or imported material and compacted to the approval of the Project Manager’s Rep. This shall be at no extra cost to the Employer.

4.12.11 Safety of excavation and adjacent structures

The Contractor shall provide support necessary to ensure the stability of the excavation and adjacent roads and structures.

4.13 Preparation of foundation

The work under this clause shall consist of preparing the foundation which is to receive compacted earth fill roads or structures or which requires preparation for other purposes as directed by the Project Manager’s Rep.

All foundation shall be freed of loose material, remoulded debris or other deleterious material, all to the satisfaction of the Project Manager’s Rep.

Any foundation area shall be well graded for proper drainage and said grading shall be maintained at all times.

Foundations, except where limited by structures, which are to receive fill or structures shall be scarified and loosened by means of a disc harrow or plough or other approved methods to a depth of no more than 0.20 m unless such loosening is not needed in the opinion of the Project Manager’s Rep. Scarifying shall be done approximately parallel to the center line of the fill.

If any unsound material occurs in the bottom of any excavation, the Contractor shall remove it on the Project Manager’s Rep’s instruction and dispose of it to the satisfaction of the Project Manager’s Rep. Unless otherwise specified or ordered by the Project Manager’s Rep, the Contractor shall fill the voids so formed with concrete grade C15 or with suitable granular material to the approval of the Project Manager’s Rep.
After removal of all unsuitable material, the entire foundation area shall be graded; moisture conditioned and thoroughly compacted to 95% of the standard maximum dry density as determined by the compaction control test conforming to BS 1377. The Project Manager’s Rep may direct at his discretion that unsuitable material for foundation shall be removed and replaced with suitable material of the same quality as the overlying fill and treated as compacted fill. No payments will be made for removal and fill not previously approved or instructed by the Project Manager’s Rep.

Where new embankments are to be placed on natural slopes or embankment slopes, benches shall be graded during the construction as directed by the Project Manager’s Rep on Site.

If foundation, which is to receive concrete structures is loosened or disturbed, it shall be compacted to 95% of the standard maximum dry density as determined by the compaction control test conforming to BS 1377, where mechanical compaction is feasible. If mechanical compaction is not feasible then 60% of the standard maximum dry density shall be achieved.

The period between completion of preparation of foundation and the construction of the overlying works shall be kept as short as possible. Structures placed on earth foundations not previously approved by the Project Manager’s Rep, will be removed and the foundation will be prepared in the manner described in this Clause, at the expense of the Contractor.

4.14 Backfill and fill

4.14.1 Fill Material General

Fill material shall not contain brush, roots, frozen material, organic or otherwise unsuitable materials.

No fill material shall be placed in any of the Permanent Works until its foundation has been prepared as specified.

Fill materials shall be handled, placed, spread and compacted in such a manner as to avoid segregation of the fill and to obtain a stable, homogeneous compacted structure.

When organizing his work, the Contractor shall take due account of the climatological conditions which may be expected in the area. Should place material by any cause become unacceptable, the Contractor shall remove such material or shall process it until all specifications are met. Such work shall be performed at no additional cost to the Employer.

Unless otherwise specified or approved the material used for backfill and fill shall be excavated material of particle size not exceeding 75 mm.

Backfill against the permanent work shall be selected, and free from boulders, cobbles, rock fragments and the like greater than 50 mm nominal size, unless otherwise specified or approved.

4.14.2 Fill Material under Structures
Where fill is specified below structures and building floors, the material shall consist of durable gravel, broken stone, crushed concrete or sand with a particle size not exceeding 100 mm. The grading of the material shall be such that there is no migration of fines into the fill.

Fill material under structures shall further comply with all requirements of Clause "Fill material general".

4.14.3 Placing and Compaction of Fill and Backfill

The works to be done under this clause shall comprise the supply of all labor, materials and plant and of all works necessary for receiving, handling, processing, placing, spreading, compacting, wetting, trimming and quality control of fill material for compacted fill as shown on the Drawings or as directed by the Project Manager’s Rep and in accordance with the Specifications.

Unless otherwise specified fill shall be spread by machine or manually in successive horizontal layers of not more than 0.20 m loose depth and the standard compaction requirement will be 95% maximum dry density in accordance with BS 1377.

Operations on earthwork shall be suspended at any time when satisfactory results cannot be obtained because of rain, or other unsatisfactory field conditions. The Contractor shall drag, blade, or slope the embankment to provide proper surface drainage.

The material in the layers shall be of the proper moisture content before compaction. Wetting or drying of the material and manipulation when necessary to secure a uniform moisture content throughout the layer may be required. The Contractor shall take such precautions as may be necessary in the opinion of the Project Manager’s Rep to protect exposed faces against deterioration.

The Contractor shall compact the fill using approved compacting methods and equipment. Backfilling shall not impose uneven or excessive load on a structure.

No fill materials shall be placed or compacted adjacent to concrete less than seven days after the placing of the concrete, without the written permission of the Project Manager’s Rep.

4.14.4 Tolerances for Fill

Unless otherwise specified hereinafter no point on the surface of the completed fill shall be more than 0.05 m above the design level as shown on the Drawings and more than 0.05 m below this design level.

Within the above tolerances the surface shall have a smooth regular face all to the approval of the Project Manager’s Rep.

4.14.5 Control Testing of Fill

Control testing shall be carried out by members of the Contractor's staff competent to perform the required tests. Additional testing may be carried out at the discretion of the Project Manager’s Rep.
4.15 Allowance for settlement

The Contractor shall make due allowance for consolidation and settlement of fill and compacted fill such that the levels and dimensions of the finished surfaces at the end of the Contract are within the tolerances specified.

4.16 Disposal of surplus material

The Contractor shall transport and dispose of all excavated material not required for the Works. The locations proposed by the Contractor for disposing or storing excavated material, whether temporarily or permanently, shall be subject to the approval of the Project Manager’s Rep. Deposits of surplus suitable material and unsuitable materials are referred to as "spoil dumps".

The Contractor shall compact, trim and drain spoil dumps as may be necessary to maintain them in a neat and stable condition and to such levels and slopes the Project Manager’s Rep shall direct.

Placing material in spoil dumps shall be such that it will not contaminate or otherwise render less efficient usable lands or interfere with natural drainage or access. Where required by the Project Manager’s Rep, drains shall be constructed to prevent the undesirable accumulation of water in or around spoil dumps.

4.17 Stockpiling

Temporary deposits of the suitable material which is not required for immediate use are referred to as “stockpiles”.

The Contractor shall compact, trim and drain stockpiles as may be necessary to maintain them in a neat and stable condition and to such levels and slopes the Project Manager’s Rep shall direct.

Stockpiled material shall if necessary be covered and sealed on the surface in wet periods to prevent washing out of the fines or other deterioration of material to the satisfaction of the Project Manager’s Rep. Should any stockpiled material become unsuitable for use as fill for any reason it shall be removed and disposed of at the Contractor's expense and replaced by suitable material at the Contractors expense.

5 CONCRETE WORKS

5.1 General

All concrete works shall be in accordance with the latest International Standards, Kenyan standards to be followed or any other equivalent standard proposed by the Contractor and approved by the Project Manager’s Rep.

5.2 Definitions

Structural concrete is any class of concrete which is used in reinforced, prestressed or unreinforced concrete construction, which is subject to stress.

Non-structural concrete is composed of materials complying with the Specification but for which no strength requirements are specified and which is used only for filling
voids, blinding foundations and similar purposes where it is not subjected to significant stress.

A formed surface is a face which has been cast against formwork.

An unformed surface is a horizontal or nearly horizontal surface produced by screeding or trowelling to the level and finish required.

A pour refers to the operation of placing concrete into any mould, bay or formwork, etc. and also to the volume which has to be filled. Pours in vertical succession are referred to as lifts.

5.3 The design of concrete mixes

The classes of structural concrete to be used in the works shall be those shown on the Drawings and designated in Table 4.1, in which the class designation includes two figures. The first figure is the nominal strength at 28 days expressed in N/mm$^2$ and the second figure is the maximum nominal size of aggregate in the mix expressed in millimetres.

<table>
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<tr>
<th>Class of Concrete</th>
<th>Nominal Strength N/mm$^2$</th>
<th>Maximum Nominal Size of Aggregate mm</th>
<th>Maximum Water / Cement Ratio</th>
<th>Trial Mixes Target Mean Strength (Clause 401 c) N/mm$^2$</th>
<th>Early Works Test Cubes (Clause 401 d)</th>
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5.4 **Hand-mixed concrete**

Concrete for structural purposes shall NOT be mixed by hand. Where non-structural concrete is required, hand mixing may be carried out subject to the agreement of the Engineer.

The mixing shall be done on a hard impermeable surface. The materials shall be turned over not less than three times dry, water shall then be sprayed on and the materials again turned over not less than three times in a wet condition and worked together until a mixture of uniform consistency is obtained.

For hand mixed concrete the specified quantities of cement shall be increased by 10% and not more than 0.5 cubic metre shall be mixed at one time. During windy weather efficient precautions shall be taken to prevent cement from being blown away during the process of gauging and mixing.

5.4.1 **Transport of concrete**

The concrete shall be transported to the Works by means which shall prevent adulteration, segregation or loss of ingredients, and which shall ensure that the concrete is of the required workability and consistency at the point and time of placing.

The time elapsed between mixing and placing a batch of concrete shall be as short as practicable as and in any case not longer than will permit completion of placing and
5.4.2 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, and the Contractor shall give the Engineer at least 1 full working days’ notice of his intention to place concrete. If concrete placing is not commenced within 24 hours of the Engineer’s consent the Contractor shall again request consent as specified above.

b) Preparation of surface to receive concrete

Excavated surfaces on which concrete is to be deposited shall be prepared as set out in Section 3 of this Specification.

Existing concrete surfaces shall be prepared as set out in Clause 414. Before deposition of further concrete they shall be clean, hard and sound and shall be wet but without any free-standing water.

Any flow of water into an excavation shall be diverted through proper side drains to a sump, or be removed by other suitable methods which will prevent washing away the freshly deposited concrete or any of its constituents. Any underdrains constructed for this purpose shall be completely grouted up when they are no longer required by a method agreed by the Engineer.

Unless otherwise instructed by the Engineer surfaces against which concrete is to be placed shall receive a prior coating of mortar mixed in the proportions similar to those of the fines portion in the concrete to be placed. The mortar shall be kept ahead of the concrete. The mortar shall be well worked into all parts of the excavated surface and shall not be less than 5mm thick.

If any fissures have been cleaned out as described in Section 3 of this Specification they shall be filled with mortar or with concrete as instructed by the Engineer.

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.

c) Chutes

In general, transportation of concrete by the use of chutes will not be permitted unless approved by the Engineer. The chute shall have a section with round corners and shall have a proper fixed slope so as to allow the concrete to flow satisfactorily and without segregation. The lower end of chute shall be provided with a drop chute not less than 0.6m in height to avoid segregation of falling concrete. The height of drop shall not exceed 1.5m. Chutes shall be protected from direct sunlight, wind and rain.

d) 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 be brought up in layers approximately parallel to the construction joint planes and not exceeding 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.

Layers shall be placed so that they do not form feather edges nor shall they be placed on a previous layer which has taken its initial set. In order to comply with this requirement, a layer may be started before completion of the preceding layer.

All the concrete in a single bay or pour shall be placed in a continuous operation. It shall be carefully worked round all obstructions, irregularities in the foundations and the like so that all parts are completely full of compacted concrete with no segregation or honeycombing. It shall also be carefully worked round and between water stops, reinforcement, embedded steelwork and similar items which protrude above the surface of the completed pour.

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. Means shall be provided to remove any water accumulating on the surface of the placed concrete. Concrete shall not be deposited into such accumulation of water.

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.

e) Interruptions to placing

If concrete placing is interrupted for any reason and the duration of the interruption cannot be forecast or is likely to be prolonged, the Contractor shall immediately take the necessary action to form a construction joint so as to eliminate as far as possible feather edges and sloping top surfaces and shall thoroughly compact the concrete already placed in accordance with Clause 406. All work on the concrete shall be completed while it is still plastic and it shall not thereafter be disturbed until it is hard enough to resist damage. Plant and materials to comply with this requirement shall be readily available at all times during concrete placing.

Before concreting is resumed after such an interruption the Contractor shall cut out and remove all damaged or uncompacted concrete, feather edges or any other undesirable features and shall leave a clean sound surface against which the fresh concrete may be placed.
If it becomes possible to resume concrete placing without contravening the Specification and the Engineer consents to a resumption, the new concrete shall be thoroughly worked in and compacted against the existing concrete so as to eliminate any cold joints.

**f) Dimensions of pours**

Unless otherwise agreed by the Engineer, pours shall not be more than two metres high and shall as far as possible have a uniform thickness over the plan area of the pour. Concrete shall be placed to the full planned height of all pours except in the circumstances described in sub-clause 405(d).

The Contractor shall plan the dimensions and sequence of pours in such a way that cracking of the concrete does not take place due to thermal or shrinkage stresses.

**g) Placing sequence**

The Contractor shall arrange that as far as possible the intervals between placing successive lifts of concrete in one section of the Works are of equal duration. This duration shall normally be not less than three or more than seven days under temperate weather conditions unless otherwise agreed by the Engineer.

Where required by the Engineer to limit the opening of construction joints due to shrinkage, concrete shall not be placed against adjacent concrete which is less than 21 days old.

When the drawings call for contraction gaps in concrete, these shall be of the widths and in the locations shown on the drawings and they shall not be filled until the full time interval shown on the drawings has elapsed.

**5.4.3 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, unless the Engineer agrees to another method.

Immersion vibrators shall operate at a frequency of between 7,000 and 10,000 cycles per minute. The Contractor shall ensure that vibrators are operated at pressures and voltages not less than those recommended by the manufacturer in order that the compactive effort is not reduced.

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.
Where the concrete contains aggregate with a nominal size of 75mm or more, vibrators with a diameter of 100mm or more shall be used.

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 not be used to move concrete laterally and shall be withdrawn slowly to prevent the formation of voids.

Vibration shall not be applied by way of reinforcement nor shall vibrators be allowed to touch reinforcement or other embedded items. 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.

5.4.4 Curing of concrete

a) General

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 as long as may be necessary to achieve the above objectives but in any case for at least seven days or until the concrete is covered by later construction whichever is the shorter period.

The above objectives are dealt with in sub-clause 407(b) and (c) but nothing shall prevent both objectives being achieved by a single method where circumstances permit.

The curing process shall commence as soon as the concrete is hard enough to resist damage from the process, and in the case of large areas or continuous pours, shall commence on the completed section of the pour before the rest of the pour is finished. Details of the Contractor’s proposals for curing concrete shall be submitted to the Engineer before the placing of concrete commences in the Works.

Formed surfaces may be cured by retaining the formwork in place for the required curing period.

If the use of the foregoing methods is inappropriate, surfaces which will not have further concrete bonded to them and which are not to receive an application of a finish may be cured by the application of a curing compound having an efficiency index of at least 90 percent. Curing compounds shall contain a fugitive dye to enable the extent of the spread to be seen easily.

Curing compound is used on surfaces exposed to the atmosphere shall contain sufficient finely divided flake aluminium in suspension to produce a complete coverage of the surface with a metallic finish when applied at the rate recommended by the manufacturer.
Curing compounds shall become stable and impervious to the evaporation of water from the concrete surface within 60 minutes of application. The material shall not react chemically with the concrete surfaces for at least the first four days of the curing period.

If instructed by the Engineer, the Contractor shall, in addition to the curing provisions set out above provide a suitable form of shading to prevent the direct rays of the sun reaching the concrete surfaces for at least the first four days of the curing period.

b) Loss of moisture

Exposed concrete surfaces shall be closely covered with impermeable sheeting, properly secured to prevent its removal by wind and the development of air spaces beneath it. Joints in the sheeting shall be lapped by at least 300mm.

If for some reason it is not possible to use impermeable sheeting, 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, unless this method conflicts with sub-clause 407(c).

Water used for curing shall be of the same quality as that used for concrete mixing as stated in sub clause 702(g).

c) Limitation of temperature differential

The Contractor shall limit the development of temperature differentials in concrete after placing by any means appropriate to the circumstances including the following:

i) limiting concrete temperatures at placing as set out in sub-clause 409(b); ii) use of low heat cement, subject to the agreement of the Engineer; iii) insulation of exposed concrete surface by insulating blankets. Such blankets shall have an insulation value at least equivalent to 50mm of dry mineral wool;

iv) leaving formwork in place during the curing period. Steel forms shall be suitably insulated on the outside; v) preventing rapid dissipation of heat from surfaces by shielding from wind; vi) avoiding the use of water sprays when such use would cause rapid cooling of the surface.

5.4.5 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 as defined in Clause 401.

If the Contractor desires to impose loads on newly-placed concrete, he shall make at least three test cubes and cure them in the same conditions as the concrete they represent. These cubes shall be tested singly at suitable intervals in order to estimate the time at which the nominal strength is reached.
5.4.6 Concreting in hot weather

a) General

The Contractor shall prevent damage to concrete arising from exposure to extreme temperatures, and shall maintain in good working order all plant and equipment required for this purpose.

In the event that conditions become such that even with the use of the equipment the requirements cannot be met, concrete placing shall immediately cease until such time as the requirements can again be met.

b) Concrete placing in hot weather

During hot weather the Contractor shall take all measures necessary to ensure that the temperature of concrete at the time of placing in the Works does not exceed 30 degrees centigrade and that the concrete does not lose any moisture during transporting and placing.

Such measures may include but are not necessarily limited to the following:

i) Shielding aggregates from direct sunshine. ii) Use of a mist water spray on aggregates iii) Sun shields on mixing plants and transporting equipment. iv) Cooling the mixing water. If ice is used for this purpose it should preferably be in flake form. Lump ice shall not be allowed to enter the tank supplying the mixer drum. v) Covering skips closely with polythene sheet so that the latter is in contact with the concrete.

Areas in which concrete is to be placed shall be shielded from direct sunshine and rock or concrete surfaces shall be thoroughly wetted to reduce absorption of water from the concrete placed on or against them.

After concrete in any part of an area has been placed, the selected curing process shall be commenced as soon as possible. If any interval occurs between completion of placing and start of curing, the concrete shall be closely covered during the interval with polythene sheet to prevent loss of moisture.

5.4.7 Finishes on unformed surfaces

Horizontal or nearly horizontal surfaces which are not cast against formwork shall be finished to the class shown on the drawings and defined hereunder.

UF 1 Finish

All surfaces on which no higher class of finish is called for on the drawings or instructed by the Engineer shall be given a UF 1 finish.

The concrete shall be levelled and screeded to produce a uniform plain or ridged surface, surplus concrete being struck off by a straight edge immediately after compaction.
UF 2 Finish

This is a floated finish for roof or floor slabs and other surfaces where a hard trowelled surface is not required.

The surface shall first be treated as a Class UF 1 finish and after the concrete has hardened sufficiently, it shall be floated by hand or machine sufficiently only to produce a uniform surface free from screed marks.

UF 3 Finish

This is a hard trowelled surface for use where weather resistance or appearance is important, or which is subject to high velocity water flow.

The surface shall be floated as for a UF 2 finish but to the tolerance stated below. When the moisture film has disappeared and the concrete has hardened sufficiently to prevent laitance from being worked to the surface, it shall be steel trowelled under firm pressure to produce a dense, smooth uniform surface free from trowel marks.

Table 2 - SURFACE TOLERANCES

<table>
<thead>
<tr>
<th>Class of Finish</th>
<th>Tolerance in mm. See notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>UF 1</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>+ 20 or - 10</td>
</tr>
<tr>
<td>UF 2</td>
<td>Nil</td>
</tr>
<tr>
<td></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>+ 20 or - 10</td>
</tr>
<tr>
<td>UF 3</td>
<td>Nil</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>+ 12.5 or -7.5</td>
</tr>
</tbody>
</table>

Notes:

1. Col. A is the maximum allowable value of any sudden change of level in the surface.

2. Col. B is the maximum allowable value of any gradual irregularity of the surface, as indicated by the gap between the surface and a three metre long straight edge or correctly shaped template placed on the surface.

3. Col. C is the maximum allowable value of the difference in level or position between a three metre long straight edge or correctly shaped template placed on the surface and the specified level or position of that surface.

Where dimensional tolerances are given on the drawings or in this Special Specification they shall take precedence over those given in Table 5.2.

5.4.8 Mortar

This clause covers mortar for use ahead of concrete placing, and other uses not covered elsewhere in the Specification.
Mortar shall be composed of fine aggregate complying with sub-clause 702(c) and ordinary Portland cement complying with SRN 103. The mix proportions shall be as stated on the drawings or elsewhere in this Specification or if not stated shall be one part of cement to two parts of fine aggregate by weight.

Small quantities of mortar may be hand mixed but for amounts over 0.5 cubic metre a mechanical mixer shall be used.

The water content of the mortar shall be as low as possible consistent with the use for which it is required but in any case the water/cement ratio shall not be more than 0.5.

Mortar which is specified as ‘dry pack’ shall be mixed with sufficient water for the mix to become cohesive but not plastic when squeezed in the hand. Dry pack mortar shall be rammed into the cavity it is required to fill, using a hand rammer with sufficient force to ensure full compaction.

5.4.9 Remedial work to defective surfaces

If on stripping any formwork the concrete surface is found to be defective in any way, the Contractor shall make no attempt to remedy such defects prior to the Engineer’s inspection and the receipt of any instructions which the Engineer may give.

Defective surfaces shall not be made good by plastering.

Areas of honey combing (of a mild nature) which the Engineer agrees may be repaired shall be cut back to sound concrete or to 75mm whichever is the greater distance. In the case of reinforced concrete the area shall be cut back to at least 25mm clear distance behind the reinforcement or to 75mm, whichever is the greater distance. The cavity shall have sides at right angles to the face of the concrete. After cleaning out with water and compressed air, a thin layer of cement grout shall be brushed on to the concrete surface in the cavity and it shall then be filled immediately with concrete of the same class as the main body but with aggregate larger than 20mm nominal size removed. A form shall be used against the cavity, provided with a lip to enable concrete to be placed. The form shall be filled to a point above the top edge of the cavity.

After seven days the lip of concrete shall be broken off and the surface ground smooth.

Surface irregularities which are outside the limits of tolerance set out in Clause 410 shall be ground down in the manner and to the extent instructed by the Engineer.

Severe honeycombing and defects other than those mentioned above shall be dealt with as instructed by the Engineer.

5.5 Material

5.5.1 Material for concrete

a) General

The Contractor shall submit to the Engineer full details of all materials which he proposes to use for making concrete. No concrete shall be placed in the Works until
the Engineer has approved the materials of which it is composed. Approved materials shall not thereafter be altered or substituted by other materials without the consent of the Engineer.

b) Cement

Cement shall comply with the following Kenya Standards:

SRN 103 for Ordinary Portland cement.

SRN 103 for Rapid Hardening Portland cement plus all special conditions to its use stipulated by the manufacturer.

SRN 104 for Sulphate Resisting or High Alumina cement.

Cement shall be free flowing and free of lumps. It shall be supplied in the manufacturer’s sealed unbroken bags or in bulk. Bagged cement shall be transported in vehicles with effective means of ensuring that it is protected from the weather.

Bulk cement shall be transported in vehicles or in containers specially built and equipped for the purpose.

Cement in bags shall be stored in a suitable weatherproof structure of which the interior shall be dry and well ventilated at all times. The floor shall be raised above the surrounding ground level and shall be so constructed that no moisture rises through it.

Each delivery of cement in bags shall be stacked together in one place. The bags shall be closely stacked so as to reduce air circulation but shall not be stacked against an outside wall. If pallets are used, they shall be constructed so that bags are not damaged during handling and stacking. No stack of cement bags shall exceed 3 metres in height. Different types of cement in bags shall be clearly distinguished by visible markings and shall be stored in separate stacks.

Cement from broken bags shall not be used in the Works.

Cement in bags shall be used in the order in which it is delivered.

Bulk cement shall be stored in weatherproof silos which shall bear a clear indication of the type of cement contained in them. Different types of cement shall not be mixed in the same silo.

The Contractor shall provide sufficient storage capacity on site to ensure that his anticipated program or work is not interrupted due to lack of cement.

Cement which has become hardened or lumpy or fails to comply with the Specification in any way shall be removed from the site.

All cement for any one structure shall be from the same source.

Cement which is stored on site for longer than one month shall be rejected.

c) Fine Aggregate
Fine aggregate shall be clean, hard and durable and shall be natural sand, crushed gravel sand or crushed rock sand complying with SRN 108. All the material shall pass through a 5mm standard sieve and the grading shall be in accordance with Zones 1, 2 or 3 of SRN 109. In order to achieve an acceptable grading, it may be necessary to blend materials from more than one source. Fine aggregate for mortar only shall comply with SRN 135.

The fine aggregate shall not contain iron pyrites or iron oxides. It shall not contain mica, shale, coal or other laminar, soft or porous materials or organic matter unless the Contractor can show by comparative tests, on finished concrete as set out in SRN 117, that the presence of such materials does not adversely affect the properties of the concrete.

d) Coarse aggregate

Coarse aggregate shall be clean, hard and durable crushed rock, crushed gravel or natural gravel complying with the requirements of SRN 110. The material shall not contain any iron pyrites, iron oxides, flaky or laminated material, hollow shells, coal or other soft or porous material, or organic matter unless the Contractor can show by comparative tests on finished concrete as set out in SRN 117 that the presence of such materials does not adversely affect the properties of the concrete. The pieces shall be angular, rounded or irregular as defined in SRN 107.

Coarse aggregate shall be supplied in the nominal sizes called for in the Contract and shall be graded in accordance with SRN 111 for each nominal size.

f) Delivery and storage of aggregates

Aggregates shall be delivered to site in clean and suitable vehicles. Different types or sizes of aggregate shall not be delivered in one vehicle.

Each type or size of aggregate shall be stored in a separate bin or compartment having a base such that contamination of the aggregate is prevented. Dividing walls between bins shall be substantial and continuous so that no mixing of types or sizes occurs.

The storage of aggregates shall be arranged so that as far as possible rapid drying out in hot weather is prevented in order to avoid sudden fluctuations in water content. Storage of fine aggregates shall be arranged so that they can drain sufficiently before use in order to prevent fluctuations in water content of the concrete.

h) Water for concrete and mortar

Sea water or brackish water containing more than 1,000 ppm chloride ion or 2,000 ppm sulphate ion shall not be used for mixing or curing concrete.

Water shall be clean and free from harmful matter and shall comply with the requirements of SRN 114.

The Contractor shall carry out tests in accordance with SRN 114 to establish compliance with the Specification.

5.5.2 Building stone
All building stone shall be capable of withstanding when wet a crushing stress of 1.4 kg./sq.mm. The source of stone shall be approved by the Engineer and stone supplied there from shall be free from Magadi, overburden, mudstone, cracks, sandholes, veins, laminations or other imperfections.

The stone shall be chisel dressed into true rectangular blocks, with each surface even and at right angles to all adjoining surfaces, to the size specified. For exposed stonework the maximum permissible variation of any of the specified dimensions shall be 6mm provided that cut stone, supplied as ‘rock face’ stone may be hammer dressed on one face only, or on one face and one end, if in other respects it conforms with this specification. Stones shorter than 375mm will not be accepted.

Unless the Engineer allows otherwise the Contractor shall at his own expense provide and dress four 100mm cubes of stone for testing.

The stone shall be sound when tested in accordance with SRN 870 except that:

i) The treatment shall be repeated for 10 cycles only; and

ii) The second criterion of failure shall be amended to allow for a loss of weight of not more than 20% of its original weight.

5.5.3 Murram

Murram shall be from an approved source quarried so as to exclude vegetable matter, loam, top soil or clay. The California Bearing Ratio of the murram, as determined for a sample compacted to maximum density (as defined under SRN 601) and allowed to soak in water for four days, shall not be less than 30%. This C.B.R. is a guide to quality only and the compaction in the work will be judged by density.

5.5.4 Cement mortar

Cement mortar shall consist of proportions by volume as specified of Portland cement and natural sand or crushed natural stone or a combination of both as specified in SRN 135 and SRN 136: Building Sands from Natural Sources. The constituent materials shall be accurately gauged and mixed in an approved manner.

Cement mortar shall be made in small quantities only as and when required, and any mortar which has begun to set or which has been mixed for a period of more than one hour shall be rejected.

5.5.5 Concrete blocks

Solid and hollow concrete blocks for walling shall comply with SRN 904 in every respect.

All solid and hollow concrete blocks used in the walling must be capable of withstanding a crushing pressure of not less than 0.35 kg per square millimeter after 28 days. The blocks shall be cast in Metric sizes.

5.5.6 Cement

The cement to be used in the works shall be obtained from approved Manufacturer and the cement shall comply with one of the following sub-Clauses (I) to (iv) below:
BS 12 (Ordinary and rapid-hardening Portland cement).

BS 146 (Portland-blast furnace cement).

BS 4027 (Sulphate resisting Portland cement).

BS 6588 (Portland pulverized-fuel ash cement) provided that sub-Clause (vii) below is complied with.

A mixture of BS 12 (Portland cement) and BS 3892: Part 1 (Pulverized-fuel ash for use in structural concrete) provided that the amount of pulverized-fuel ash is not less than 15% nor more than 35% by weight of the total cement and sub-Clause (vii) below is complied with.

A mixture of BS 12 (Portland cement) and BS 6699 (Ground granulated blast furnace slag for use with Portland cement) provided that the amount of slag is not more than 65% by weight of the total cement.

The pulverized-fuel ash used shall have a maximum color index of 6 (Color comparator disc reference No. 296570) when measured using the Lovibond Color 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 80°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 Engineer may allow such cement to be used in non-structural concrete mixes. Any cement which is stored on site for a period in excess of 28 days shall be tested in accordance with the relevant standard prior to use. Cement of different types shall be kept separate in storage and shall not be mixed together in the production of concrete. If intermixing occurs all cement concerned will be condemned by the Engineer and shall be removed immediately from site.

No cement containing hardening or waterproofing compounds shall be used nor shall calcium chloride or other chemicals be added to cement or to concrete except on the instructions of the Engineer. Any cement so treated shall be stored separately and clearly marked and shall only be used in accordance with the requirements of the Engineer.

It shall be stored off the ground and under cover, thoroughly dry and well ventilated. Cement in bags shall not be stacked more than 2m high. Each batch shall be stacked separately and be easily identifiable and used in the order of delivery. No cement shall
be used which has been manufactured more than twelve (12) months prior to its proposed use on Site.

5.5.7 Water

Water used in the Works shall be clean, fresh, water free from all deleterious matter, silt, organic matter, alkali, slate and other impurities. It shall preferably be from a potable water source (from the public water supply network) or from other approved sources.

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.

5.5.8 Aggregates

Aggregates shall be obtained from a source to be approved by the Engineer. Coarse and fine aggregates shall be delivered and stored separately on to a clean, hard base, in separate compartments or into approved hoppers. Samples of aggregates and sand for use on the works shall be submitted and the together with tests results from reputable materials testing laboratories.

Fine and coarse aggregates shall be as defined by and be of the quality and nature required by BS 882 and BS 1201 whichever is applicable. In addition they shall be chemically inert to alkali reaction.

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

The Contractor shall ensure that the nature and grading of aggregates remain reasonably consistent, and shall, if necessary, stockpile and include different grading to ensure that the overall grading remains constant for each section of the work.

Dust or flour resulting from crushing the aggregate shall not be allowed to contaminate the stockpiles. When, in the opinion of the Engineer, 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, may, subject to test, be included in controlled quantities to supplement the fine aggregate.

The aggregates of various sizes shall be kept separate and away from all possible contamination, and shall be stored on a hard-standing area or in bins and provided with proper drainage at the base of the stockpiles.

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

10 mm max. Size, graded, for all "fine" concrete.

20 mm max. Size, graded, for all reinforced concrete in beams and for wall sand slabs not greater than 400 mm thick.

40 mm max. Size, graded, for all reinforced concrete walls and slabs in excess of 400 mm thick.

**Fine Aggregate:**

Where aggregates conforming to Zones 2 or 3 of BS 882 are available they shall be used.

For Prescribed Mixes, Zones 1, 2, or 3 aggregates only shall be used.

**Additives**

The concrete shall be made from the cement, aggregates and water as specified. No other ingredients shall be mixed with the concrete without the prior written approval of the Project Manager’s Rep.

**5.5.9 Reinforcement**

**Steel**

Reinforcement shall be:

Plain round mild steel or High Yield steel bars conforming to BS 4449.

Cold worked steel bars conforming to BS 4461

Fabric reinforcement made of cold drawn high tensile bars conforming to BS4483. The Contractor shall obtain from his suppliers’ certificates of the mechanical and physical properties of the reinforcement and shall submit them to the Engineer 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 galvanized reinforcement is specified, galvanizing shall comply with the requirements of BS 729, Part 1.

Steel tying wire for reinforcement shall comply with the relevant Kenyan Standards and be 3-4 mm in diameter.

**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 Engineer.
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 Engineer.

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 3.26. 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 recent cold subject to the Engineer's prior approval. Any discrepancy or inaccuracy found in the drawings shall be notified to the Engineer immediately.

After bending, reinforcement shall be securely bundled and labeled 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.

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 Engineer'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 Engineer, 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 a delayed period of time, it shall be thoroughly cleaned and painted with neat cement grout.
Where galvanized reinforcement is used any damage suffered by galvanizing shall be made good by the application of an approved galvanizing formulation, before concrete placing is commenced.

**Couplers**

Couplers for reinforcement shall be either Standard Swaged Splices or Type II Alpha Couplers manufactured by CCL Systems Limited, 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.

**Supply and Testing**

All reinforcement shall be obtained from a manufacturer approved by the Project Manager’s Rep. The Contractor shall have samples of the steel tested as specified by the Project Manager’s Rep by a testing authority approved by the Project Manager’s Rep to prove that the quality is in accordance with the specifications. The costs of such tests will be borne by the Contractor. The Contractor shall supply to the Project Manager’s Rep a manufacturer's test certificate in respect of each batch of reinforcement delivered to Site together with the delivery note giving details of such consignment.

Reinforcement steel shall be delivered firmly tied in bundles. On all bundles shall be indicated on the outside, the manufacturer and the quality, the date of delivery at the Site and the length, diameters and number of bars.

Reinforcement steel shall be stored in racks, clear off the ground and shall be protected from rusting, damage and oil or other deleterious matter.

**5.5.10 Control of Alkali-Silica Reaction**

The risk of cracking and expansion due to alkali-silica reaction shall be minimized by compliance with the specification and guidance notes set out in Concrete Society Technical Report No. 30.

**5.6 Concrete**

The Contractor shall design and form all concrete to meet the requirements of this Specification and the associated service conditions. These requirements are directed to the achievement of durability as well as strength. All concrete shall be designed for a Severe Exposure Condition as indicated in BS 8110, Clause 4.3.2. Water retaining structures shall be designed to BS 8007. All other concrete shall be designed to BS8110.
The concrete shall be designed to resist chemical attack by the water and soil into which it will come into contact. Evidence of this design, using internationally recognized codes, shall be submitted to the Project Manager’s Rep.

5.6.1 Ready-mixed Concrete

Where concrete is to be obtained from a ready-mix supplier, the Contractor shall obtain the Project Manager’s Rep’s approval of the source and shall satisfy the Project Manager’s Rep that the supplying plant is capable of producing concrete to the required standard. The Contractor shall also inform the Project Manager’s Rep what alternative suppliers are available to him if the approval of the source referred to above has to be withdrawn by the Project Manager’s Rep during the currency of the Contract.

The delivery ticket required for each load of ready mixed concrete shall detail:

- the grade or mix description of the concrete
- the specified workability
- the minimum cement content
- the maximum free water/cement ratio
- the quantity of concrete in cubic meters
- the time of loading
- the type and nominal maximum size of aggregate
- the type or name and proportion of any admixture,
- the actual cementitious content and the percentage of any Pfa or Ggbs included
- the position of the concrete in the Works.

All delivery tickets shall be kept at the Site and shall be made available for inspection by the Project Manager’s Rep.

The full requirements for the materials and workmanship specified herein, including all sampling, testing and returns, shall apply equally to concrete mixed on site as to ready-mixed concrete.

Water shall not be added to concrete in a truck mixer drum other than at the batching plant. The mix shall be continuously agitated during transportation. The transportation and placing times shall be reviewed and rigidly enforced in relation to the circumstances of distance and risk of traffic delays I transit.

5.6.2 Concrete Mixes

Schedules for specifying concrete (Forms A, B, C and D) are appended at the end of this section. These are to be completed by the Contractor for any Contractor-designed elements and submitted to the Project Manager’s Rep for approval prior to the Contractor placing an order for the supply of concrete. The 4 mix types are defined as follows.

a) Designed mix: Mix for which the purchaser is responsible for specifying the required performance and the producer is responsible for selecting the mix proportions to produce the specified performance.
b) **Prescribed mix**: Mix for which the purchaser specifies the proportions of the constituent materials and is responsible for ensuring that these proportions produce a concrete with the required performance.

c) **Standard mix**: Mix selected from the restricted list given in section 4 of BS5328 Part 2 1997 and made with a restricted range of materials.

d) **Designated mix**: Mix produced in accordance with the specification given in section 5 of BS5328 Part 2 1997 and requiring the producer to hold current product conformity certification based on product testing and surveillance coupled with the approval of the producer's quality system to BS EN ISO9001.

Concrete mixes designed by the Contractor shall take adequate precautions against the risk of cracking from thermal contraction and shrinkage and alkali-aggregate reactivity.

At least four weeks before any concrete works are proposed, the Contractor shall submit to the Project Manager’s Rep, and obtain his approval before concreting commences, the following information:

- The nature and source of each constituent material. The source of supply of concrete and any alternative sources that may be used. Details of all concrete mixes such as: concrete grade the proposed proportions or quantity of each constituent per cubic meter of fully compacted concrete air content of air-entrainment if applicable chloride, reactive alkali and sulphate contents target workability

e) Details of the proposed general method of construction, striking times of formwork, the methods of placing concrete, and the size and sequence of concrete pours.

f) The proposed methods of curing concrete. The Project Manager’s Rep shall be informed of any changes to the source of constituent materials or their proportions.

**5.6.3 Trial Mixes**

Unless existing data on materials and properties of concrete mixes are available, preliminary laboratory tests shall be carried out to determine that the mixes satisfy the specification with the available materials.

Where field trial mixes are required, three separate batches of concrete shall be made using materials typical of the proposed source of supply and, where practicable, under full scale production conditions.

The workability, air content and density of each of the trial batches shall be determined and three cubes made from each batch for test at 28 days. The average 28-day strength of the three trial mixes shall not be less than the design target mean strength.

**5.6.4 Concrete Mixes Containing PFA or GGBS**
The free water /cementitious ratio of concrete mixes containing pfa shall be reduced in relation to the pfa content, consistent with maintenance of the required workability, and shall not exceed 0.50 for concrete designed to retain an aqueous liquid.

Sulphate-resisting cement shall not be used in concrete mixes containing pfa. Sulphate-resisting cement shall not be used in concrete mixes containing ggbs.

**8.6.5 Porous No-fines Concrete**

Porous no-fines concrete shall contain ordinary Portland cement and 20mm single sizes aggregate in a proportion of 1:10 by mass.

The concrete shall be mixed to a uniform color and consistency with the addition of water sufficient only to coat all of the aggregate without forming excess grout.

The concrete shall not be mechanically vibrated or excessively worked when placed.

**8.6.6 Air-entrained Concrete**

Where air-entrained concrete is required, it shall have an average air content by volume of the fresh concrete at the time of placing of 5%-7% measured using an air-entrainment meter.

**5.6.7 Chloride Content**

Calcium chloride or admixtures containing calcium chloride shall not be used in the production of reinforced concrete or concrete which is to contain embedded metal.

The total estimated content of chloride ion by mass of cement in reinforced concrete or concrete which is to contain embedded metal shall not exceed the following limits:

<table>
<thead>
<tr>
<th>TABLE 3: CHLORIDE ION LIMITS FOR CONCRETE CONTAINING EMBEDDED METALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland cement concrete, or combination with Pfa and Ggbs</td>
</tr>
<tr>
<td>Concrete made with sulphate resisting cement</td>
</tr>
<tr>
<td>Steam –cured and prestressed concrete</td>
</tr>
</tbody>
</table>

**5.6.8 Batching and Mixing**

Cementitious components and aggregates shall be batched by mass to within ±2% of the target batch masses. Water and admixtures shall be batched by volume to within ±1% of the target batch volumes.

Due allowance shall be taken of the moisture content of the aggregates when batching the aggregates and water.

Mixing shall be by a forced impeller action pan mixer or horizontal axis drum mixer. The batch quantities shall be between 30% and 60% of the rated capacity of the mixer.

The time of mixing shall not be less than 2 minutes and shall be sufficient to produce a concrete of uniform color.

**5.6.9 Workability**
Workability of fresh concrete shall be such that the concrete can be handled and placed without segregation and, after compaction, can completely fill the formwork and surround all reinforcement and ducts.

5.6.10 Transporting, Placing and Compacting

Concrete shall be transported from the mixer and placed in the Works as rapidly as practicable by methods which will prevent the segregation or loss of any of the ingredients and will maintain the required workability. It shall be deposited as nearly as practicable in its final position and all equipment for transporting concrete shall be kept clean. The Contractor shall give to the Project Manager’s Rep not less than 24 hours written notification of his intention to pour concrete.

Concrete shall be thoroughly compacted in its final position within 30 minutes of discharge from the mixer, unless carried in purpose-made agitators operating continuously, when the time shall be within 2 hours of the introduction of the cement to the mix and within 30 minutes of the discharge from the agitator.

The plant used for compaction shall be operated continuously during the placing of each batch of concrete until the expulsion of air has virtually ceased, and in a manner which does not promote segregation of the ingredients.

Whenever vibration has to be applied externally, the design of formwork and disposition of vibrators shall be such as to ensure efficient compaction and to avoid surface blemishes.

Placing shall not be commenced until the fixing and condition of reinforcement and items to be embedded and the condition of the containing surfaces or formwork have been approved.

Concrete shall be transported by means which prevent contamination (by dust, rain etc.), segregation or loss of ingredients, and shall be transported and placed without delay. The height of concrete to be placed in one pour shall be agreed with the Project Manager’s Rep before placing commences. Concrete shall be placed directly in its final position without displacement of the reinforcement, embedded items and formwork.

The size and sequence of pours in either precast units or in situ concrete, and the sequence of erection and in situ connection of precast units, shall be arranged in such a manner as to minimize internal and external restraint and associated thermal and shrinkage cracking. Detailed methods shall be set out by the Contractor in his method statements.

Vibration shall not be applied directly or indirectly to concrete after the initial set has taken place, nor shall it be used to make concrete flow in formwork.

Placing in each section of work shall be continuous between construction joints. The Contractor shall make provision for standby equipment. If the placing of concrete is delayed by more than 30 minutes due to breakdown then the Contractor shall erect vertical stop ends and form a construction joint or remove the concrete already placed and restart after repair of the breakdown, as directed.
Placing shall not take place in the open during storms, heavy rains or snow. If such conditions are likely to occur the Contractor shall provide protection for the materials, plant and formwork so that work may proceed. If strong winds are prevalent, protection from driving rain and dust shall be provided. The Contractor shall agree a casting sequence with the Project Manager’s Rep at least 7 days before placing concrete. The Contractor shall cast concrete bays sequentially and shall avoid infill panels.

5.6.11 Concrete Temperature

The resultant temperature of the combined materials in any batch of concrete at the point and time of delivery to the Works shall not exceed 60°C above the prevailing shade temperature, when the latter is over 210°C.

Where the temperature of the fresh concrete is likely to exceed 320°C, concreting shall not be permitted unless measures are taken to keep the temperature below that level. These measures may include, but not be restricted to the following:

- cooling the mixing water
- shading the materials
- spraying the aggregates with water
- painting the plant white

5.6.12 Curing

Concrete shall be cured for a period not less than 7 days when the ambient temperature is 200°C or greater by methods that shall ensure that cracking, distortion and efflorescence are minimized.

Where the temperature is below 200°C the curing period can be calculated using the following equation:

\[
Curing\ period = 7 \times \left( \frac{36}{mean\ ambient\ temperature + 16} \right)^2 \text{ days}
\]

In cold weather, when the temperature of freshly placed concrete may approach 0°C, alternatives to water curing shall be used.

Components which are intended to have a similar exposed surface finish shall receive the same treatment.

The Contractor shall prepare and submit detailed method proposals for curing of concrete and maintaining the curing regime. Concrete shall be wet cured or water based membrane cured for a minimum period of 7 days. The method proposals shall be to the approval of the Project Manager’s Rep and the approved methods will be rigorously enforced.

During the curing period measures shall be taken to prevent the loss of moisture and to minimize thermal stresses caused by the difference in temperature between the surface of the concrete and the core of the concrete mass and promote sustained hydration of the concrete. Attention is drawn to the necessity for thorough and continuous curing, particularly in the case of concrete containing Pfa or Ggbs.
For water based curing membranes: spray applications shall be applied within one hour of striking formwork and shall be of a type approved by the Project Manager’s Rep. Application shall be at the rate recommended by the manufacturer. In hot sunny weather, light reflecting membranes shall be used if the Project Manager’s Rep considers it necessary. Sprayed-on water based curing membranes shall not be used on surfaces to which concrete is subsequently to be bonded or subsequently painted.

The Contractor shall take precautions against plastic shrinkage cracking of newly formed concrete surfaces. These precautions may include, but not be limited to the following:

shading newly cast surfaces prompt application of polythene sheeting to reduce evaporation erecting wind breaks.

5.6.13 Records of Concreting

The Contractor shall keep up to date records of the dates and times when concreting is carried out and of the weather and temperatures at those times. The records shall be available for inspection by the Project Manager’s Rep.

5.6.14 Construction of Formwork

Formwork shall be sufficiently rigid and tight to prevent loss of grout from the concrete and to maintain the correct position, shape and dimensions of the finished work. It shall be so constructed as to be removable from the cast concrete without shock or damage.

The forms shall be capable of producing a consistent quality of surface as described in the Contract.

Where holes are required in forms to accommodate projecting reinforcement, fixing devices or other built-in items, precautions shall be taken to prevent loss of mortar matrix.

Formwork shall give access for the preparation of joint surfaces before the concrete has hardened. For the purposes of compliance with the provisions of this specification, the Contractor’s method of constructing formwork shall allow for props to soffit forms to remain in position continuously for the period described.

Metal ties or anchors within the formwork shall be so constructed or sleeved so as to permit either their complete removal or their removal to a depth of at least the minimum specified cover from the face without damage to the concrete. All fittings for removable metal ties shall be of such design that, upon removal, the cavities left are of the smallest possible size. The cavities due to either partial or complete removal of ties shall be roughened and filled with a material approved by the Project Manager’s Rep.

Formwork panels shall have true edges for accurate alignment and shall be fixed with either vertical or horizontal joints. Where chamfers are required the fillets shall be cut to provide an even line. Joints shall not permit leakage of grout, nor steps and ridges in exposed surfaces. Due allowance shall be made for deflection of formwork during concrete placement.
Wrought formwork shall be steel panels, GRP, plywood or other suitable materials to produce a fine finish. Individual panels shall be arranged in a uniform pattern.

Rough formwork shall consist of sawn boards, sheet metal or any other suitable material which will prevent the undue loss of grout when the concrete is vibrated and produce a concrete surface suitable for the application of any specified protective coating.

Unless otherwise indicated on the drawings all exposed arises shall be chamfered 25mm x 25mm.

The Contractor shall take every precaution in the selection and use of forms and in removing the forms and curing the concrete to prevent rapid temperature variations in the concrete.

5.6.15 Cleaning and Treatment of Forms

The interiors of all forms shall be thoroughly cleaned out before any concrete is placed. The faces of the forms in contact with the concrete shall be clean and treated with a suitable release agent, where applicable. Not less than 4 hours’ notice shall be given for the inspection and approval of the formwork and reinforcement.

Where a concrete surface is to be permanently exposed, only one release agent shall be used throughout the entire area. Release agents shall be applied evenly and contact with reinforcement and other embedded items avoided. Where the concrete surface is to receive an applied finish, care shall be taken to ensure the compatibility of the release agent with the finish.

5.6.16 Striking of Formwork

Formwork shall be removed without shock to or disturbance of the concrete. If frost is possible formwork shall not be removed until the in-situ concrete has a strength of 5 N/mm2.

Formwork to vertical surfaces or sloping formwork not supporting concrete in flexure shall not be removed until the concrete strength shall be sufficient to meet any wind loading upon the concrete likely to arise at the time when the formwork is removed; and

the in-situ concrete strength (as confirmed by tests in cubes cured under representative conditions e.g. cubes alongside the formwork or temperature-match cured cubes) has reached 5N/mm2 or; for concrete containing only Portland cement, in the absence of cube test results a minimum period shall have elapsed since the concrete was poured equivalent to 8 hours at 200C for unsealed plywood forms, or 6 hours at 200C for impermeable forms.

The periods at other temperatures can be calculated using the equation below:

$$Period\ at\ T^\circ C = \left(\frac{36}{T+16}\right)^2 \times period\ at\ 20^\circ C$$

Formwork supporting concrete in flexure shall not be removed until:
the in-situ concrete strength (as confirmed by tests on cubes cured under representative conditions) has reached 10N/mm², or twice the stress to which the concrete will then be subjected, whichever is the greater or; for concrete containing only Portland cement, in the absence of cube test results or any formal procedure agreed in writing with the Project Manager’s Rep, the periods before striking calculated from the relevant formula given in the following table shall be used:

**TABLE 4: FORMULAS FOR CALCULATING THE REQUIRED DAYS FOR STRIKING FORMWORK**

<table>
<thead>
<tr>
<th>Type of form work</th>
<th>Period calculated for mean ambient temperature (t) between 0°C and 25°C using formula below</th>
</tr>
</thead>
</table>
| Soffit forms to slabs and beams    | \[
\frac{100}{(t + 100)} \]
| Props to slabs and beams           | \[
\frac{250}{(t + 10)} \] days                                                        |

The Contractor shall give adequate notice to the Project Manager’s Rep of his intention to strike formwork.

After removal remedial work shall not be undertaken until the concrete has been inspected and approved. Before striking formwork or applying loads to concrete the Contractor shall ensure that the concrete is able to withstand stresses induced.

The formwork striking times may be assessed by one of the alternative methods below, if approved by the Project Manager’s Rep:

- maturity measurements
- penetration tests
- pull-out tests
- break-off tests

**5.6.17 Sloping Formwork**

Top formwork shall be provided to slopes 300 or more from the horizontal

**5.6.18 Cutting and Bending of Reinforcement**

Cutting and bending of reinforcement shall be in accordance with ISO 4066 and shall be done without the application of heat and in a temperature of not less than 50°C. Bends shall have a substantially constant curvature.

Reinforcement shall not be straightened or rebent without the approval of the Project Manager’s Rep. If permission is given to bend projecting reinforcement, care shall be taken not to damage concrete and to ensure that the radius is not less than the minimum specified in ISO 4066. At the discretion of the Project Manager’s Rep, a number of reinforcement bars may be required to be tested independently at a laboratory approved by the Project Manager’s Rep and test certificates obtained indicating the following: chemical composition, tensile strength, elongation and bend
test values. To this end, the Contractor may be required to supply an extra bar of each
diameter for three different shape codes.

5.6.19 Fixing of Reinforcement

Reinforcement shall be firmly supported in position and secured against displacement.
Non-structural connections for the positioning of reinforcement shall be made with
tying wire or other fixing devices. Precautions shall be taken to ensure that projecting
ends of ties or clips do not encroach into the concrete cover.
Reinforcement shall be held in position during the placing of concrete by use of
distance pieces, spacers or other methods approved by the Project Manager’s Rep.
Only approved spacers may be used in permanent works. Before spacers are approved
for use in the works, their capacity to hold the reinforcement securely in position
during concreting without detriment to concrete placement, compaction or durability
shall be fully demonstrated.
Links shall be taut so that bars are braced and the inside of their curved parts shall be
in contact with the bars being connected.
Partially-set concrete adhering to exposed bars during concreting operations shall be
removed.

5.6.20 Surface Condition of Reinforcement

Concrete shall not be placed until reinforcement is free from any substance which
might adversely affect the steel or concrete chemically or reduce the bond.

5.6.21 Laps and Joints

Laps and joints in reinforcement shall be made only at the positions described and
detailed in the construction documentation, reviewed by the Project Manager’s Rep.

5.6.22 Welding of Reinforcement

Reinforcement shall not be welded on Site except where described in or
permitted in the Contract Documentation. All welding procedures shall be subject to
the prior approval of the Project Manager’s Rep in writing.

5.6.23 Built-in Items

Where pipes, sleeves, water bars or other items are built into concrete, they shall be
rigidly secured in position to prevent movement and shall be free from external
coatings which might reduce the bond. The Contractor shall take precautions to
prevent the formation or air pockets, voids or other defects whilst the concrete is
being placed.

5.6.24 Construction Joints

Contraction joints shall be made only at the positions described and detailed in the
construction documentation, as reviewed by the Project Manager’s Rep. Joint lines
shall be arranged to coincide wherever possible with features of the finished work.
Concrete placing shall not be interrupted except where joints occur, and shall continue after normal hours if necessary to achieve this.

Concrete shall not be allowed to taper off to a thickness of less than 50mm. Vertical joints shall be formed against a stop board suitably notched to accommodate the reinforcement. The top surface of each lift of concrete shall be straight and level unless described otherwise in the Contract.

Where a kicker is used, it shall be at least 70mm high and shall be cast monolithically with the previous concrete.

The surface of any concrete against which new concrete is to be cast shall be free from laitance and shall be roughened to the extent that the large aggregate is exposed but not disturbed. The joint surface shall be cleaned immediately before the fresh concrete is placed against it.

Where practicable, such preparation of joints shall be carried out when the concrete has set but not hardened. Construction joints shall be located and the sequence of placing arranged as approved to minimize shrinkage and thermal strains to the concrete.

Upon removal of the formwork the joint face shall be inspected, and if the soundness of the concrete is not approved by the Project Manager’s Rep the Contractor shall investigate and remedy defects.

Where a design joint includes a continuous waterstop, concrete shall be well worked around the embedded part of the waterstop and be free from honeycombing. Projecting portions of the waterstop shall be protected from damage during operations and, in the case of rubber and plastic, from light and heat.

To minimise leakage at construction joints in water retaining structures adjacent panels shall be concreted within 3 days. If this is not achieved the procedure for bonding new concrete to old shall be adopted.

Where it is necessary to bond new concrete to old, the bonding agent to be used shall be an epoxy based bonding agent used in accordance with the manufacturer’s instructions. The existing concrete surface shall first be wire brushed or hacked and cleaned to remove all dirt, dust, loose material and laitance and to expose the aggregate. If oil or grease has affected any area this shall be removed by chipping away down to unaffected material.

8.6.25 Surface Finishes Produced Without Formwork

**Screeded Finish:** The concrete shall be levelled and screeded to produce a uniform plain or ridged surface as required. No further work shall be applied to the surface unless it is a first stage for a Wood Float or Steel Trowel Finish.

**Wood Float Finish:** The Screeded Finish shall be wood floated under light pressure to eliminate surface irregularities.
Steel Trowel Finish: When the moisture film has disappeared and the concrete has hardened sufficiently to prevent laitance from being worked to the surface, the surface to the Wood Float Finish shall be steel-trowelled under firm pressure to produce a dense, smooth uniform surface free from trowel marks. Where the type of finish is not given: hidden surfaces shall be ‘screeded finish’ and exposed surfaces “steel trowel” finish.

5.6.26 Surface Finishes Produced With Formwork

Rough Finish: This finish shall be obtained by the use of moulds or properly designed forms of closely-jointed sawn boards. The surface shall be free from substantial voids, honeycombing or other large blemishes.

Fair Finish: This finish shall be obtained from forms designed to produce a hard smooth surface with true, clean arises. Only very minor surface blemishes shall be permitted and there shall be no staining or discoloration. Any projections shall be removed and the surface made good.

Fair Worked Finish: This finish shall be obtained by first producing a Fair Finish and then filling all surface blemishes with a fresh, specially prepared cement and fine aggregate paste whilst the concrete is still green where possible. After the concrete has been properly cured, the faces shall be rubbed down, if required, to produce a smooth and even surface. If the surface is to be exposed in the final work, every effort shall be made to match the color of the concrete.

The following standard of concrete finish shall be achieved:

**TABLE 5: CONCRETE SURFACE FINISHES**

<table>
<thead>
<tr>
<th>Position</th>
<th>Type of Surface Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>External vertical surfaces below ground</td>
<td>Rough Finish</td>
</tr>
<tr>
<td>External horizontal surfaces below ground</td>
<td>Rough Finish</td>
</tr>
<tr>
<td>Internal Vertical surfaces</td>
<td>Fair Finish</td>
</tr>
<tr>
<td>Slab soffits</td>
<td>Fair Finish</td>
</tr>
<tr>
<td>All other vertical, horizontal and sloping surfaces</td>
<td>Fair Finish</td>
</tr>
</tbody>
</table>

5.7 Types of Formwork

5.7.1 Formwork for concrete

Definitions

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.

False work means the structural elements supporting both the formwork and the concrete until the concrete becomes self-supporting.

A formed face is one which has been cast against formwork.

An exposed face is one which will remain visible when construction has been completed.
5.7.2 Construction of formwork and falsework

Before construction begins, the Contractor shall submit to the Engineer, drawings showing details of the proposed formwork and false work.

Formwork and false work 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 set out in Clause 506.

Ground supports shall be properly founded on footings designed to prevent settlement.

Joints in formwork for exposed faces shall, unless otherwise specified, be evenly spaced and horizontal or vertical and shall be continuous or form a regular pattern.

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 be so designed that it may be easily removed from the work without damage to the faces of the concrete. It shall also incorporate provisions for making minor adjustments in position if required, to ensure the correct location of concrete faces. Due allowance shall be made in the position of all formwork for movement and settlement under the weight of fresh concrete.

Where overhangs in formwork occur, means shall be provided to permit the escape of air and to ensure that the space is filled completely with fully compacted concrete.

Formwork shall be provided for concrete surfaces at slopes of 30 degrees to the horizontal or steeper. Surfaces at slopes less than 20 degrees may be formed by screeding. Surfaces at slopes between 20 degrees and 30 degrees shall generally be formed unless the Contractor can demonstrate to the satisfaction of the Engineer that such slopes can be screeded with the use of special screed boards to hold the concrete in place during vibration.

Horizontal or inclined formwork to the upper surface of concrete shall be adequately secured against uplift due to the pressure of fresh concrete. Formwork to voids within the body of the concrete shall also be tied down or otherwise secured against floating.

The internal and external angles on concrete surfaces shall be formed with fillets and chamfers of the sizes shown on the drawings unless otherwise instructed by the Engineer.

Supports for formwork for non-water retaining structures may be bolted to previously placed concrete provided the type of bolt used is acceptable to the Engineer. If metal ties through the concrete are used in conjunction with bolts, the metal left in shall not be closer than 50mm to the face of the concrete.

Supports for formwork for water retaining structures may be bolted to previously placed concrete provided the type of bolts and positions of fixing are acceptable to the
Engineer. After concreting the Contractor shall remove all support bolts and seal all holes with well rammed cement/sand mortar containing approved waterproofing cement additive. Metal ties which would be left in the concrete shall not be permitted.

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.

Shear keys shall be provided in all construction joints of the size and shape indicated on the drawings.

Where precast concrete elements are specified for use as permanent formwork, or proposed by the Contractor and agreed by the Engineer, they shall comply with the requirements of the Specification. Such elements shall be set true to line and level within the tolerances prescribed for the appropriate class of finish in Clause 506 and fixed so that they cannot move when concrete is placed against them.

**5.7.3 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 order to avoid colour difference on adjacent concrete surfaces, only one type of release agent shall be used in any one section of the works.

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.

Before concrete placing commences, all wedges and other adjusting devices shall be secured against movement during concrete placing and the Contractor shall maintain a watch on the formwork during placing to ensure that no movement occurs.

**5.7.4 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 5.1 and apply to ambient temperatures higher than 10 degrees centigrade. At lower temperatures or if cement other than ordinary Portland are involved, the Engineer may instruct that longer periods be used.

Alternatively, formwork may be removed when the concrete has attained the strength set out in Table 5.1, provided that the attained strength is determined by making test cubes and curing them under the same conditions as the concrete to which they refer.

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 6 - Minimum Periods for Formwork Removal

<table>
<thead>
<tr>
<th>Position of Formwork</th>
<th>Min. period for temp over 10 degrees Centigrade</th>
<th>Strength to be attained</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical or near vertical faces of mass concrete</td>
<td>24 hours</td>
<td>0.2 C</td>
</tr>
<tr>
<td>Vertical or near vertical faces of reinforced walls, beams and columns</td>
<td>48 hours</td>
<td>0.3 C</td>
</tr>
<tr>
<td>Underside of arches, beams and slabs (formwork only)</td>
<td>4 days</td>
<td>0.5 C</td>
</tr>
<tr>
<td>Supports to underside of arches, beams and slabs</td>
<td>14 days</td>
<td>C</td>
</tr>
<tr>
<td>Arched linings in tunnels and underground works</td>
<td>24 hours</td>
<td>4 N/mm²</td>
</tr>
</tbody>
</table>

Note: C is the nominal strength for the class of concrete used.

If the Contractor wishes to strip formwork from the underside of arches, beams and slabs before the expiry of the period for supports set out above, it shall be designed so that it can be removed without disturbing the supports. The Contractor shall not remove supports temporarily for the purpose of stripping formwork and subsequently replace them.

As soon as the formwork has been removed, bolt holes in concrete faces other than construction joints which are not required for subsequent operations shall be completely filled with mortar sufficiently dry to prevent any slumping at the face. The mortar shall be mixed in the same proportions as the fine aggregate and cement in the surrounding concrete and with the same materials and shall be finished flush with the face of the concrete.
5.7.5 Surface finishes on formed surfaces

Classes of finish

The surface finish to be achieved on formed concrete surfaces shall be as shown on the drawings and defined hereunder:

a) Class F1 finish

This finish is for surfaces against which backfill or further concrete will be placed. Formwork may be sawn boards, sheet metal or any other suitable material which will prevent the loss of fine material from the concrete being placed.

b) Class F2 finish

This finish is for surfaces which are permanently exposed to view but where the highest standard of finish is not required. Forms to provide a Class F2 finish shall be faced with wrought thicknessed tongued and grooved boards with square edges arranged in a uniform pattern and close jointed or with suitable sheet material. The thickness of boards or sheets shall be such that there shall be no visible deflection under the pressure exerted by the concrete placed against them. Joints between boards or panels shall be horizontal and vertical unless otherwise directed. This finish shall be such as to require no general filling of surface pitting, but fins, surface discoloration and other minor defects shall be remedied by methods agreed by the Engineer.

c) Class F3 finish

This finish is for surfaces which will be in contact with water flowing at high velocity, and for surfaces prominently exposed to view where good appearance is of special importance. To achieve this finish, which shall be free of board marks, the formwork shall be faced with plywood complying with B.S. 1088 or equivalent material in large sheets. The sheets shall be arranged in an approved pattern. Wherever possible, joints between sheets shall be arranged to coincide with architectural features or changes in direction of the surface.

All joints between panels shall be vertical and horizontal unless otherwise directed. Suitable joints shall be provided between sheets to maintain accurate alignment in the plane of the sheets. Unfaced wrought boarding or standard steel panels will not be permitted for Class F3 finish. The Contractor shall ensure that the surface is protected from rust marks, spillages and stains of all kinds.

d) Curved surfaces

For curved surfaces where F2 or F3 finishes are called for, the formwork face shall be built up of splines cut to make a tight surface which shall then be dressed to produce the required finish.

Alternatively, single curvature surfaces may be faced with plastic or plywood linings attached to the backing with adhesive or with escutcheon pins driven flush. Linings shall not bulge, wrinkle or otherwise deform when subjected to temperature and moisture changes.
5.7.6 Tolerances

All parts of formed concrete surfaces shall be in the positions shown on the drawings within the tolerances set out in Table 5.2.

In cases where the drawings call for tolerances other than those given in Table 5.2 the tolerances shown on the drawings shall take precedence.

Where precast units have been set to a specified tolerance, further adjustments shall be made as necessary to produce a satisfactory straight or curved line. When the Engineer has approved the alignment, the Contractor shall fix the units so that there is no possibility of further movement.

<table>
<thead>
<tr>
<th>Class of finish</th>
<th>Tolerances in mm (See Note)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>F1</td>
<td>10</td>
</tr>
<tr>
<td>F2</td>
<td>5</td>
</tr>
<tr>
<td>F3</td>
<td>2</td>
</tr>
</tbody>
</table>

Note: The tolerances A, B and C given in the table are defined as follows:

1. Column A is an abrupt irregularity in the surface due to misaligned formwork or defects in the face of the formwork.

2. Column B is a gradual deviation from a plane surface as indicated by a straight edge 3m long. In the case of curved surfaces the straight edge shall be replaced by a correctly shaped template.

3. Column C is the amount by which the whole or part of a concrete face is displaced from the correct position shown on the drawings.

5.7.7 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.
5.7.8 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 thicknesses 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.

5.7.9 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.

5.8 High Strength Concrete Topping

High strength concrete topping (granolithic finish) shall be provided, laid and wood float finished unless otherwise specified.

5.9 Tie Bolts for Formwork

Only tie bolts which avoid embedding any metal parts permanently within 50mm of the concrete surface shall be permitted. Voids remaining after the removal of all or part of each tie bolt shall be filled flush with the surrounding concrete using a freshly prepared cement and fine aggregate paste.

In the case of structures designed to retain an aqueous liquid, the Contractor shall ensure that the tie bolts shall have a pre-formed water stop.

5.10 Tolerance for Concrete Surfaces

The “very minor surface blemishes” permitted in the Fair Finish are defined as follows:

The surface blemish must not penetrate more than 5mm into the concrete. The area of an isolated surface blemish must not be more than 0.01m². The total area of all the surface blemishes on the face of a particular pour must not be more than 2% of the total surface area of that pour.

No work in connection with the making good of new concrete surfaces shall be carried out until the Project Manager’s Rep has examined the surfaces in question and has given his consent to the proposed preparation and treatment.
All surfaces to be made good shall be carefully prepared in order to provide a good bonding surface to the satisfaction of the Project Manager’s Rep. This preparatory work may involve cutting out, chipping, wire brushing, air blowing and drying to remove curing membranes etc. Unless otherwise directed or approved by the Project Manager’s Rep the following methods shall be used:

All making good of water retaining concrete surfaces shall be carried out using an epoxy resin in accordance with the manufacturer’s instructions. This material is a two part mortar pack which shall be mixed and applied strictly in accordance with the manufacturer’s instructions. All making good of non-water retaining concrete surfaces shall be carried out with a cement/sand mortar and PVA-based adhesive in accordance with the manufacturer’s instructions.

The mortar mix proportions, use of adhesives and method of application shall be as to the satisfaction of the Project Manager’s Rep. It should be noted that in certain instances the Contractor may have to experiment with trial mixes to achieve a color/texture match to the original surfaces that is acceptable to the Project Manager’s Rep.

The setting out tolerance for the position of structures shall be ±20mm.

Unless otherwise stated, or directed by the requirements of mechanical equipment, concrete surfaces in the final work shall not vary by more than the permissible amounts shown in the table below:

5.11 Tolerance for Concrete Surfaces

**TABLE 8: TOLERANCES FOR CONCRETE SURFACES**

<table>
<thead>
<tr>
<th>Type of Structure</th>
<th>Dimension measured</th>
<th>Tolerance(mm)</th>
<th>Finish produced with formwork</th>
<th>Finish produced without formwork</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buried concrete</td>
<td></td>
<td></td>
<td>Fair</td>
<td>Fairworked</td>
</tr>
<tr>
<td></td>
<td>Position</td>
<td>+or – 25</td>
<td>-</td>
<td>+or – 25</td>
</tr>
<tr>
<td></td>
<td>Alignment</td>
<td>+or – 15</td>
<td>-</td>
<td>+or – 15</td>
</tr>
<tr>
<td></td>
<td>Height up to 5m</td>
<td>+or – 25</td>
<td>-</td>
<td>+or – 15</td>
</tr>
<tr>
<td></td>
<td>Thickness</td>
<td>+or – 10</td>
<td>-</td>
<td>+or – 10</td>
</tr>
<tr>
<td></td>
<td>Straightness in 5m</td>
<td>+or – 15</td>
<td>-</td>
<td>+or – 10</td>
</tr>
<tr>
<td></td>
<td>Plumb per m (limit)</td>
<td>20(30)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Step displacement</td>
<td>10</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Ordinary exposed concrete</td>
<td>Position</td>
<td>-</td>
<td>+or – 20</td>
<td>+or – 10</td>
</tr>
<tr>
<td></td>
<td>Alignment</td>
<td>-</td>
<td>+or – 10</td>
<td>+or – 10</td>
</tr>
<tr>
<td></td>
<td>Height up to 5m</td>
<td>-</td>
<td>+or – 10</td>
<td>+or – 5</td>
</tr>
<tr>
<td></td>
<td>Thickness</td>
<td>-</td>
<td>+or – 5</td>
<td>+or – 5</td>
</tr>
<tr>
<td></td>
<td>Straightness in 5m</td>
<td>+or – 10</td>
<td>+or – 10</td>
<td>+or – 10</td>
</tr>
<tr>
<td></td>
<td>Plumb per m (limit)</td>
<td>3(15)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
### Definitions of Dimensions Measured

**Position** - relation to position, in line, slope or level shown on the drawings.

**Alignment** - relation to any previously placed coincident and adjacent part of the structure. **Height** - vertical dimension

**Thickness** - dimension between opposite faces dimensioned on the drawings.

**Straightness** - departure from a 5m template which may be straight or curved as appropriate, placed horizontally and/or vertically.

**Plumb** - true vertically.

**Step Displacement** - abrupt displacement of any exposed face or surface. No relaxation in the required concrete cover to reinforcement shall be implied or permitted.

Finished surfaces shall have no abrupt irregularities.

In case of failure to comply with the required tolerances in areas determined to be visually or functionally non-critical, the Contractor may submit for approval details of remedial surface works as an alternative to removal and proper re-execution.
In case of failure to comply with the required tolerances in visually or functionally critical areas, out of tolerance work shall be removed and properly re-executed as provided in the Contract.

5.12 Grout Quality Control Testing
Grout is specified by nominal mixes, unless specified elsewhere in the Contract.

8.13 Marking of Precast Concrete Components
Where appropriate, indelible identification and orientation marks shall be put on all precast concrete components in such a position that the marks shall not show or be exposed in the finished work.

5.14 Concrete Testing
Testing may be carried out to any recognized appropriate set of standards, provided that consistency in the application of the standards is ensured. The limits of acceptance shall, however, be as defined herein relative to the specified standard.

Sampling and testing shall be in accordance with the relevant sections of EN 12350 or BS 1881, the relevant following ISO, or as directed by the Project Manager’s Rep. ISO 1920 - dimensions, tolerances and applicability of test specimens; ISO 2736-1 - test specimens part 1 - sampling of fresh concrete; ISO 2736-2 - test specimens part 2 - making and curing of test specimens for strength tests.

Ready mixed concrete shall be tested by the supplier as part of his quality control. Copies of such test results shall be made available to the Project Manager’s Rep on request. Where concrete is mixed on site, or where records are not available from the supplier, additional testing will be required on site as directed by the Project Manager’s Rep.

The Contractor shall be responsible for manufacturing, transporting, storing, curing and testing of concrete cubes required to ensure compliance of mixes as specified.

5.15 Quality and Testing
Sampling for test purposes shall comply with ISO 2736/1 (on site) and BS 1881 Part 125 (in Laboratory). The making and curing of specimens shall comply with ISO 1920 and ISO 2736/2.

Cubes shall be 150mm size and tested to BS 1881 Part 116.

The cubes shall be tested by a laboratory which has third party accreditation for compressive strength testing of concrete.

5.16 Sampling Cubes
The rate of concrete sampling shall be as follows. At least one sample of concrete shall be taken from each grade and type of structural concrete each day.

**TABLE 9: NUMBER OF SAMPLES FOR CONCRETE BLOCKS**

<table>
<thead>
<tr>
<th>Type of structure</th>
<th>Sample to represent a volume of (m³)</th>
</tr>
</thead>
</table>

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From each sample two cubes shall be made for testing at 7 days, 14 days, 21 days and at 28 days for control purposes. The 28 day test result shall be the mean of two cubes. The Contractor shall, for each cube taken, keep and make available to the Project Manager’s Rep detailed records showing:

- Cube reference number
- Location and batch from which the sample has been taken for the preparation of the cube
- Date of preparation
- Weather conditions at time of sampling
- Date of testing
- Age of concrete at time of test
- Compressive Strength in N/mm$^2$

### 5.17 Cube Strength Results

The assessment of concrete compliance shall be carried out in accordance with the following requirements:

Any one strength shall be over the required strength minus the following: 2.0 N/mm2 (required strength = 7.5 to 15.0 N/mm2) 3.0 N/mm2 (required strength = 20.0 N/mm2 or more), and An average of any 2, 3 or 4 consecutive test results shall be over the required strength plus the following:

### TABLE 10: CUBE TESTS

<table>
<thead>
<tr>
<th>Required Strength N/mm$^2$</th>
<th>No of consecutive tests</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>7.5 – 15.0</td>
<td>---</td>
</tr>
<tr>
<td>20.0 or more</td>
<td>10</td>
</tr>
</tbody>
</table>

If the specified characteristic strength has not been achieved or individual results do not comply with the above conditions then any of the following actions may be instructed:

- Changing the mix;
- Improving quality control;
- Cutting and testing cores from placed concrete;
- Load testing relevant structural units;
- Non-destructive testing of placed concrete;
- Cutting-out and replacing defective concrete.

### 5.18 Other Tests
Compaction factor (EN 12350-5, ISO 4111), slump (EN 12350-2, ISO 4109), Vebe (EN 12350-3, ISO 4110) or other workability tests shall be carried out as required during concreting of permanent works to control workability at the batching plant and at the site of the pour. The degree of workability shall be as for the trial mixes.

5.19 Contamination

Concrete shall be protected from contamination by sea or brackish water, oil, fuel and other deleterious materials for a minimum period of 30 days after placing.

5.20 Protection of Joints

Rebates formed to receive sealant and the surfaces of construction joints shall be protected from curing compound by wet hessian to ensure proper curing of the joint surface and adjacent concrete. The protection shall remain in place until the joint surface is sealed.

5.21 Specimen Panels of Concrete

If required, the Contractor shall produce specimen panels of finished concrete for approval.

5.22 Benching

Where benching is used the minimum thickness will be 40mm.

6 REPAIR OF EXISTING CONCRETE

In case of repair works to existing concrete structures being necessary the following procedures shall be adhered to.

6.1 Dewatering and cleaning

All repair work to existing concrete shall be carried out in the dry. The Contractor shall therefore dewater the concerned structures and clean the surfaces from all sediment, algae, bushes, stones, trash and all other foreign matter to the satisfaction of the Project Manager’s Rep.

6.2 Identification of repairs

After cleaning the concrete from any foreign matter the Contractor shall survey the exposed surfaces and make an inventory of the work to be done distinguishing the types of defects as described in this Section and submit the inventory of proposed work to the Project Manager’s Rep for approval. In a joint survey of the Project Manager’s Rep and the Contractor the inventory will be discussed and the Project Manager’s Rep may instruct the Contractor to make modifications in the inventory of proposed work after which modifications the Project Manager’s Rep shall approve the inventory for execution. The Contractor shall furnish the Project Manager’s Rep with three (3) signed copies of the inventory of proposed work for approval to the Project Manager’s Rep and after approval the Project Manager’s Rep shall sign these copies and return one (1) signed copy to the Contractor. The Contractor will execute the work accordingly and in accordance with these Specifications.
6.3 Materials

General

For all mortars, grouts, resins and other products described in this section, the Contractor shall propose the products he intends to use in the Works and shall submit to the Project Manager’s Rep for approval full information on these products. All products shall have no adverse effects on potable water.

Products named elsewhere in this section are an indication of the standard type and workmanship of goods which are satisfactory to the Project Manager’s Rep. The Contractor may use named products or equivalent other products after the approval of the Project Manager’s Rep in accordance with the Specifications, Conditions of Contract and with the manufacturers specifications.

Water, Steel and Aggregate

Water for use in mortars and concrete shall comply with the requirements described in Clause "Water". Reinforcement steel shall in all respects comply with the requirements described in Clause "Reinforcement Steel".

Sand or other aggregate for mixing with grout shall comply with the requirements for fine aggregate described in the Clause "Aggregate".

6.4 Types of defects

For the purpose of repairs to existing concrete the following defects shall be distinguished:

- Cracks 1 up to 3 mm wide
- Leaking Cracks 1 up to 3 mm wide
- Cracks 3 up to 20 mm wide
- Defective Concrete as loose, broken or honeycombed concrete
- Deteriorated Joints
- Voids under Concrete Slabs

6.5 Repair of cracks 1 up to 3 mm wide

The Contractor shall repair cracks in structural concrete by injection with an appropriate injection resin.

When the cracks are dry an epoxy resin of low viscosity shall be used. In other cases injection shall be done with a low viscosity polyurethane resin.

The Contractor shall first blow, clean, oil free compressed air through the crack before any resin in injected in order to remove as much as possible any dust or grit that may obstruct the flow.

When the crack is cleaned, a superficial seal will be applied at the surface of the member by using a fast setting material such as any appropriate polyester resin, in which injection nipples are fixed at intervals. The most satisfactory spacing of the injection nipples shall be found by experience, but is usually less than the estimated depth of the crack. The most suitable pressure for injection the resin shall also be
found by experience. The spacing and pressure are to be to the satisfaction of the Project Manager’s Rep.

Injection shall be done by an approved and established epoxy resin injection system. Epoxy injection resin of low viscosity shall be subject to the approval of the Project Manager’s Rep. No injection shall be done without the approval of the Project Manager’s Rep.

6.6 Repair of leaking cracks 1 up to 3 mm wide

Repair by Injection

The Contractor shall inject leaking joints with waterstops in structures with a suitable polyurethane injection resin.

The polyurethane injection resin shall be of low viscosity and reacting with water as to fill all cavities in and adjacent to the joint. Injection shall continue until all leaks are stopped.

To relieve the water pressure if necessary, drain pipes shall be fixed into the remaining concrete so that the water can discharge freely. After the injection material has hardened, the drain pipes shall be cut off or removed and the remaining holes will be plugged one by one with a very quicksetting material that can be held in place by hand until it has set. The Contractor shall submit for approval to the Project Manager’s Rep the method of injection, material and equipment he proposes to use. The Project Manager’s Rep may at his discretion instruct the Contractor to modify his proposal in accordance with the instructions of the Project Manager’s Rep. No injection will be done without the approval of the Project Manager’s Rep.

Repair by Lining

Concrete slabs featuring many leaks due to cracks and other small porosities of the concrete shall be waterproofed by application of an internal lining. Slabs subjected to variable direction of water pressure shall not be repaired with this method but only via the method as described in Clause "Repair by Injection".

The lining shall be applied only on the inside of water retaining structures so that the lining is compressed between water and concrete.

The lining shall be an epoxy resin and or cement based sealant. The material shall have a durability of 25 years or more and provide a watertight and easy to clean surface. The material shall be capable of bridging and filling 3 mm wide cracks under the existing water pressures.

Particular care shall be taken to ensure all concrete surfaces are completely free from algae, oil, dust, grease, corrosion and any other deleterious matter before application of the lining.

6.7 Repair of cracks 3 up to 20 mm wide
The Contractor shall clean the crack from all dirt and other foreign matter and roughen the surfaces mechanically. After cleaning the crack with oil free compressed air the surfaces will be primed with an approved and established primer.

All exposed reinforcement shall be thoroughly cleaned from any loose rust or other foreign matter. Exposed reinforcement shall be primed with an approved and established primer, to prevent further corrosion.

If the reinforcement has broken or deteriorated too far the crack must be repaired as described in Clause "Repair of Defective Concrete". Then the crack shall be filled with a suitable, approved and established watertight non shrink grout and cured directly after application with a curing agent.

6.8 Repair of defective concrete

When concrete has broken out, has become loose, shows honeycombing or any other similar defects, it shall be removed and the affected member reconstructed to its original section.

The Contractor shall remove all loose or deteriorated concrete until only sound material is encountered. Concrete shall in any case be removed to 25 mm behind any exposed reinforcement.

All exposed reinforcement shall be thoroughly cleaned from any loose rust or other foreign matter. Exposed reinforcement shall be primed with an approved and established primer, to prevent further corrosion.

If the reinforcement has broken or deteriorated too far, new reinforcement shall be placed. To accommodate this reinforcement, holes shall be drilled in which the new bars are fixed with an epoxy resin. As an alternative the surrounding sound concrete can be broken out until sufficient lap length has been acquired to accommodate the new bars. If neither option is suitable, an external steel or concrete bracing shall be constructed. The final solution to be applied shall be approved by the Project Manager’s Rep.

Particular care shall be taken to ensure all exposed concrete surfaces are completely free from laitance, oil, dust, grease, corrosion and any other deleterious matter. Laitance shall be mechanically removed by high pressure water blasting, grit blasting or a combination of both.

The edges of the repair area shall be sawn or cut to a depth of 10 mm to avoid feather edging. All concrete surfaces shall be in a saturated surface dry condition prior to priming.

Priming shall be done with an approved and established primer after which the broken out area will be repaired with a suitable watertight non-shrink grout approved by the Project Manager’s Rep. Immediately after finishing the repair the mortar shall be cured with a curing agent.

6.9 Repair of deteriorated joints
At contraction, construction or movement joints where the filler and or sealant has deteriorated, replacement is required. Here the Contractor shall replace both the joint filler and or the sealant. He shall cut out and remove the existing joint filler and or sealant and clean the joint from vegetation, sediment and other foreign matter. The edges of the concrete shall be square. If edges have broken up to 10 mm deep the new joint filler shall be placed deeper. Broken edges from 10 to 30 mm shall be cut square to give a square but wider joint. At edges broken deeper than 30 mm the concrete shall be broken back till 25 mm behind the nearest reinforcement and repaired in accordance with the clause “Repair of defective concrete”.

After clearing and squaring up the recess in the concrete the joints shall be filled with flexible filler and or sealant. This shall comply with the requirements as described in sub-clauses "Movement Joint Filler" and "Joint sealer".

Only in movement joints the following alternative construction may be used; a vacuum tube of butyl rubber shall be placed in the joint and the voids left over shall be filled with butyl putty. The vacuum tube and butyl putty shall be of an established type and approved by the Project Manager’s Rep.

6.10 Repair of voids under concrete

During reparation of cracks or joints in otherwise sound slabs, hollow spaces may be found behind the slabs. In such cases and where indicated by the Project Manager’s Rep the Contractor shall fill the hollow spaces with a suitable cement based grout. Depending on the type of joint, grouting shall be done either before or after completing other repair works on the joints or cracks.

If the voids are not accessible through at least 10 mm wide joint rebates then holes shall then be drilled through the concrete slab, with a maximum distance between successive holes of 700 mm centre to centre. Through the holes the hollow spaces shall be grouted. The grout will be subject to the approval of the Project Manager’s Rep and shall be of a suitable viscosity.

The area to be grouted and working method will be proposed by the Contractor to the approval of the Project Manager’s Rep; or as instructed by the Project Manager’s Rep. No grouting or drilling shall be done without the approval of the Project Manager’s Rep.

7.0 BLOCKWORK WALLS

7.1 General

All masonry work shall be constructed from building stone as specified in drawings. For walls, facing and other exposed works the stone shall unless otherwise specified, be medium chisel dressed from approved source.

7.2 Workmanship

The Contractor shall provide and use proper setting out rods for all work.
Stones shall be well soaked before use and the tops of walls shall be kept wet as the work proceeds. The stones shall be properly bonded so that no vertical joint in a course is within 115mm of a joint in the previous course. Alternate courses of walling at angles and intersections shall be carried through the full thickness of the adjoining walls. All perpends, reveals and other angles of the walling shall be built strictly true and square.

The stones shall be bedded, jointed and pointed in mortar 1 to 3 in accordance with Clause 707 with beds and joints 9mm thick flushed up and grouted solid as the work proceeds.

All masonry work shall be cured in accordance with the relevant requirements of Clause 406.

7.3 Cast stonework

Cast stone shall be as specified see 7.1 below. Facing stones shall be brought up in courses to a height not exceeding 1 metre at a time, the concrete backing being then brought up and well incorporated into and round the backs of the stones and the projecting metal ties to ensure a complete bond. The stones shall be bedded and jointed as shown on the drawings.

All materials, moulds, mixing, casting and surface treatment, setting, jointing and pointing, and all centering, scaffolding and labour required to complete the cast stonework specified or as shown on the drawings, shall be included in the rates for such work.

7.4 Precast concrete blocks

Precast concrete blocks shall be manufactured to BS 6073.

Blocks shall be either hollow or solid and the thickness of the blocks shall be as indicated in the Drawings. The blocks shall have minimum compressive strength of 3.5 N/mm².

All blocks shall have a dense, even surface and a density of not less than 1700 kg/m³.

The Contractor shall submit samples of blocks for every batch brought to the Site to the Project Manager’s Rep for approval. The Contractor shall arrange strength tests required by the Project Manager’s Rep to be executed by a testing authority approved by the Project Manager’s Rep.

7.5 Mortar

Mortar for both masonry and block work shall be cement mortar consisting of one part of ordinary Portland cement complying to BS 12 to four parts of sand by volume, mixed with just sufficient water to make the mixture workable. No lime shall be added to the mortar.

Natural sand shall be used in cement mortar unless otherwise approved. The sand shall be obtained from sources approved by the Project.
Plasticisers, air entraining agents or other additives may be used in the mortar subject to the approval of the Project Manager’s Rep.

7.6 Storage of materials

Blocks shall be loaded and unloaded by hand and not tipped, and shall not be used until 4 weeks after casting unless otherwise approved by the Project Manager’s Rep.

All blocks shall be handled carefully from manufacture to laying and properly stacked in position convenient for the work. They shall be kept free from standing water and protected from rain, mud and contamination by other materials.

Sand shall be stored separately on clean hard dry standing and protected from contamination.

Cement shall be stored off the ground under cover and away from damp, and in such a manner as to enable it to be used in rotation in order of delivery and in accordance with the requirements of Clause "Concrete Work", sub-clause "Supply".

7.7 Mortar mixing

All materials shall be accurately gauged by gauge boxes and mechanically mixed to a uniform consistency. Mortars shall be used within 1 hour of the addition of cement after which they shall be discarded. Re-tempering of mortar will not be permitted. Gauge boxes and mixers shall be kept clean.

7.8 Block work

All block work unless otherwise specified shall comply with the recommendations of BS 8000; Part 3; 1989 (Code of Practice for masonry). All surfaces on which block work is to be built shall be clean from any foreign matter influencing the bond between the surface and block work. The use of chipped or defaced blocks will not be permitted in any face work. All work shall be built uniform, true and level, with all perpends vertical and in line, all cross joints shall be solid, filled with mortar in every course as the work proceeds.

All blocks shall be clean before placing and shall be moistened with water for at least 3 hours before using by a method which will ensure that each block is thoroughly and uniformly wetted.

No work shall rise more than 1000 mm above the adjoining works and such risings are to be properly racked back. No blockwork shall be carried up higher than 1500 mm in one day. Joints in walling to be plastered or rendered shall be raked out 10 mm deep to form a key. All cross (vertical) joints shall be filled by well buttering the ends of the block with mortar and then sliding it against its neighbour.
Block work of single block thickness shall be laid in stretcher bond, and block work of double block thickness in alternate courses of headers and stretchers. No broken blocks will be accepted except where necessary for bonding. All blocks shall be cut by means of a mechanical disc cutter.

Alternate courses of load bearing block walling at intersection shall be carried through the full thickness the adjoining wall.

Course heights shall not vary throughout the building and each course shall be level and set out so that bed joints occur in line with sills, lintels and other features.

Damp-proof Courses in Walls Damp-proof courses in walls shall be bituminous damp-proof course to BS 743 weighing not less than 3.8 kg/m² overlapped 75 mm at all jointings and bedded in mortar whilst the mortar is still wet.

7.9 Protection

When constructing masonry or block work in unfavorable weather and in protecting the finished work, the Contractor shall observe the same instructions as are specified for concrete work.

All block work, including pointing, shall be cured by keeping the wall wet or moist with a method as approved by the Project Manager’s Rep.

7.10 Non load-bearing walls

All walls which are not load-bearing shall not be brought up to final finished level until the construction of any reinforced concrete roof slabs has been completed and the roof finishes have been installed.

7.11 Ties to concrete structures

Ties at junctions with reinforced concrete work shall be of the 'butterfly' type to BS 1243 and shall be cast into the concrete at such centers to be in line with the center of the depth and width of mortar joints.

7.12 Movement joints

Movement joints shall comply with the requirements for movement joints in concrete work as the described in these specifications.

8.0 STEEL WORK

8.1 General

The work under this Clause shall include as far as necessary the design of connections and other details, manufacture, inspection and testing, delivery to Site, unloading and where necessary storage at Site, complete erection, testing on completion and setting to work, all to the satisfaction of the Project Manager’s Rep.

The dimensions given on the drawings are based on available information or design. The Contractor shall be responsible for checking actual dimensions of gates, structures, etc. either existing or after construction against the dimensions given on the drawings.
8.2 Standards for materials and workmanship

Unless otherwise approved, steel and other metal work shall comply with the following British Standard Specifications:

- BS 4S Structural Steel Sections, Part 1, Hot-rolled sections;
- BS 153 Steel Girder Bridges;
- BS 639 Covered Electrodes for the Manual Metal-arc Welding;
- BS 709 Methods of Testing Welds;
- BS 916 Black Bolts, Screws and Nuts;
- BS 1775 Steel Tubes for Structures;
- BS 1856 Metal-arc Welding of Mild Steels;
- BS 4360 Weldable Structural Steels;
- BS 5950 Structural Use of Steelwork in Buildings.

Fabrication and erection on Site shall be to the same standards as specified for work off Site.

8.3 Materials

8.3.1 Steel

Unless otherwise specified all structural mild steel parts shall be manufactured from steel Grade 43 A, or equivalent. The ultimate tensile stress shall not be less than 360 N/mm² and the yield stress shall not be less than 235 N/mm².

8.3.2 Sections

Steel sections can be cold formed or hot rolled.

8.3.3 Nuts, Bolts and Welding Electrodes

Unless specified otherwise, nuts and bolts shall have hexagonal heads, ISO metric threads, comply with BS4190 and be of Grade 4.6 or Grade 43. High strength friction grip bolts shall be of grade 8.8 or 10.9 and shall comply with BS 4395.

All bolts, nuts, washers shall be galvanized in accordance with BS 729. Where bolting is incompatible with the material being fixed, suitable isolating washers and sleeves shall be used. Metal washers shall comply with BS 4320.

All anchor bolts to cast in concrete shall not be less than M16. Bolts for structural steelwork shall be not less than M12.

Bolt lengths shall be sufficient to ensure that nuts are full-threaded when tightened in final position.
Welding electrodes for arc welding of grades of structural steel to BS 4360, shall be low hydrogen type and shall comply with the requirements of BS 639.

8.4 Working drawings and method statement

Before fabrication commences the Contractor shall submit to the Project Manager’s Rep for his approval design calculations, working and shop drawings of the steel and other metal work to be supplied under the contract. He shall also submit to the Project Manager’s Rep for approval of a detailed method statement describing the fabrication methods to be used.

The Contractor shall be responsible for the correctness of his shop details and for shop fittings and site connections.

8.5 Fabrication

8.5.1 Welding

Welding shall be metal-arc welding complying with the requirements of BS 1856 or BS 5135, as appropriate. All welds shall be continuous unless specified otherwise. All fillet welds shall approximate to the thickness of the thinnest member to the joint. All parts shall have the edges accurately prepared to the appropriate profile for welding.

Welding shall be carried out only under the direction of an experienced and competent supervisor and only certified welders qualified in this class of work shall be employed. Welding procedures shall be such that residual stresses are minimal and that distortion is avoided.

All fillet welding shall be tested by ultrasonic, crack detection, or other approved means. For all items off steel work the Contractor shall allow for the cost of adequate radiograph examination of the welds. The welds and positions to be examined will be indicated by the Project Manager’s Rep.

8.5.2 Bending

No straightening or flattening by bending or use of heat shall be carried out without approval of the Project Manager’s Rep and, if so approved such straightening or flattening shall be carried out as specified by the Project Manager’s Rep.

8.5.3 Cutting

Shearing or cropping shall only be allowed for cutting of strips and plates less than 12 mm thick. Hand flame cutting shall not be allowed. Irregularities as a result of cutting shall be removed by welding and grinding.

8.5.4 Holing

All holing shall in principle be carried out by drilling unless approved otherwise by the Project Manager’s Rep. All holes for bolts shall be 2 mm more in diameter than the nominal bolt size unless higher tolerances are approved by the Project Manager’s Rep. All holes shall be free from burrs.
8.5.5 Bolting

Unless specified otherwise all bolts shall be mild steel isometric bolts. All nuts and screws shall be securely fastened, to prevent loosening due to vibration, by means of spring washers, lock nuts, split pins or other approved means.

Between all nuts and steelwork at least one normal washer must be used. If deemed necessary by the Project Manager’s Rep, washers shall be placed both under the nut and the bolt head. Stainless steel bolts, nuts and washers shall be used for holding all renewable parts and all parts made of stainless steel.

At all times shall the Contractor have a torque wrench at Site for tightening and checking of bolts.

8.5.6 Marking of Parts

Steel and other metal work shall be uniquely and indelibly marked to indicate position and direction in which it is to be fixed.

8.6 Works erection

If required by the Project Manager’s Rep, the steel and other metal work shall be temporarily assembled at the place of manufacture for inspection by the Project Manager’s Rep and, if considered necessary, for testing before delivery.

8.7 Site erection

Before any work on erection is begun on the Site, the Contractor shall submit to the Project Manager’s Rep for his approval the methods he proposes to use for the erection of the steel and other metal work

and shall make any arrangements and take any precautions directed by the Project Manager’s Rep. Notwithstanding these requirements the entire responsibility for the adequacy of the Temporary Works shall rest with the Contractor.

The Contractor shall fix the steel and other metal work complete and shall provide and erect all temporary staying and bracing necessary for carrying out the Works.

The Contractor shall be responsible for the accuracy of setting out of all steel and other metal work. He may use shop details and other necessary drawings prepared by the supplier. The approval of the Project Manager’s Rep for any such drawings shall not relieve the Contractor of responsibility for the correct fitting of all material.

Unless specified otherwise, all bases shall be positioned 50 mm or as shown on the drawings above the concrete foundations on levelling nuts. Thereto every base shall feature at least 4 anchor bolts. Stanchions shall be plumbed and levelled by adjusting the levelling nuts and then be tightening the closing nuts. The space between the baseplate and concrete shall be filled with a free flowing non shrink grout with a 28 days strength of at least 25 N/mm2

8.8 Open grid flooring
Open mesh decking shall be in accordance with BS 4592. The panels shall be constructed with bearer bars not less than 25 mm deep. Adjacent panels and panels at the same level shall span in the same direction and unless specifically required for frequent access, shall be secured together by stitching bolts with a minimum of two fixing clips when supported on structural steelwork.

Each panel shall be designed for a uniformly distributed load of 7 kN/m2 with a maximum deflection within 10 mm or 1/200th of the span whichever is the lesser.

Mild steel open mesh flooring shall be manufactured from Grade 43A mild steel to BS 4360 and hot dip galvanized to BS 729 after fabrication.

Unless otherwise specified, GRP open mesh decking with a bonded grit surface satisfying the foregoing specification may be used in lieu of mild steel decking.

8.9 Walkway platforms, access steps, ladder and hand railing

8.9.1 Walkways and Access Platforms

Standard structural steel sections shall be used for the support structure.

Toe plates shall be fitted along the outer edges of all walkways and shall be part of the structure and not the floor panels. Toe plates shall extend 100 mm above the top level of the floor panels. Floor panels shall be sized so that each panel does not weigh more than 50 kg.

The support structure shall be constructed so that it can readily be dismantled. Provisions shall be made in the design for adjustment to eliminate irregularities in structural floor levels.

All components including floor fixings shall be galvanized after fabrication.

All assemblies shall be marked at the factory with distinguishing numbers, letters or marks corresponding to those of Approved Drawings or parts lists. Such marks if impressed before painting shall be clearly readable afterwards. Any temporary bolts for field erection shall be readily distinguishable from any bolts used for permanent connections.

Where dissimilar materials come into contact with each other an insulating membrane or paint coating shall be applied to minimize direct contact.

All components shall be hot dip galvanized after fabrication in accordance with BS 729.

8.9.2 Access Ladders

Where access ladders are provided as part of a structural steelwork installation they shall comply with the following requirements. The cross-section of the stringers shall be suitable for the weight of the ladder, taking into consideration the spacing of the points at which they are fixed to supporting steelwork or floors. The minimum thickness of the stringers shall be 12 mm. The stringers shall be drilled to take the 20
mm diameter rungs, which shall be uniformly spaced at between 230 and 260 mm centers. The rungs shall pass through and be welded to the stringers at each side of each stringer, and each weld shall be continuous. Supports shall be arranged to allow a minimum clearance of 200 mm behind the rungs to the wall or other obstruction.

Access ladders and all fittings shall be hot dipped galvanized after fabrication in accordance with BS 729.

8.9.3 Handrailing

Handrailing shall be double rail 1 100 mm high and 900 mm high on stairs, unless specified otherwise, measured vertically from the nose of the tread.

Standards shall be 38 mm diameter solid forged steel to BS 4360 Grade 43A with 60 mm diameter solid forged steel balls at handrail locating points drilled to give 1.5 mm clearance to handrails. Each ball shall incorporate a concealed grub-screw with Allen-type head to secure the rail. Standards shall have a minimum base width of 65 mm, drilled for M 16 fixing bolts and be set at maximum 1 800 mm centers.

Handrails shall be 33.7 mm OD x 3.2 mm thick tubular steel to BS 6323 Grade 13. Joints shall be arranged to coincide with the spacing of standards where possible otherwise they shall have butt joints with a tubular steel ferrule, plug welded or fixed with a 5 mm diameter countersunk head pin.

Removable sections of handrail shall have half-lap joints secured with a countersunk head pin.

Chains across openings shall be 10 mm x 3 links per 100 mm galvanized mild steel. The hooks and retaining eyes shall be securely fixed to the balls of the standards.

All components for handrailing shall be hot dip galvanized after manufacture in accordance with BS 729. Where aluminum handrailing is provided this shall be polished after manufacture is complete.

8.9.4 Chequer Plating

Chequer plating complete with cut-outs and in sizes suitable for removal by hand shall be of galvanized steel of sufficient thickness to carry a loading of 10 kN/m². Deflections shall not exceed 0.005 of the span and if the spans are over 1 m stiffeners shall be used.

Plating shall be of non-slip, self-draining pattern securely fixed to the supporting structure. The sections shall fit without gaps and squarely on the supporting structure.

The weight of each removable section shall not exceed 50 kg.

Each length shall have two formed holes for lifting keys. Two pairs of lifting keys shall be supplied for every 10 m² of plating. Where a single area is covered by several pieces of plating the direction of the pattern on all plates shall be the same and the pattern shall be continuous.

Curbing shall be built in so as not to reduce the width of the opening and it shall provide a minimum of 25 mm bearing surface for the chequer plating. It shall be
supplied with fixing lugs at centers, not exceeding 1 m. Curbing and cheque plating shall be finished flush with the surrounding finished floor.

Chequer plating shall be screwed to its curbing or supporting steelwork by countersunk screws so that individual plates cannot rattle or move. At the edges of raised floors, gangways and platforms toe plates 100 mm high shall be provided.

9.0 PIPELINES

9.1 General

Definitions

The following words or expressions shall have the meanings hereby assigned to them except where the context otherwise requires:

"Pipeline" shall mean a line of pipes having an appreciable length; it may have branch lines; it does not include piping system such as process piping within factories or treatment plant, "Pipework" shall mean all pipes excluded from the definition of pipeline,

"Pressure pipeline" shall mean pipelines, in which the nominal internal working pressure exceeds 0.3 bar and such other pipework as may be designated,

"Pipes" shall mean straight tubes having plain ends or ends shaped to form joints,

"Regime or working pressure" shall mean the pressure necessary in a hydraulic system to obtain the normal operating conditions to use the water,

"Fittings" shall mean bends, junctions, reducers, tapers, joint adapters, couplings and similar items which are not joints or flow control equipment,

"Internal" shall mean those parts of pipes and fittings, which are to be in contact with the liquid being conveyed,

"Flexible joints" shall mean joints made with factory made joint materials, loose collars, rubber joint rings and the like, which permit angular deflection between adjacent pipes, "Chambers" shall mean structures on the pipeline housing pipes, fittings, valves, including fittings through chamber walls,

"Raw water" is water derived from a river, lake, well field, watercourse or other source before it has received any treatment other than that inherent in pumping and conveyance, "Water supply system" shall mean all the pipelines, pipework, chambers, reservoirs, pumping stations etc., which comprise complete system which extracts raw water and distributes it to users,

"Distribution network" shall mean a part of the water supply system; located downstream of any reservoirs, in which water is distributed to users.

This Clause comprises the requirements for the supply and installation of pipelines for water. It shall be applicable for raw water and treated potable water mains both under gravity and pressurized. It also applies to sewer pipelines, drains and culverts.
Pipes, fittings and valves shall be of the diameter and class of material as specified or shown on the Drawings and their joints shall be completely watertight.

The contractor shall provide, install and maintain temporary protective caps or discs to prevent water, animals or extraneous material entering pipelines. Such caps or discs shall not be permanently removed until immediately prior to the relevant pipe or fitting being jointed.

The construction of open channels and trenches for pipelines shall at any one time be limited to lengths previously approved by the Project Manager’s Rep in writing. Except with the written approval of the Project Manager’s Rep, work on each approved length shall be completed to the satisfaction of the Project Manager’s Rep before work on any new length is commenced.

Cleaning of drains shall comprise the cleaning earth, concrete and blockwork drains and included culvert barrels from all stones, earth, domestic waste and other materials in order to assure proper functioning of the drain. The Project Manager’s Rep shall direct which drains will be cleaned. Cleaning shall proceed until the drains original cross section is restored. All removed material shall be dumped at approved sites.

9.2 Materials

All pipes, valves and pipe fittings shall conform to the relevant International Standards. The Contractor shall, if required, forward to the Project Manager’s Rep certificates showing that the materials have been tested and comply with the requirements of this Specifications and The relevant Standard.

Pipes shall be ordered in the maximum lengths available to minimize the number of joints. The Contractor shall be responsible for the supply of all materials in sufficient quantities and shall immediately prior to placing any order, especially for imported goods, ascertain the required the quantities.

9.2.1 General

The approval in writing or otherwise by the Project Manager’s Rep of any materials shall not in any way whatsoever relieve the Contractor from any liability or obligation under the Contract and no claim by the Contractor on account of the failure, insufficiency or unsuitability of any such materials will be entertained.

a) All items shall be suitable for water works purposes and for use with cold water installation and operation being in a tropical climate.

b) All items hereinafter specified shall be to such other Standard or Specification which in the opinion of the Engineer provides for a quality of material and workmanship not inferior to the Standard Reference Number (SRN) quoted. The Standard or Specification must be submitted to the Engineer for approval before commencement of work.

c) All ferrous pipes and fittings shall be coated with a protective paint suitable for use in and transport through a tropical climate.
d) The Contractor shall supply to the Employer a certificate stating that each item supplied has been subjected to the tests hereinafter laid down and conforms in all respects to the said Specification.

e) The Contractor shall provide adequate protection to all piping, flanged items and valves so as to guard effectively against damage in transit and storage and ingress of foreign matter inside the valves.

f) All pipework and fittings shall be subjected to a works hydrostatic test pressure which shall be not less than twice the maximum operating pressure.

g) The Contractor should exercise diligence to provide the best material. h) Where applicable the manufacturer’s Specification should accompany all offers. The name of the manufacturer must in every case be stated.

j) Where necessary the Contractor shall provide rubber gaskets to comply with SRN 208 and all other bolts, nuts, washers, etc. to undertake jointing at fittings etc.

k) Any articles required under this Contract which are found to be faulty due to a crack, flaw or any other reason or is not in accordance with the Specification stipulated will not be accepted nor will the Employer be liable for any charges in respect of such an article. Where any such rejected article can, in the opinion of the Engineer, be rendered usable, the Contractor may deal with it accordingly and include it in the Contract at a price to be mutually agreed. Straight pipes which have been cut will be accepted at the discretion of the Engineer, provided the length is not less than 4 metres or two thirds of the standard length whichever is the lesser and will be priced pro-rata.

l) Wherever possible, samples of pipes and fittings shall be submitted for approval of the Engineer prior to the Contractor obtaining the total requirements.

9.2.2 Galvanized pipes and specials

All piping shall conform to SRN 823 and SRN 903 for “Medium” Piping. The pipes shall be screwed and socketted, coupled or flanged.

All specials shall be of such dimensions as will mate with the piping supplied. Screw down stop valves shall conform to SRN 826. Barrel nipples shall conform to SRN 823 and all other specials shall conform to SRN 824.

All pipes supplied shall be certified by the manufacturer to have been tested in accordance with the relevant Standard Specification.

9.2.3 Gate valves

Gate valves shall comply with the requirements of SRN 501.

The gate valves shall be suitable for use in pipelines and for the operating pressure to a head of 160 metres or 250 metres of water (NP 16) or NP 25.

The gate valves shall be double flanged. The dimensions and drilling of flanges shall be in accordance with SRN 207. Flanges shall be machined flat. Flanges shall be NP 16 / NP 25 complying with SRN 207.
Spindles of the gate valves shall be provided with cast iron caps conforming to the requirements as specified under “Valve Caps” in SRN 501 or hand wheels if so specified.

The spindles of the gate valves shall be of the non-rising type and screwed so as to close the valves when rotated in a clockwise direction. The direction of closing shall be clearly cast on the valve cap or hand wheel. The gate valves shall be subject to “Closed End Tests” in accordance with the procedure set out in SRN 501.

The gate valves shall be suitable for opening and closing against an unbalanced head by manual operation.

9.2.4 Submission of samples

As soon as possible after the contract has been awarded, the Contractor shall submit to the Engineer a list of the suppliers from whom he proposes to purchase the materials necessary for the execution of the Works. Each supplier must be willing to admit the Engineer or his representatives, to his premises during ordinary working hours for the purpose of obtaining samples of the materials in question. Alternatively, if desired by the Engineer, the Contractor shall deliver the samples of the materials to the Engineer’s office without charge.

The information regarding the names of the suppliers may be submitted at different times, as may be convenient, but no source of supply shall be changed without the Engineer’s prior approval once a supplier, source or material has been approved. Samples of materials approved will be retained at the Engineer’s office until the completion of the contract. Samples may be tested to destruction.

All materials delivered to site must be at least equal in all respects to approved samples, otherwise they shall be rejected. No special payment will be made for compliance with clauses specifying tests etc. to ensure quality control etc. unless specifically itemized in Bills of Quantities.

9.2.5 Ductile Iron Pipes and Fittings

Ductile iron pipes shall comply with ISO 2531 and European Standard BS EN 545. Unless specified otherwise all joints will be of the "push fit type" with spigot and socket which shall be sealed with continuous rubber ring gaskets and feature a rotation capacity of at least 3°. Gaskets shall be the sole elements depended on to make the joints watertight. Prior to use jointing rings shall be stored in a cool place, protected from direct sunlight and frost.

The material used in the manufacture of ductile iron pipes and fittings shall comply with ISO 2531 or equivalent. Tests on ductile iron pipes and fittings shall comply with ISO 2531 or equivalent.

All ductile iron pipes and fittings shall be coated both internally and externally. The external pipe surfaces shall be zinc sprayed before coating in accordance with relevant the provisions of the appropriate following standards, ISO 8179 and DIN 30674. Both pipes and fittings shall be coated with bitumen to BS 3416 type 1, class A. Optionally, as indicated on the drawings or directed by the Project
Manager’s Rep., pipes may be coated internally with a cement mortar lining in accordance with the provisions of the appropriate following standards, ISO4179 and DIN 2614.

In the areas with electric or telephone underground cables, polythene sleeving shall be drawn over the pipe in addition to the coating. The sleeving shall be heavy duty black polythene of not less than 0.25 mm thickness.

Saddles shall be manufactured from gunmetal/bronze to BS 1400. Saddles shall include a strap with a tapping though boss into the pipe wall. The ferrule stem will continue through the boss into the wall. The saddle is to be suitable for working pressures up to 21 bar without leakage. All saddles shall be fitted in two parts, top and bottom, bolted a both sides and shall be fitted with a rubber gasket contained in a retaining groove and bonded to the saddle. All saddles shall be available undrilled, or drilled and tapped for tapered internal pipe threads in accordance with ISO 7/1 and BS 21, fitted according to ISO 7/2.

Saddles shall be suitable for use with conventional drilling and tapping machines which mount onto the saddle assembly and suitable for use with the standard pattern 360 degree swivel ferrules. The sealing ring of the saddle is to be manufactured from nitrile rubber to BS 2496/1986 or ISO 463. Each saddle strap is to be supplied complete with the required nuts and bolts.

9.2.6 Steel pipes and fittings

Carbon Steel pipes, fittings and joints shall comply with the relevant provisions below

### TABLE 11: PIPE FITTINGS SPECIFICATIONS

<table>
<thead>
<tr>
<th>NOM. SIZE</th>
<th>MATERIAL</th>
<th>PRODUC T</th>
<th>END</th>
<th>WALL THICK</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIPE</td>
<td>A53Gr.B</td>
<td>ERW</td>
<td>PE</td>
<td>SCH80</td>
</tr>
<tr>
<td></td>
<td>A53Gr.BA53Gr. B</td>
<td>ERW</td>
<td>PE BE</td>
<td>SCH40</td>
</tr>
<tr>
<td></td>
<td>A105</td>
<td>SW</td>
<td>SW</td>
<td>SCH20</td>
</tr>
<tr>
<td>ELBOW, TEE, REDUCER, CAP 15-40mm &gt;50mm</td>
<td>A105 A234Gr.WPB</td>
<td>SW</td>
<td>SW BE</td>
<td>ANSI3000</td>
</tr>
<tr>
<td>SCREWEDCAP 15-40mm</td>
<td>A105 SCR</td>
<td>ANSI3000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COUPLING 15-40mm</td>
<td>A105</td>
<td>ANSI3000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FLANGE 15-40mm</td>
<td>A105</td>
<td>ANSI150</td>
<td>SW-RF</td>
<td></td>
</tr>
<tr>
<td>&gt;50mm</td>
<td>A105</td>
<td>ANSI150</td>
<td>SO-RF</td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>--------</td>
<td>---------</td>
<td>-----------</td>
<td></td>
</tr>
<tr>
<td>BLINDFLANGE allsizes</td>
<td>A105</td>
<td>ANSI150</td>
<td>RF</td>
<td></td>
</tr>
<tr>
<td>GASKET 15-40mm &gt;50mm</td>
<td>SPIRALWOUND (ASB.)</td>
<td>ANSI150</td>
<td>ANSI150</td>
<td>1.5t 3.0t</td>
</tr>
<tr>
<td>BOLT/NUT allsizes</td>
<td>A193Gr.B7/A194 Gr.2H</td>
<td>ANSI150</td>
<td>ANSI150</td>
<td>S,BOLT HEX.NUT</td>
</tr>
<tr>
<td>GATE&amp;GLOBEVALVE 15-40mm &gt;50mm</td>
<td>A105/13Cr A126Gr.WCB/13Cr</td>
<td>800 ANSI125</td>
<td>SW FLGDF &amp;BB,OS&amp;Y BB,OS&amp;Y</td>
<td></td>
</tr>
<tr>
<td>CHECKVALVE 15-40mm &gt;50mm</td>
<td>A105/13Cr A126Gr.WCB/13Cr</td>
<td>800 ANSI125</td>
<td>SW WAFFER BB,LIFT BB,SWING</td>
<td></td>
</tr>
<tr>
<td>BUTTERFLYVALVE &gt;200mm</td>
<td>A126Gr.WCB/VITON</td>
<td>ANSI150</td>
<td>WAFER</td>
<td></td>
</tr>
</tbody>
</table>

Specification of pipes, valves, fittings for Carbon Steel

**9.2.7 uPVC pipes and fittings**

Unplasticised PVC pipes and fittings for gravity mains shall comply with the relevant provisions of BS 4660. Unplasticised PVC pipes and fittings for pressure pipes shall comply with the relevant provisions of BS 3505 and 4346.

Glass reinforced plastics pipes and fittings shall comply with the relevant provisions of BS5480.

Saddles shall be performed using HDPE tapping saddle pieces, manufactured to the same standard as the HDPE pipework. HDPE saddle pieces shall be fusion welded to the HDPE pipe.

**9.2.8 HDPE Pipes and Fittings**

All HDPE pipes and fittings shall be manufactured by a Quality Assured manufacturer in accordance with ISO9001. HDPE pipes shall be manufactured from PE 100 material, as classified by the European Technical Committee Report CEN\TC 155. In accordance with ISO 12162 the PE 100 material shall have a Minimum Required Strength (MRS) value of 10 MPa. The pipes and fittings shall be colored blue or black and be suitable for below ground use. The HDPE distribution pipes shall be provided with metalised indicator band in order to be subsequently detected from the ground surface by specific equipment.

For the purpose of this Specification pipework has been specified in accordance with current British Standard. These are denoted by a British Standard (BS) or UK Water Industry Specification (UK WIS) reference. This provides a guide as to the required
standard and the Contractor may use any other recognized international standards, which are applicable to HDPE pipework.

All HDPE pipes shall comply with the provisions of UK WIS 4-32-03. Joints and fittings shall comply with the provisions of UK WIS 4-32-15, UK WIS 4-32-11, UK WIS 4-32-14, UK WIS 4-24-01 and UK WIS 4-32-08, depending on the type of joints and fittings used.

Generally, all buried pipes shall be jointed using either butt or electrofusion welding techniques. Small diameter pipes (D<63 mm), pipes within structures and pipes connecting to metal fittings shall be jointed using mechanical jointing techniques, such compression, flanged joints or push-fit joints.

9.2.9 GRP pipes and fittings

Glass reinforced plastics (GRP) pipes and fittings shall comply with the relevant provisions of BS 5480.

All pipes and fittings shall have the minimum initial specific stiffness and be classed as pressure pipe with a pressure classification as given in the Contract. Allowable pipe deflections shall be as follows:

**TABLE 12: GLASS REINFORCED PIPES**

<table>
<thead>
<tr>
<th>Pressure pipes</th>
<th>Gravity pipes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long term permissible deflection – 6%</td>
<td>Long term permissible deflection – 6%</td>
</tr>
<tr>
<td>Initial deflection – design – 3 %</td>
<td>Initial deflection – design – 0.5 to 4 %</td>
</tr>
<tr>
<td>Initial deflection – installed - 5 %</td>
<td>Initial deflection – installed - 1 to 5 %</td>
</tr>
</tbody>
</table>

*Note that the lower limits will apply in weaker soils*

Every individual pipe's wall thickness shall be measured and recorded. Where the pipe's wall is less than the designed minimum, it shall be rejected unless it can be shown to meet the minimum stiffness value.

Pipes shall be jointed by means of a push fit sleeve coupling comprising an EPDM rubber seal bonded inside a GRP casing. The rubber seal shall extend over the full length of the joint and shall have moulded central register with two pressure-actuated lip seals either side.

Pipes shall be plain ended, shall have a smooth outer surface and shall have a constant outside diameter throughout their length thus allowing them to be cut and jointed at any position along their length without the need for any special preparation of the cut end, other than resealing the exposed fibres.

Handling, storage and installation shall be carried out strictly in accordance with the manufacturer's recommendations. The Contractor's pipe laying labour will be required to demonstrate that they have attended the pipe manufacturer's own training course for the installation of GRP pipes and fittings, before they are permitted to commence pipe laying activities.
Where bends are fabricated in GRP they shall be to the same standard as the pipes. Longitudinal angular deflections at the joints shall not exceed the maximum stated by the manufacturer.

Fittings including flange joints, bends, tee pieces, tapped pieces and junctions shall be standard GRP fittings and shall comply with BS 5480.

9.2.10 Ferrules

The ferrules shall be a main stem complete with a 360 degree swivel outlet at 90 degrees suitable for push fit connection to HDPE pipe with control of water flow via a threaded inner plug. The inlet thread shall be a male taper thread to BS 21/1975 or ISO 7/1.

The ferrules shall be for use underground and handling of potable water at temperatures up to 35 degrees Celsius and capable of working at 21 bar without leakage. The ferrules shall either be self-tapping or shall permit service pipe installation via conventional drilling and tapping machines dry, or under pressure with saddles. The ferrules shall further permit use with conventional drilling machines which mount onto the ferrule/saddle assembly and drill the main via the ferrule stem water way, dry or under pressure.

The ferrule stem, banjo, inner plug and top cap shall be manufactured of gunmetal/bronze to BS 1400/1986LG2. The banjo washers and top cap washer shall be manufactured in nitrile rubber to BS 2494 and shall provide the sealing between the outer body and the ferrule stem.

The ingress of dirt shall be prevented by a polyethylene top plug.

9.2.11 Push fit joints

In order to make up for mounting distances and not to force the pipes or fittings, push fit joints shall be mounted.


All materials, grip ring for end resistance, O ring for watertight seal and live, from metal or rubber shall be in accordance with ISO 9001 or EN 2900 1.

9.3 Transportation of pipes and fittings

Any vehicle on which pipes are to be transported shall have a body of such length that the pipes do not overhang. The pipes shall be handled in accordance with the manufacturer’s recommendations. Approved slings shall be used and all hooks and dogs and other metal devices shall be padded. Hooks engaged on the inner wall surface at pipe ends shall not be used. Pipe handling equipment shall be maintained in good repair and any equipment which in the opinion of the Project Manager’s Rep may cause damage to the pipes shall be discarded.

Under no circumstances shall pipes be dropped, be allowed to strike one another, be rolled freely, or dragged along the ground.
9.4 Storage of pipeline materials

All pipes shall be stored in accordance with the manufacturer’s recommendations, in order to preserve their quality and condition to the standards set out in the Specification. Particular care shall be taken in respect to HDPE and GRP pipes.

Pipes and fittings shall be stored raised from the ground and shall be carefully supported, cushioned and wedged. Pipes shall not rest directly on one another and shall not be stacked more than four pipes high, or two pipes high in the case of pipes greater than DN 500. Couplings and joints (and all components thereof) and other similar items shall be stored in dry conditions, raised from the ground in sheds or covered areas.

Storage areas shall be carefully set out to facilitate unloading, loading and checking of materials with different consignments stacked or stored separately with identifications marks clearly visible.

9.5 Inspections of pipes and fittings

Before incorporation into the pipeline each pipe shall be brushed out and carefully examined for soundness. Damaged pipes, which in the opinion of the Project Manager’s Rep cannot be satisfactorily repaired, shall be rejected and removed from the Site. If the Project Manager’s Rep considers that an unacceptable proportion of the pipes within a test length has failed, the Contractor may be required to test hydraulically, to the site test pressure each pipe and joint before pipe laying. In this event, test results shall be submitted to and approved by the Project Manager’s Rep before any further pipes are laid. The cost of individual pipe testing shall be borne by the Contractor.

9.6 Survey of pipeline routes

9.6.1 General

Prior to the commencement of excavation for any particular pipeline the Contractor shall set out and survey the route of the pipeline as shown on the Drawings, or as agreed with the Project Manager’s Rep. The length of the route shall be accurately measured and ground levels taken where required by the Project Manager’s Rep. The route of the pipeline shall be clearly marked on the ground.

9.6.2 Underground services

Having identified the proposed pipeline route, the Contractor shall liaise with the utility companies before commencing any excavation. With the assistance of the utility companies the Contract shall satisfy himself as to the exact location of all existing-underground services which may affect or be affected by the excavation of the pipeline. This may require the use of an electromagnetic pipe locator and test pits as described in b) above.

Having determined the exact location of any underground services, the Contractor shall prepare a details and issue them to the Project Manager’s Rep.

9.6.3 Survey results
The results of the survey, comprising ground levels, connection point invert levels, diameters and underground service details shall be submitted to the Project Manager’s Rep. The Contractor shall prepare details of the following for the agreement of the Project Manager’s Rep: the route and invert levels of the new pipeline, where there is a conflict with the existing drawings; the fittings required to make the connection into the existing pipe; measures to be adopted in relation to underground services.

At all times the pipeline surveying shall be sufficiently ahead of the excavation and pipe laying to permit agreement to be reached between the Project Manager’s Rep and the Contractor on the lines, levels and gradients of the pipeline.

Notwithstanding the requirement for an 'excavation permit', the Contractor shall not commence any excavation until confirmation of the above has been provided by the Project Manager’s Rep.

9.7 Pipelines under roads, footpaths and River crossings

The Contractor shall program the works to reduce the disruption to road traffic to a minimum, and before work commences in the existing roads and footpaths shall obtain the full permission of Town Halls and relevant utility companies; Submit details of his proposals, and obtain approval from the Project Manager’s Rep.

Pipelines shall run along and cross roads and footpaths, where shown on the Drawings and approved following the pipeline surveys. The roadway and footpath shall be reinstated in accordance with the Specification.

All the pipes crossing roads, footpaths and rivers shall be Galvanized Iron pipes conforming to the standards provided in the Pipe Material Section.

9.8 Installation

9.8.1 General

Installation of pipelines includes the excavation of trenches, supply, laying and jointing of pipes and fittings, construction of beddings and foundations, manholes and other structures in the line, testing, backfilling of trenches, disinfecting and commissioning.

Pipes shall be laid in accordance with BS 8010.

All plant, operation and haulage required from source of supply or store to bring the pipes, valves, etc., to their place of laying of fixing, including any unloading into temporary storage areas and any subsequent reloading for haulage to the place of laying shall be included in the supply of pipes and fittings.

During installation pipes are to be suitable anchored to prevent flotation prior to backfilling. The Contractor shall submit to the Project Manager’s Rep for his approval his proposed method for control of the pipe laying to the correct levels and alignment.

Plastic pipes shall be marked with metallized indicator bends or plastic material braiding provided with metallic wire insertion. The width of the metallized indicator
bends or plastic material braiding will be of 100 -150 mm and will be blue or black. The wire for insertion will be made by stainless steel, if the plastic material braiding is used. Also, the material will have humidity resistance and will be resistant to underground location. They will be inductively and conductively detectable.

9.8.2 Excavation for pipes in trenches

Whether trenches for pipe lines are constructed with vertical, sloping, or stepped sides, that portion of the trench which extends from the formation level to not less than 300 mm above the crown of the pipe when laid in its correct position, shall, unless otherwise specified, or ordered by the Project Manager’s Rep, be formed with vertical sides the minimum practical distance apart and shall be such that the distance between the sides of the trench and the barrel of the pipe does not exceed the following, inclusive of any allowances for temporary trench supports:

- width - pipe outside diameter + 0.4 m
- total width of cables and spacing + 0.2 m
- absolute minimum 0.6 m
- depth- pipe or cable outside diameter + 1.65 m
  (0.15 under and 1.5 m cover on top of service)

No excavations with battered sides shall be made in roads, footpaths, private gardens, or within 10 m of any existing or proposed building or other structure.

Excavation of the trenches for pipelines shall always be at least 15 m ahead of pipe laying. Unless otherwise specified, this shall include excavation in the vicinity of junctions where at least 15 m in each direction shall be excavated before the junction fittings are installed. Should an obstacle be encountered during the excavation, then the Project Manager’s Rep shall be informed and the necessary action agreed prior to laying more pipes on that section of the works. Should the Contractor have failed to excavate ahead of pipe laying, then the cost of lifting and relaying the laid pipes be met by the Contractor.

The material excavated from the trenches shall be handled with care, with asphalt, stone blocks, rock and stone from road construction or broken out of the trench during excavation, stock piled separately from the granular material of the natural ground.

9.8.3 Foundation and bedding

Unless specified otherwise, pipelines shall be laid in trenches excavated in the ground conforming to Clause "Excavation ". Unless unsuitable soil is encountered, trenches shall be excavated to 250 mm below the barrel of the pipe and prepared conforming to Clause "Preparation of Foundation”.

On the trench bottom a sand bedding shall be laid to a compacted thickness of 250 mm. The bedding sand shall comply with BS 882 grading zone C for Fine Aggregate and an aggregate impact value not exceeding 45%. Pipe bedding to concrete pipes shall contain no more than 0.3% sulphate. The bedding shall be compacted to 95 % of the standard maximum dry density. The level tolerance for the bedding shall be 10 mm.
In case a pipe of over 400 mm is to be used, the bedding shall be 5% of the diameter thicker than 250 mm. The additional layer shall be shaped concentrically with the pipe along the bedding angle. Where pipes are jointed, bell holes of ample dimensions shall be formed in the bedding to ensure that each pipe is uniformly supported throughout the length of its barrel and to enable the joint to be made. Pipes shall be laid on sufficient setting blocks only where a concrete bed or cradle is used. Pipe bedding shall be constructed as shown on the Drawings.

The classes of bedding to be used are indicated below:

<table>
<thead>
<tr>
<th>Class of bedding</th>
<th>Brief description of bedding material</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Mass Concrete</td>
</tr>
<tr>
<td>A2</td>
<td>Reinforced Concrete</td>
</tr>
<tr>
<td>B</td>
<td>Granular material</td>
</tr>
<tr>
<td>S</td>
<td>Granular material (bed and surround)</td>
</tr>
</tbody>
</table>

The granular material shall be spread over the full width of the formation and lightly hand compacted to a level slightly higher than the level corresponding to the underside of the pipe barrel to allow for settlement of the pipe to the correct level.

Further granular material shall be placed in the trench, special care being taken to fill under the sides of the pipe to ensure full contact with the barrel of the pipe, but leaving the joint exposed for a length of approximately 200 mm on each side of the joint collar, sleeve or socket. The granular material shall then be compacted evenly on both sides of the pipe.

Clay, or other approved impermeable material barriers shall be constructed to limit the uninterrupted length of granular bedding and backfill to a maximum of 500 m. The cost of this provision shall be deemed to be included.

9.8.4 Jointing and cutting

All joints shall comply with the relevant provisions of the appropriate International standard and shall be made to the manufacturer's recommendations and the Specifications hereafter.

Flanged joints shall be properly aligned before any bolts are tightened. Gaskets for flanged joints shall be of the inside-bolt-circle type. Jointing compounds shall not be used when making flanged joints, except that to facilitate the making of vertical joints, gaskets may be secured temporarily to one flange face by a minimum quantity of clear rubber solution. Bolt threads shall be treated with graphite paste and the nuts shall be tightened evenly in diametrically opposite pairs. Nuts shall be secured against loosening by vibration.

Rubber joint rings for water mains and drainage purposes shall be Types 1 and 2 respectively, complying with the relevant provisions of BS 2494 and shall be obtained from the pipe manufacturer. Joint lubricants for sliding joints and used for
jointing water mains shall not impart to water taste, color, or any effect known to be injurious to health, and shall be resistant to bacterial growth.

Unless specified otherwise joints having exposed mild steel components shall be cleaned and all loose rust shall be removed. The internal lining in a gap which has been left for the joint to be made shall be completed in accordance with the recommendations issued by British Steel Corporation or other approved supplier, unless specified otherwise. The external protection shall comprise bitumen applied to a thickness of not less than one millimeter on to the external surface of the joint, followed where appropriate by a spiral wrap of heavy duty glass fiber tape bonded with hot bitumen.

For closing lengths, it may be necessary to cut pipes of various materials. Pipes shall be cut by a method which provides a clean square profile without splitting or fracturing the pipe wall, and which causes minimum damage to any protective coating. Where necessary, the cut ends of pipes shall be formed to the tapers and chamfers suitable for the type of joint to be used and any protective coatings shall be made good.

Where ductile pipes larger than 450 mm diameter are to be cut to form a non-standard lengths, the Contractor shall comply with the manufacturer's recommendations in respect of ovality correction to the cut spigot end.

Where cut concrete pipes are used any exposes reinforcement shall be sealed with an approved epoxy resin.

9.8.5 Curves and bends

The pipes shall be laid in straight lines where possible. Curves of long radius shall be obtained by deflection at the joints. The deflection of the joints for this purpose shall not be more than 50 % of the maximum deflection as specified by the pipe manufacturer for the relevant type of joint. Where a required change of direction cannot be obtained by deflection of the joints, prefabricated bends shall be used.

Concrete thrust blocks shall be provided to pressure pipelines at reducers, tee junctions, caps, etc. and curves or bends deflecting 11.25° or more, where ordered by the Project Manager’s Rep or indicated on the Drawings, except where welded steel pipes or self-anchoring joints are used. The type and size of thrust blocks shall be in accordance with the Drawings or as approved by the Project Manager’s Rep.

Concrete for thrust blocks shall comply with all the relevant requirements of Clause "Concrete Work" and shall be placed carefully against undisturbed earth or rock with suitable bearing capacity and shall in no case be less than 150 mm of cover to the pipe. Concrete shall be grade Bc 7.5. When casting thrust blocks, no couplings or joints shall be covered, and if required the pipe with fittings shall be firmly fixed to the block by a suitable stainless steel strap bolted to the block. Where timber shuttering has been used such timber shall be removed before backfilling. The concrete shall be allowed to develop adequate strength prior to any pressure being applied to the pipeline.
9.8.6 Protection and backfill

After excavation of the trench, placing and compacting the bedding, laying the pipe and concreting the thrust blocks the pipe must be surrounded by fill or concrete. Unless otherwise specified, the space between the sides of the trench and the pipe must be backfilled with the same material as for the bedding. It shall be placed and compacted conform the requirements of Clause "Placing and Compaction of Fill and Backfill". Special care must be taken to backfill on both sides of the pipe evenly to support the pipe properly and avoid distortion of the pipe. Unless specified otherwise the pipe surround is continued up to a level 200 mm above the pipe crown. The layers shall be compacted, in layers not exceeding 100 mm thick after compacting, by hand controlled vibration on each side of the pipe only and not over the top of the pipe. Site tests shall be made to prove the effectiveness of the method of compacting at intervals instructed by the Project Manager’s Rep.

Unless otherwise specified the surround for concrete pipes shall be covered with clay or concrete tiles of at least 40 mm thickness and compression strength of 5 N/mm².

The trench above the so finished pipe surround shall be filled with fill complying with the requirements of Clause “Earthworks” and shall be compacted flush with ground level according to the requirements of the Clause “Backfill and Fill ”. Trench supports shall be gradually withdrawn in accordance with the progress of the fill, subject at all times to the provision that such withdrawal will not prejudice the safety of all works.

9.8.7 Concrete bed and surround

Where indicated on the Drawings, ordered by the Project Manager's Rep and where pipes are surfacing or having less than the required ground cover of 600 mm, pipes shall be surrounded by concrete grade C25. The pipes shall be supported on regularly spaced blocks in accordance with any recommendations from the manufacturer. Plastic pipes to receive concrete bed and surround shall be closely wrapped in a sheet of plastic (nominal thickness 120 µm).

For pipes with flexible joints a compressible filler shall be cut and placed at each pipe joint over the entire cross section of the concrete

Concrete shall be poured in a single operation and shall comply with the requirements of Clause "Concrete Works".

9.9 Manholes and chambers

All chambers for valves, mixers, flow meters and the like shall be constructed from reinforced concrete as indicated on the Drawings. Rectangular precast units shall be interlocking and comply with the requirements of BS 5911: Part 2.
All manholes shall be constructed from reinforced concrete except brickwork may be used where indicated on the Drawings. Unless otherwise indicated they shall be provided with a reinforced concrete cover slab and with a ductile iron cover and frame in a square rectangular or circular opening or as specified on the drawings. The clear opening shall be a minimum of 600mm diameter or square and the edges of the opening are to be chamfered. Covers are to be suitable for the anticipated loading and are to comply with the provisions of BS EN 124. They shall be set in mortar, not weigh more than 100 kg and be provided with handles or suitable lifting eyes. Covers are to be free from surface imperfections or blemishes.

All concrete shall be grade BC 25 as Clause "Concrete mixes" and shall meet the requirements of Clause "Concrete work". The concrete shall be watertight and have a thickness of not less than 200 mm and incorporate water stops. Where indicated on the Drawings, drainage into a granular filter shall be provided to the manhole.

Brickwork shall comply with the relevant provisions of BS 5628, part 3.

Rung irons or step irons are to be provided where indicated. They shall comply with the relevant provisions of BS 1247. Their size and strength shall be suitable for access to the manhole with a maximum vertical spacing between steps of 350mm in a vertical alignment.

Pipes passing through the concrete walls of a manhole shall be provided with ductile iron or steel spool pieces with puddle flanges. Alternative means of preventing the passage of water are subject to the approval of the Project Manager’s Rep. A flexible joint shall be situated as close as practicable to the outside face of any manhole or other structure.

Manhole inverts and benchings in drains and culverts shall be formed in concrete grade C25 to the same gradient and diameter as the connected pipework and with a smooth finish.

9.10 Pipe work connections

Breaking out of existing chamber walls and/or bases for the connection of new pipelines shall be undertaken with all due care and attention, to minimize damage to the structure of the existing chamber. After introduction of the new pipe the remainder of the opening shall be sealed and made good with epoxy based mortar or other suitable material as approved by the Project Manager’s Rep.

For connections to existing reinforced concrete wall or bases, the existing reinforcing bars shall be cropped cleanly and new reinforcement introduced around the opening.

For connections to existing concrete sewer pipes saddles shall be used, bedded on mortar. Where a saddle is not available for the particular location a pipe may be cut to the required angle so as not to protrude into the pipe. The cut pipe is to be bedded firmly in mortar externally and, where possible, internally.

9.11 Interference with Structures
Pipes shall be laid as far as possible clear from any structures. For pipes built into structures, the same requirements as for pipes passing through manholes apply.

9.11.1 General

As soon as pipes have been placed on their bedding and before backfilling they shall be tested for leakage. Before any testing, the Contractor shall ensure that the pipeline is anchored adequately and that thrusts from bends, branch outlets or from the pipeline ends are transmitted to solid ground or to a suitable temporary anchorage. Open ends shall be stopped with plugs, caps or blank flanges properly jointed.

Testing shall be done under supervision of the Project Manager’s Rep. The Contractor shall notify the Project Manager’s Rep at least one clear working day beforehand of his intention to test a section of pipeline.

9.11.2 Testing of pressure pipelines

Gauges for testing pressure pipelines shall either be of the conventional circular type, not less than 300 mm in diameter, calibrated in meters head of water, or shall have a digital indicator capable of reading increments of 0.1 m head. They shall be graduated such that the test pressure is at least 75% of the reading. Before any gauge is used the Contractor shall arrange for it to be checked independently, and a dated certificate of its accuracy shall be provided. Two gauges of each type to be used shall be provided for the sole use of the Project Manager’s Rep and shall remain in the Project Manager’s Rep’s possession for the duration of the contract.

Before testing, valves shall be checked and sealed, the sections of main filled with water and the air released. After having been filled, pipelines shall be left under operating pressure for the period of not less than 3 hours, so as to achieve conditions as stable as possible for testing.

The pressure shall then be raised slowly in 3 steps (0.5Pn, Pn, 1.5Pn) every fifteen minutes until the test pressure being 150 % times the working pressure is reached in the lowest part of the tested section, and the pressure shall be maintained at this level, for a period of one hour.

The pipe section shall be considered as having passed the test if leakage is less than 0.02 litres/mm of pipe diameter per kilometer per 24 hours for each 1 bar of pressure applied when measured over a period of steady pressure of not less than 4 hours. The period of sustained pressure shall be extended in accordance with the Project Manager’s Rep’s instructions. Where high daily variations in ambient temperature prevail the Project Manager’s Rep may require that 24 hour test periods are mandatory. In case of failure of the test the fault will be repaired and the test will be repeated completely at the Contractor’s expense.

Notwithstanding the satisfactory completion of the hydraulic test, if there is any discernible leakage of water from any pipe or joint the Contractor shall at his own cost, replace the pipe, repair the pipe or remake the joint and repeat the hydraulic test.

In addition to the tests on separate sections, the whole pipeline shall be tested on completion to the same procedure as that outlined for individual sections.
9.11.3 Testing of Gravity Pipelines

For the purpose of this clause "gravity pipelines" are defined as pipelines which are not completely filled with water such as certain sewers and culverts in open drains.

Testing Gravity pipelines laid in open cut shall be tested after they are jointed but before any concreting or backfilling is commenced, other than such may be necessary for the structural stability whilst under test. A further test shall be carried out after the backfilling is complete.

The pipelines shall be tested by means of a water test and by visual inspection, in lengths determined by the course of construction, in accordance with a program approved by the Project Manager’s Rep.

The test pressure for gravity pipelines shall be not less than 1.2 metres head of water above the pipe soffit at the highest point and not greater than 6 metres above the lowest point of the section.

The pipeline shall be filled with water and a minimum period of two hours shall be allowed for absorption, after which water shall be added from a measuring vessel at intervals of 10 minutes and the quantity required to maintain the original water level noted. Unless otherwise specified the length of pipeline shall be accepted if the quantity of water added over a 30 minute period is less than 0.5 litre per lineal metre per metre of bore. The contractor is responsible for the supply and disposal of water from the test, and any subsequent re-test, in a safe and acceptable manner.

Notwithstanding the satisfactory completion of the above test, if there is any discernible leakage of water from any pipe or joint, the pipe shall be replaced and or the joint shall be re-made, as appropriate, and the test repeated until the leakage is stopped.

Gravity pipelines and manholes shall be tested for infiltration after backfilling and removal of any temporary drainage. All inlets to the system shall be effectively closed, and any residual flow shall be deemed to be infiltration.

The pipeline, including manholes, shall be accepted as satisfactory if the infiltration in 30 minutes does not exceed 0.5 litres per lineal metre per metre of bore.

9.12 Tolerances

Pipes shall be laid accurately to the lines and levels shown on the Drawings. The maximum permitted deviation from the specified line and level for pipelines shall be for the following diameters,

up to 600mm 10mm

greater than 600mm 15mm

9.13 Disinfection

On completion of the hydraulic test on water mains, a foam swab shall be passed through the main for final cleansing sufficient times to achieve clear wash water.
The mains and tanks shall then be filled with a chlorine solution of a strength of 30 mg/l. The chlorine solution shall remain in the system for 24 hours or for such longer period as the Project Manager’s Rep shall require and all valves in the system shall be operated at least once during this period. After which the system shall be flushed till the outflowing water at all points has a chlorine content equal to that produced by the treatment plant.

After 24 hours samples of water in the system shall be taken and tested by an approved laboratory for compliance with the requirements of the appropriate utility companies or organizations if the results of such tests are not satisfactory sterilization shall be repeated until satisfactory results are obtained.

The Contractor shall obtain the Project Manager’s Rep’s approval of the method to be adopted for disposing of the chlorinated water and the time when such disposal shall take place on completion of the disinfection.

9.14 Reinforced concrete tanks

Reinforced concrete tanks shall be constructed as indicated in the Drawings. All clauses in the Specifications for "Concrete Works" shall apply. The concrete shall be watertight. All joints shall thus be provided with suitable waterstops. Upon completion the tank shall be tested for water tightness and comply with requirements of clause "Concrete Works - Testing of Concrete Water Retaining Structures”.

9.15 Design details for steel pipes

9.15.1 Material specification changes

When a line is connected to another line of different material specification or pressure rating, a valve or flanges connecting these two lines shall be constructed with the higher material specification or pressure rating between the two, unless otherwise indicated on the applicable drawings.

9.15.2 Bends, mitres and elbows

Elbows shall be used to change the direction of piping, however bends and mitres may be used instead. The radius of bends shall be from 4-6 times the nominal outside diameter.

Pipes indicated below may be cold bent at site: Carbon steel piping: < 40 mm;
Stainless steel piping: < 40 mm.

Long radius elbows shall be used for piping larger than 50 mm, unless specified otherwise.

9.15.3 Reducers

Reduction in line size shall be made by screwed, butt welded or socket weld fittings.

9.15.4 Branch connections

Branch connections shall generally be made by screw tees, socket or butt welding tees, half couplings, welding outlet fittings or welded pipe-to pipe connections. When
welded pipe-to-pipe connections are applied, unless the wall thickness of the pipe is sufficient to sustain the pressure and thermal stress, it is necessary to provide reinforcement. Welded pipe-to-pipe connections shall be designed so that the angle of intersection between the branch and the run is not less than 45°.

9.15.5 Flanges

The use of flanges in piping shall be limited to connections at flanged equipment and valves. Flanges shall also be used in special cases such as:

- where frequent dismantling of piping is required;
- where plastics, non-metallic, cast-iron or lining piping cannot be welded or otherwise joined except by flanges.

Steel flanges to be bolted to cast iron flanges of ANSI or PN code shall be as follows:

- class ANSI-150 / PN-10 flat face steel flanges to class ANSI-125 /PN-6 cast iron;
- class ANSI-300 / PN-40 raised face steel flanges to class ANSI-250 /PN-16 cast iron flange.

9.15.6 End closures

Welding caps, blind flanges and screwed caps shall be used as end closure.

9.15.7 Flanges

Inside diameters of welding neck type flanges shall generally be equal to those of connected pipes. Unless otherwise specified, welding and preparation of flange shall conform to those of pipes.

9.15.8 Fittings

Wall thickness of butt welding type fittings shall be equal or greater than the nominal wall thickness of connected pipe.

9.15.9 Bolt and nuts for line flanges

Dimension and surface finish shall be as follows:

Unified coarse screw threads, for U1-1/8 and over, 8 thread per inch; Stud bolts shall be threaded in their total length; Bolt length shall be determined by the Contractor.

9.15.10 Welding end preparation

When two piping materials whose nominal wall thickness is different from each other by more than 1.6 mm are butt-welded. The ends shall be trimmed.

9.15.11 Provisions for expansion and flexibility

Provision for expansion shall normally be made with Bellows type, Rubber expansion joints or other expansion joints may be used where necessary. When expansion joints are applied, adequate guides for piping shall be provided to avoid eccentricity of the centre line.
All piping systems shall be designed so that the loads and moments at the flanges of mechanical equipment such as pumps and compressors shall not exceed the permissible reactions for this equipment as specified by the manufacturers of the equipment.

9.15.12 Supports and hangers for above-ground piping

Pipes across valleys and river crossings shall have reinforced concrete support piers as directed in the drawings or by the Project Manager’s Rep. Concrete works for the piers shall conform to the specifications in the Concrete Works Section. These exposed pipes will be Galvanized Iron pipes of respective sizes.

All pipe sections which pass through walls of water retaining structures shall incorporate integral puddle flanges for building in and shall be left uncoated externally over the length encased in the concrete.

All piping shall be adequately supported by hangers or supports of proper structural design. Support span shall be determined, considering the stress and strain caused by the weight of the piping component, fluid and insulation.

Lines shall be provided with suitable supports to prevent excessive expansion forces on equipment and excessive vibration.

Piping at valves and mechanical equipment, such as pumps, requiring periodical maintenance shall be supported so that the valves and equipment can be removed with a minimum necessity of installing temporary pipe supports.

Pipe support details shall be furnished for piping of 50 mm and over, piping subject to high pressure or vibration, and other specific piping.

Pipe lines 200 mm and under shall be supported to carry their weight with water for hydrostatic test. Pipe lines 250 mm and over shall be supported to carry their weight conforming to service fluid conditions.

9.15.13 Joints and connections

Pipe joints shall be as follows:

joints in piping systems shall preferably be butt-welded; connections to equipment and vessels shall be flanged.

9.15.14 Pump Piping Installation

Suction lines to pumps shall generally be designed to avoid pockets.

The discharge line from centrifugal pumps shall be provided with a check valve between the pump and the block valve. For vertical discharge pumps, the check valve shall be located in the vertical line whenever practical.

Suction and discharge lines of pumps shall be drained through drains located at the low point of the pump casing whenever possible.
Temporary strainers shall be provided at the largest flanges between the pump suction nozzle and the first valve in the suction line. Permanent strainers should be as indicated on the drawings.

9.15.15 Vents and Drains
Venting and draining shall be accomplished through vessel or equipment connections. Vessel vents and drains may be located in overhead or bottom piping when valves or blinds are not located in overhead or bottom piping when valves or blinds are not located between vent or drain connections and vessels.

Pockets of piping shall be provided with 20 mm vents or drains.

9.15.16 Pressure Testing
On completion of erection, all pipe work shall be hydraulically tested to 1.5 times the maximum working pressure. The test pressure shall be maintained for two hours in the presence of the Project Manager’s Rep and any leaks shall be rectified at the Contractor's expense.

The Contractor shall supply all necessary equipment including pumps, blank flanges, gauges, etc for these tests.

9.16 Steel piping material specifications

9.16.1 General
When the piping is connected to equipment, this specifications shall be used to the extent given below: Companion flanges, gaskets, bolts and nuts for equipment nozzles;
First block valve with companion flanges, gaskets, bolts and nuts for relief valves;
Companion flanges, gaskets, bolts and nuts at the matching point between the piping furnished as a part of equipment by its manufacturer.
This specification shall not be used for special designed companion flanges, gaskets, bolts and nuts at equipment nozzles.

9.16.2 Materials
Each component of all piping systems shall meet dimensional, material and other requirement of standards for piping elements by BS, ASTM or DIN. Pipes and fittings shall be coated internally and externally with hot applied bitumen coatings or equivalent.

9.16.3 Carbon content
Carbon steel having a carbon content of more than 0.33 % shall not be used in welding constructions or to be shaped by oxygen cutting or thermal cutting process.
9.16.4 Corrosion allowance

Corrosion allowance shall be 1.7 mm for carbon steel and low alloy steel pipes. No corrosion allowance shall be taken for stainless steel pipes. Corrosion allowance shall be 3.0 mm for cooling water, fire water and service water lines.

9.16.5 List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSI</td>
<td>American National Standard Institute</td>
</tr>
<tr>
<td>MSS</td>
<td>Manufacturers Standardization Society of the Valve and Fitting Industry</td>
</tr>
<tr>
<td>BB</td>
<td>Bolted Bonnet</td>
</tr>
<tr>
<td>BE</td>
<td>Bevelled End</td>
</tr>
<tr>
<td>BW</td>
<td>Butt Weld</td>
</tr>
<tr>
<td>ERW</td>
<td>Electric Resistance Weld</td>
</tr>
<tr>
<td>FF</td>
<td>Flat Face</td>
</tr>
<tr>
<td>FLGD</td>
<td>Flanged</td>
</tr>
<tr>
<td>GI</td>
<td>Galvanized Iron</td>
</tr>
<tr>
<td>OS&amp;Y</td>
<td>Outside screw and Yoke type</td>
</tr>
<tr>
<td>PE</td>
<td>Plain End</td>
</tr>
<tr>
<td>RF</td>
<td>Raised Face</td>
</tr>
<tr>
<td>S</td>
<td>Seamless</td>
</tr>
<tr>
<td>SCRD</td>
<td>Screwed</td>
</tr>
<tr>
<td>SMLS</td>
<td>Seamless</td>
</tr>
<tr>
<td>SCH</td>
<td>Schedule</td>
</tr>
<tr>
<td>SW</td>
<td>Socket Weld</td>
</tr>
<tr>
<td>SO</td>
<td>Slip On</td>
</tr>
</tbody>
</table>

10 VALVES AND PENSTOCKS

10.1 General

All equipment and materials shall be of the highest quality from an approved manufacturer whose products have proved reliable in service in similar installations. The Contractor shall submit within his tender manufacture's literature describing the equipment and materials he intends to provide.

Flanges on valves are to be fully faced drilled and rated in accordance with the relevant Standards. Back faces shall be fully machined or spot faced for nuts and washers. Flanged joints shall be provided to the relevant provisions of BS4504.
Valves and penstocks shall open by counter clockwise rotation of wheel or operating nut.

All valves and penstocks shall be pressure tested in accordance with the appropriate Standard or pressure rating to which they are manufactured. During such tests there shall be no signs of leaking.

Where necessary valves and penstocks shall be fitted with extension spindles or universal joint operating rods and headstock or spindle caps as appropriate.

All valves and penstocks arranged for keyway operation shall be supplied with the necessary cast iron surface boxes.

The valves and penstocks shall be carefully selected for the duties to be performed, due regard being paid to the fluid being conveyed, climatic conditions and operating temperatures and pressures, and shall be suitably protected internally against corrosion.

Where electric actuators are fitted on to valves or penstocks they shall be pre-assembled and tested in the valve manufacturer's works with all necessary limit switches and other devices pre-set before delivery to site.

Valves incorporated in the delivery pipework shall be sized such that maximum velocities do not exceed 2.5 meters/sec. Each pump delivery pipe shall incorporate isolating valve and a check valve.

The working pressure rating of valves shall be suitable for 120% of the maximum pressure that can be developed by the pump in the pipework system plus the maximum pressure at the pump inlet.

Except as otherwise specified or approved, valves shall be of double-flange cast iron construction and shall be designed and tested to the declared Standard Specification and as a minimum shall comply with the relevant provisions of the appropriate Standards detailed below;

**TABLE 13: VALVES STANDARDS**

<table>
<thead>
<tr>
<th>Type of valve</th>
<th>ISO</th>
<th>DIN</th>
<th>BS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cast iron gate valves</td>
<td>5752</td>
<td>3202</td>
<td>5150</td>
</tr>
<tr>
<td>Cast iron gate (parallel slide) valves</td>
<td>5151</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cast iron check valves</td>
<td>5151</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Butterfly valves</td>
<td>5752</td>
<td>3202</td>
<td>5155</td>
</tr>
<tr>
<td>Diaphragm valves</td>
<td></td>
<td></td>
<td>5156</td>
</tr>
</tbody>
</table>
All ductile iron sluice valves shall have bodies, spindle seal housing, bonnets and gates of ductile iron (to BS2789); gates covered with nitrile rubber and have stainless steel spindle (to BS 970), gunmetal spindle nuts, rubber wiper rings and double ‘O’ ring spindle seals contained in nylon housing bushes. The set screws and body/bonnet bolts shall be fitted with ‘O’ ring seals. The bodies shall have straight through bores (without seating recess).

All ferrous parts are to receive the following protection system. All painting for shop and site application to be obtained from the same manufacturer.

**Shop Applied**

Zinc spray to Zn4 of BS 2569: Part 1 to be applied immediately after shot blasting. Surfaces are then to be etch primed and coated with high build coal tar epoxy to dry film thickness of 150 microns.

**Site Applied (After Erection)**

High build coal tar epoxy to dry film thickness 150 microns to give total of 300 microns after all surfaces have been thoroughly cleaned and degreased and touched up.

Non-ferrous materials may be used for valves and cocks of 40mm nominal bore and below. Such valves may be flanged or internally threaded for screwed tube.

Each valve and penstock shall have cast-in lettering showing maker, year of manufacture, nominal bore, rated working pressure and the Standard with which the valve conforms, and where appropriate an arrow to indicate the direction of flow. In addition each sluice and butterfly valve shall be provided with a complete set of operating gear as set out below.

Valves and penstocks shall be installed on the suitable places to permit proper and safe operation of the unit. Valves shall preferably not be installed with their stems below horizontal.

Valves shall generally be gate valves. Globe valves shall be used when throttling is required. Other kind of valves may be used where required or specified.

Valves having extended operating shafts shall be provided with all necessary lubricated support brackets for the shaft extensions.

Gate, globe, lift and swing check valves for general use shall be in accordance with table 5.5. Dimensions of other valves (butterfly, tilting check valve, ball valve, etc.) shall be in accordance with manufacturer's standard, but face to face dimension and end flange dimension shall conform to those for same class valves in prescribed standards as much as possible.

The machine faces of flanges shall be coated with a suitable protective composition in order to prevent their being affected by corrosion.

**10.2 Valve installations**
Valves shall be installed so that the centre line of the stem shall be not more than 1800 mm above the pavement of the platform levels. Frequently operated valves, on which the centre line of the stem is more than 1800 mm above the pavement or platform levels, shall be provided with remote operating devices, such as chain wheels, or extension stems to permit ease of operation. Chains shall hang within 900 mm of the operating level.

Other valves, which may be used infrequently, and which are not less than 3600 mm of the operating level, shall be installed so that they can be reached from an operation stand.

Frequently operated valves in trenches shall be provided with extension stems extending to within 100 mm below the cover plate when the hand wheels are more than 300 mm below the cover plate.

All valve outlet ends, in process services which do not connect to a piping system, shall be provided with a blind flange or a screwed cap assembly.

Manually operated valves, which are used in conjunction with locally mounted flow indicators, etc., shall be placed at the same operating level and located where the instrument can be readily observed.

10.3 Valve operation

Each valve shall be fitted with a handwheel and headstock and shall be suitable for operation by one man against the maximum working head. Valves shall be geared if necessary to permit this and shall close by clockwise operation of the handwheel. Handwheel shall be readily removable.

The position of valve handwheels and operating gear shall be carefully arranged so as to afford easy operation from the adjacent floor or platform level.

Valves having extended operating shafts shall be provided with all necessary lubricated support brackets for the shaft extensions.

Gate valves shall be provided with pressure equalizing by-pass with a globe type by-pass valve, when a differential pressure approximately equal to the pressure rating of the valve at the operating temperature may exist at the valve shut condition, and cannot otherwise be equalized in normal operation and startup.

Gear operations shall be provided in the following sizes and larger, unless otherwise specified:

<table>
<thead>
<tr>
<th>Class</th>
<th>Gate valve</th>
<th>Globe valve</th>
<th>Ball valve</th>
<th>Butterfly valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>PN6</td>
<td>350 mm</td>
<td>300 mm</td>
<td>200 mm</td>
<td>200 mm</td>
</tr>
<tr>
<td>PN16</td>
<td>300 mm</td>
<td>250 mm</td>
<td>200 mm</td>
<td>200 mm</td>
</tr>
</tbody>
</table>
Where gearing is required for operation the gears shall be machine cut and shall be fully enclosed with external greasing points.

**10.4 Penstocks**

All penstocks shall be of stainless steel or cast iron construction unless otherwise specified and of the flat-back type and shall be watertight when tested either to 5 meters head or 1.5 times the design seating head, whichever is the greater, with a leakage of less than 0.3 liters per minute per meter of perimeter. The thrust from the spindles shall be taken on the frame of the penstock.

Where specified or shown on the drawing flush bottom penstocks shall be used and shall have a flush invert with adequate sealing arrangements.

The Contractor shall be responsible for providing an adequate watertight seal between penstock frame and the wall and shall allow for possible irregularities of the wall surface. The proposed method of sealing shall be to the approval of the Project Manager’s Rep.

Penstock doors, wedge support beams, frames, guides, frame extensions and bridge pieces shall be of cast iron of minimum grade 14 BS 1452 or stainless steel of minimum grade 316 S11 BS 1449 Part 2 1983Doors and frames shall be fitted with renewable seatings of zinc free bronze. Wedges shall be adjustable with stainless steel adjusting screws and shall be readily removable. Stems shall be made either from manganese bronze or aluminium bronze. Penstock spindles shall be of stainless steel EN57 or similar approved materials. Extension spindles shall be of EN8 steel and attached to the penstock spindle by means of muff couplings. They shall be scarf jointed and pinned in an approved manner. At least two coupling joints shall be incorporated. Intermediate support bearings of PTFE or similar approved type shall be fitted to long shafts where necessary.

All bolt holes shall be drilled and spot faced. The top part of the penstock frame shall be sufficiently robust and substantial to prevent frames bowing and if necessary additional holding down bolts shall be fitted. The wedges on the doors and guides shall be matching and wedges shall not be fitted to the bottom or lower sections of the penstock doors. Inverts of rectangular penstocks shall be flush and fitted with renewable synthetic rubber of a type approved for the application. Doors shall have lifting eyes cast in or eye bolts of sufficient size to permit the lifting of the door against seating pressures. All working parts shall have provision for adequate lubrication.

After cleaning and inspection and prior to dispatch from the manufacturer the machined surfaces shall be covered with an approved preserving fluid or otherwise protected as agreed with the Project Manager’s Rep. All cast iron is to be given two coats of 2 pack epoxy pitch of an approved type. Other
steel shall be zinc or aluminium sprayed to a thickness of 0.15mm, one coat of suitable primer applied at the works and two coats of 2 pack epoxy paint applied at the site after renovation of primer as necessary. All external steel screw fixings for the penstock shall be supplied in the galvanized condition, stainless steel or sheradised to comply with BS 4921 Class 1 and Class2 with treatment.

The Contractor shall obtain details of the positioning of the holding down bolts and locate any reinforcing bars in the walls away from the penstock fixing locations. Dimension of spindle support brackets shall be determined by the Contractor and submitted to the Project Manager’s Rep for approval. Penstocks shall be installed in accordance with the manufacturer’s recommendations. The frame shall be secured in position with approved resin anchor bolts complying with the relevant clause of the Specification Clause or sheradised. Holes shall be drilled at the correct location and to the recommended dimensions of the approved fixing bolt. Bolts shall be installed in accordance with the manufacturer’s recommendations.

Adequate support shall be provided to all headstocks. Where headstocks are not used, the extension spindle shall be of sufficiently rigid construction and additional supporting metalwork shall be provided, as necessary, to allow satisfactory operation of the penstock.

Weir penstocks shall have a perfect level cill and shall be complete with top seals unless otherwise stated.

10.5 Gate valves

Gate valves of 50mm to 600mm size shall comply with the latest Standards. Each valve shall have cast or stamped on the outside of its body, the manufacturer's name, its size and its pressure rating.

Each valve shall be fitted with a hand wheel not exceeding 450mm diameter and headstock where specified and shall be suitable for operation by one man against the maximum working head. Valves shall be geared if necessary to permit this and shall close by clock-wise operation of the hand wheel. Hand wheels shall be readily removable. Spindles shall be non-rising.

10.6 Butterfly valves

Butterfly valves shall comply with the latest Standards and shall be of the drop tight closure, wafer type of the appropriate class with horizontal spindles. The valves shall have cast iron body and disc and removable neoprene or nitrile rubber sealing faces. Means of slinging shall be provided where necessary.

The operation of the valve shall be by hand and each valve shall be fitted with a handwheel and headstock where specified, so arranged that (unless otherwise specified) the valve will CLOSE by CLOCK-WISE operation of the hand wheel. Valves shall be geared for one man operation and shall be fitted with indicators. Hand wheels shall be readily removable.

10.7 Check valves
All check valves complying with the latest Standards shall be of the recoil type designed to close rapidly without shock. The valves shall have a cast iron body to the latest Standard, and renewable gunmetal seating faces to the latest Standards. The valve covers shall be of ample size to allow clear access to the valve seats when the valve is fully open and each valve shall be fitted with a bypass and isolating valve.

Each check valve shall have the direction of flow, nominal pressure rating and size cast or stamped onto the body.

Check valves of 50 mm and over shall be furnished with a boss on the downstream side of the check valve when the wall thickness is not sufficient to permit a drain connection to be drilled and tapped in the field.

10.8 Automatic air relief valves

10.8.1 General

Automatic air relief valves shall be designed to meet the following conditions:

• discharge air during charging of the pipeline;
• admit during emptying of the pipeline;
• discharge air accumulated at local peaks along the pipeline under normal operating conditions.

Conditions (a) and (b) shall be met by the employment of a large orifice capable of handling large volumes of air at a high flow rate, and condition (c) by a small orifice capable of discharging small quantities of air as they accumulate.

Valves with air intake or exhaust facilities shall have approved screening arrangements to prevent the ingress of air-borne dust.

10.8.2 Double Acting Air Valves

These shall combine both large and small orifices within one valve. The large orifice shall be sealed by a buoyant rigid ball and the chamber housing shall be designed to avoid premature closing of the valve by the air whilst being discharged. The small orifice shall be sealed by a buoyant ball at all pressures above atmospheric except when air accumulates in the valve chamber.

10.8.3 Single Air Valves

These include a small orifice only, or large orifice only, operating in a manner identical with the small or large orifice in a double acting valve. The nominal pressure range shall be PN 16 or as indicated on the Drawings.

Body ends shall be flanged with raised faces and drilled to BS 4504 for the nominal pressure specified or indicated on the Drawings.

The materials for the valves shall be as follows:

- Body cover and cowl: cast iron
- Small orifice: cast iron with gunmetal seat
- Small orifice ball: rubber covered or other approved
Large orifice - cast iron with rubber seat
Large orifice ball - vulcanite covered or other approved.

Each valve shall be provided with its own isolating gate valve.

10.9 Pressure relief valves

Relief valves shall be of the poppet type. The valves shall be rated to pass at least 200% of the rated flow at the point of connection, at 150% of the working pressure.

Safety valves shall comply with BS 6759: Part 1. They shall be designed to blow off at the specified pressure and re-close and prevent further flow of fluid after normal pressure conditions of service have been restored. The pressure/temperature rating shall be in accordance with Table PE-1 in BS 1560: Part 2.

Shell material shall be from the materials listed in Table PE-1 BS 1560: Part 2. Flanged ends shall be BS 4504 unless otherwise specified.

The pressure setting of the valve shall be manually adjustable and secured with a brass padlock. The valve shall be adjusted to the maximum safe working pressure at the manufacturer's works and the setting secured with a brass padlock. A test certificate and duplicate keys shall be provided. A wire lock and lead seal, stamped with the pressure setting, may be used in place of the padlock.

10.10 Water level gauges

Water level gauges shall be made of enamelled steel plate bolted or screwed in sections to a timber or plastic backing placed at locations as shown on the Drawings. The backing shall be of a durable quality and preserved so as to be capable of withstanding the environmental conditions at the water level. The plaque and gauge shall be fixed to the structure with stainless steel screws approved by the Project Manager’s Rep.

The gauge shall be marked at 0.10 m intervals with English numerals and with gradation marks at 10 mm intervals. Each gauge shall have a plaque to be placed alongside, marked with the Datum level referred to the Datum of the Specified zero level. Configuration of the scale shall conform to the locally used configuration of water level gauges used in the region, all as approved or directed by the Project Manager’s Rep. Location and overall lengths shall be as shown on the drawings or as directed by the Project Manager’s Rep.

10.11 Non return valves (lift pattern)

Lift pattern check valves shall be used for clean water service and small bore pipework. Valves shall be manufactured in accordance with BS 5154 and shall incorporate bronze bodies, and guided bronze discs. Bodies shall be screwed with BS 21 taper threads.

10.12 Ball valves
Ball valves shall be of the lever operated quarter turn top entry pattern, shall comply with BS 5159. Valves may be flanged or fitted with double union ends to suit the size and type of connecting pipework. Materials shall be compatible with the service fluid.

**10.13 Pressure reducing and pressure sustaining valves**

Pressure reducing valves shall be capable of maintaining a constant downstream pressure from a higher constant or variable upstream pressure. Pressure sustaining valves shall be capable of maintaining a constant upstream pressure irrespective of a variable downstream pressure. Both types of valves shall be droptight under no flow conditions.

Valve operation shall be achieved by the interaction of the inlet pressure, outlet pressure and an intermediate pressure produced by a pilot valve or relay system acting on the upstream side of the main valve.

The pilot valve or relay system shall be operated by a diaphragm connected to the outlet pressure for a pressure reducing valve, or the inlet pressure for a pressure sustaining valve, on its underside and a constant pressure derived from either weights or a spring on its upper side.

Nominal pressures will be PN 16 or higher pressures as otherwise indicated.

Body ends shall be flanged and drilled to BS 4504, PN 16 or for the higher operating pressure indicated. The materials for the valves shall be as follows:

- Body and cover - cast iron
- Internal valve - gunmetal with bronze liner and leather cups and facing rings
- Relay valve - bronze containing not more than 5% zinc with stainless steel spindle and nylon valve face
- Diaphragm - reinforced synthetic rubber
- Loading spring - spring steel (if employed)
- Cylinder and weights - cast iron (if employed)
- Lever - steel with gunmetal pins and links
- Connecting pipework to cylinder - copper
- Cylinder - epoxy lined mild steel with internal parts gunmetal bushed

Valves shall be factory tested, and supplied with a test certificate indicating valve serial number and set pressure.

**10.14 Float controlled valves (delayed action type)**

Float controlled valves for regulating the flow into a reservoir or tank shall be the angle type, mounted terminally on the supply line, for downward discharge to the water surface.

The valve shall be single beat type controlled by the action of the float on a pilot valve having a sensitive response to small mechanical forces. The valve shall close drop tight.

The float shall be mounted within a siphon type stilling tank, mounted as shown on the Drawings. The stilling tank shall fill through a siphon pipe and empty through a
subsidiary ballcock, such that the tank cannot begin to fill until the water in the reservoir reaches top level. The stilling tank fills and the valve moves from the fully open to the fully closed position in a continuous stroke. The valve remains closed until the reservoir level has dropped to allow the ballcock to open.

Valves shall be flanged to BS 4504. Pressure rating shall be suitable for closing against the maximum operating head in the pipeline, and no less than 4 bar.

The valve body, cover, piston and gland housing shall be manufactured from high grade cast iron. Guides and seatings shall be gunmetal. Levers and links shall be stainless steel with a copper float. Brasses containing more than 5% zinc shall not be used.

11.0 BUILDING WORKS

11.1 Carpentry and joinery

11.1.1 Timber

Timber shall be unused and of the best quality, well-seasoned, perfectly dry and free from splits, radial cracks, long loose or dead knots or other imperfections and shall be of a clean surface.

Timber shall be stacked in such manner as to prevent warping and to have all elements readily available for inspection. All timber shall be subject to inspection on Site piece by piece by the Project Manager’s Rep who shall reject such timber which is not to the specified quality. Any portion of the timber that warps or develops shakes or other defects shall be replaced.

Timber shall in principal be sawn to scantlings of the required dimensions at least one month before use.

11.1.2 Nails and Screws

All nails and screws shall comply with BS 1202:1974 and BS 1210: 1963. In all surfaces to be painted nail heads shall be punched and screws screwed below the surface and filled with leadless filler.

11.1.3 Finished Sizes

Sawn timber shall be the full size required. The sizes given in the Bills or otherwise for wrought carpentry are the nominal sizes; 3 mm will be allowed off the nominal dimensions for each wrought face.

11.1.4 Workmanship

All joinery shall comply with BS 5268; "Structural Use of Timber".

Carpenter's and joiner's work shall be framed and put together in a workmanlike manner with a sufficient number of nails of adequate size to maintain the work. All necessary notching, halving, nogging, etc. shall be carefully executed and bearing surfaces shall be in proper contact. All forms of joints shall be such to transmit safely
the loads and stresses to which the timber will be subjected and shall be to the satisfaction of the Project Manager’s Rep.

Glue shall comply with BS EN 301 and shall be classification WBP of the resorcinol-formaldehyde (CRF) or phenol-formaldehyde (PF) type, and shall be used strictly in accordance with the manufacturer’s instructions.

Beams, purlins and structural timbers are to be in as long lengths as possible. Where joints are unavoidable in beams or purlins they shall be properly scarfed and bolted and where practicable to be placed at points of support. Scarfs, unless otherwise directed, are to be of a length equal to twice the depth of the element, provided that the adjacent timbers are continuous. Wall plates shall be halved at angles and joints in length if otherwise unobtainable in one piece.

Joiner's work shall be framed up as soon as possible and kept carefully stacked clear of the ground and protected until required. It shall not be glued and wedged or doweled until immediately before being required for use. Door frames, etc. shall have full mortice and tenon joints with hardwood dowels or wedges, glued and cleaned up. The quality of workmanship shall comply with BS 1186 Part 2 and shall be generally in accordance with that of the samples of joinery to be indicated by the Project Manager’s Rep on the Site.

11.1.5 Check before priming

The priming specified in Clause "Painting and other Coatings" shall not be carried out until the prepared timber has been Inspected and approved by the Project Manager’s Rep, but shall be done before the final assembly and fixing.

11.1.6 Defects

If during the defects liability period any shrinkage, warping or winding should occur or any other defect appear in any of the joinery which is attributable to defective materials or workmanship, such defective work is to be taken down and replaced to the Project Manager’s Rep’s approval. Should any other work be affected by the removal and replacement thereof it also shall be made good at the Contractor's expense.

11.2 Doors and windows

11.2.1 General

Unless specified otherwise, all doors and windows shall be in accordance with the following clauses.

All doors and windows both interior and exterior shall be completely weather and waterproof. Material for doors should be mild steel.

The Contractor shall assemble one finished prototype of each component, fitted with ironmongery for approval of the Project Manager’s Rep before any repetitive production, or fixing of prefabricated frames commences. The Contractor shall also
submit to the Project Manager’s Rep for approval samples of locks, handles, latches and similar ironmongery.

All window and door openings in blockwork walls shall be spanned by suitable reinforced concrete lintels.

11.2.2 Fixed Windows

Material for windows should be aluminium. Fixed windows shall consist of single sheet glazing in aluminium frames of approved quality.

11.2.3 Ironmongery

All moving parts of joinery components are to be fixed with equal tolerance spaces all round. Hinges, etc., are to be fitted in perfect alignment, locks and fastenings are to engage properly in their striking plates or sockets without clatter. Screws for fixing ironmongery shall be of the same metal as the hardware. On completion all joinery shall be adjusted and ironmongery oiled and the whole shall be in perfect working order. Removable ironmongery, except hinges, shall be removed for painting and refitted prior to the final coat of paint or on completion as ordered by the Project Manager’s Rep. Locks are to be fixed where shown in the Drawings or as directed by the Project Manager’s Rep. All external door locks shall have three keys, and all internal locks two keys. All locks and moving parts are to be oiled and left in perfect working order and all keys shall be properly marked and labelled and delivered up to the Project Manager’s Rep as required. All timber doors shall be fitted with an approved pattern of combined mortice lock and latch complete with aluminium lever handles. In addition double doors shall have barrel bolts fitted top and bottom to one leaf.

All locks, handles, latches and other similar ironmongery shall be subject to the approval of the Project Manager’s Rep.

11.3 Roof and wall sheeting

The trapezoidal type of sheeting which includes flashings, copings and the like for roofing and wall cladding shall be a hot dip galvanized steel substrate of zinc coating mass G 350 to BS 2989:1982. It shall be coated on both sides with a protective coat against corrosion bonded to the sheeting, of a type and quality approved by the Project Manager’s Rep.

Unless otherwise required by the design, the working environment or the Specification, assuming a safety coefficient of 1.8, with a span of 1.0 m the sheeting shall be able to bear without plastic deformation:

- a uniformly distributed load of 1.0 kN/m²;
- a concentrated load of 1.5 kN at midspan.

The deflection of the sheeting with a span of 1.0 m and a concentrated load of 1.5 kN at midspan shall be less than 10 mm. The sheeting and the fixings thereof shall be able to withstand safely uplift forces due to wind of 1.0 kN/m² with a span of 1.0 m.
The sheeting shall not be scratched, stained, distorted or have any other defects. The sheeting shall without any maintenance and under the local conditions not be adversely affected by corrosion. All ancillary items necessary for fixing the sheeting, protecting it against corrosion, making the joints leakproof and the like shall be adequate for their purpose, shall not cause corrosion of the sheeting and shall be of a type and quality approved by the Project Manager’s Rep. The Contractor shall place and fix the sheeting and take all measures necessary to prevent corrosion and to obtain an adequately fixed leakproof roofing and cladding as specified by the supplier and approved by the Project Manager’s Rep.

Roof and wall cladding shall be supplied with a test certificate of the supplier confirming that the sheeting complies with all relevant standards and the Specifications.

11.4 Rendering and other finishes

11.4.1 Plastering and rendering

Before plastering or rendering is carried, all joints shall be raked out to depth of 10 mm, the surface of the wall cleaned and all foreign matter removed.

External rendering shall be applied in two coats of cement/sand mortar of mix type II, Table 1 BS 5262 with a wood float finish to a minimum overall thickness of 20 mm.

Plastering to internal walls and ceiling surfaces shall be applied in two coats to a minimum overall thickness of 20 mm as follows:

Undercoat: cement/sand - Type II, Table 2 BS 5492 Finish: anhydrous gypsum plaster to BS 1191: Part 2, Class C with smooth finish.

Undercoats shall be thoroughly applied, straightened and scratched and brought to a true surface. Finished surfaces shall be left true, even and free from blemishes and all corners shall be finished true, vertical and even and carried out at the same time as adjacent wall surfaces.

Re-tempering or reconstitution of mixes will not be permitted after the initial set has taken place.

11.4.2 Glazed ceramic wall Tiles

Unless specified otherwise, glazed tiles shall be white, complying with BS 1281. They shall be laid on a bed of cement mortar (1:4) and pointed afterwards with accurate and straight joints.

11.4.3 Roofing tiles

Unless specified otherwise, roof tiles and skirting shall conform to the following. They shall be Portland cement tiles to exterior roof surfaces. Cement tiles shall be made with standard quarry aggregates of an abrasive hardness to the approval of the
Project Manager’s Rep. The tiles and skirting shall be 300 mm x 300 mm x 20 mm thick unless otherwise stated, and shall have smooth and even surfaces, square edge and sharp arises. Roof tiles shall be guaranteed at 200 freeze-unfreeze cycles. All tiles shall be black color to a sample approved by the Project Manager’s Rep.

11.4.4 Laying of tiles

Where roof tiles are laid on a concrete fill the surface shall be swept and cleaned of all waste materials and shall be thoroughly wetted. A layer of slurry in neat cement and water shall be applied to the area to be paved prior to the laying of the bed. This slurry shall be brushed into the surface immediately before laying the cement bed. The tiles shall be thoroughly soaked in clean water before laying.

Tiles shall be laid with continuous joints and bedded in a cement and sand (1: 6) screed or backing not less than 30 mm thick and pointed or grouted with cement slurry to match the tiles. Tiles shall be accurately cut and fitted to all doors, thresholds, wall openings, projections, etc. The finished floor shall be perfectly true, level or to the falls specified and cleaned off on completion of the work to the satisfaction of the Project Manager’s Rep.

11.4.5 Protection of tiling

After the tiles have been laid, the floor shall be covered immediately to give complete protection from dirt and damage during all subsequent stages of the work.

The Contractor will be required at his own expense to remove any tiles which have been stained or damaged before completion of the work and replace them with new ones.

11.5 Plumbing installations

11.5.1 Materials and workmanship

All materials and workmanship shall be of best quality and comply with the relevant British Standards. BS 6465; Part 1 for sanitary appliances and BS 6700 for Water Supply, where applicable.

The Contractor shall submit full details together with drawings of his proposals for approval of the Project Manager’s Rep before commencing the work and shall carry out all tests and inspections of the finished work as may be considered necessary by the Project Manager’s Rep and specified below.

Unless specified otherwise all piping on floors and ceilings shall be exposed.

11.5.2 Plastic pipes for hot and cold water services

Plastic pipes for hot and cold water services shall be ABS, with solvent welded joints and fittings, installed and fixed in accordance with manufacturer's printed instructions.

11.5.3 Coupling unions

Coupling unions shall be installed at reasonable intervals on vertical and horizontal pipe runs to facilitate erection and dismantling of the pipework without interference to
the structure. Similar union connections shall be provided for connecting the pipework to all valves, cisterns, electric heaters, etc.

11.5.4 Valves

Stop valves shall be to BS 1010 and shall be of all gunmetal construction with union tails for connection to ABS pipework. Stop valves shall be located in connections to every single structure or building or where indicated on the Drawings. Chambers shall be as detailed in clause “manholes and chambers”, or as otherwise specified.

11.5.5 Draw-off Taps

Draw-off taps shall be chromium plated or natural finished gunmetal high pressure screw down easy clean pattern, threaded for union with crutch handles as BS 1010, fitted with hose union.

11.5.6 Water Storage Tanks

Storage cisterns shall comply with BS 417; Part 2 Grade A. Cisterns shall be supplied complete with inlet connection and ball valve, overflow connection with pipe, outflow connections, and drain connection with gate valve.

Water storage tanks shall be of glass reinforced plastic to sizes indicated on the Drawings, complete with close fitted cover secured to the tank. Ball float valves shall be suitable for use with the storage cisterns specified.

11.5.7 Overflow Pipes

Overflows to water storage tanks and WC cisterns shall be in PVC tubing as specified for service pipes. Overflow pipes shall be visible externally, and shall incorporate a minimum of vertical drop of 300 mm. They shall project 60 mm beyond and discharge clear of the wall face. All external overflow pipes shall be painted.

11.5.8 Soil, Waste and Vent Pipes

Soil, waste and vent pipes shall be of the highest grade to BS 5255 or shall be cast iron pipe with B spigot and socket joints to BS 416. PVC pipe shall be jointed with solvent welded fittings. Jointing shall be carried out strictly in accordance with the manufacturer's printed instructions.

Soil pipes shall not be less than 110 mm nominal diameter. Vent pipes shall be not less than 50 mm nominal diameter while waste pipes shall not be less than 35 mm diameter.

All waste and soil pipes shall be vented at roof-level and provided with gully traps at ground level. Waste pipes shall be fixed at least 25 mm clear of finished wall surfaces with PVC brackets.

Fixing intervals shall be 0.5 m horizontally and 1.2 m vertically, except that 50 mm pipes shall be fixed at 0.6 m intervals horizontally.

Where soil waste and vent pipes pass through roofs they shall have a uPVC roof terminal and be positioned to enable the roof finish to be suitably weatherproofed.
The vent shall terminate with a balloon guard to the approval of the Project Manager’s Rep.

11.5.9 Sanitary appliances
Sanitary appliances shall generally comply with BS 6465.

WC suites shall comprise a black plastic ring seat, a white vitreous china pedestal WC pedestal pan and UPVC flushpipe. Flushing shall be hand-operated from a 9 litre plastic cistern with plastic ball valve to BS 2456. The overflow pipe shall discharge into the pan.

Wash-hand basins shall be white vitreous china (635 mm x 475 mm) to BS 1188, with concealed fixing brackets and bolts, fitted with 13 mm hot and cold chrome plated pillar taps, complete with trap, waste and overflow assembly to BS 3380.

Taps shall comply with BS 1010: Part 2:1973 and shall be chromium plated, brass type of approved local manufacture. Taps for wash-basins shall be pillar taps with spray outlet. Sinks shall be provided with a "swan neck" swivel outlet. Where hot water services are provided, taps shall be a combination tap assembly.

All connections of sanitary fittings shall be made by a trap with a water seal (siphon) of not less than 50 mm depth and all traps shall be of the removable bend type.

11.5.10 Pipework and fittings
Bends shall be used where practicable in preference to elbows. Square elbows will not be accepted for soil, waste and vent pipes.

Pipework shall be fixed to walls using an approved pattern plastic brackets for screwing into walls or concrete. The brackets shall be such that the pipe is held 15 mm clear of the finished wall surface. Brackets shall be fixed at regular intervals appropriate to the pipe diameter in order to ensure that the pipe is securely fixed to the wall.

Pipelines shall be straight except at changes of direction which shall be made using standing fittings.

Eccentric reducing sockets shall be used (to facilitate air venting and draining) where changes of diameter are made in runs of normally horizontal pipework.

Pipework shall be installed to permit even fluid flow, draining and dismantling of the system.

The expansion and contraction of pipelines shall be taken up in the geometry of the layout.

Pipes passing through walls, partitions and ceilings shall be provided with pipe sleeves. Sleeve sizes shall allow for the free movement of the pipes. Sleeves passing through finished surfaces or exposed to view shall be flush with the surface of the
partition through which they pass and they shall be provided with suitable end covers of approved pattern and finish.

Connections to water-closets and floor mounted soil fittings shall be made by using the correct sized socket for the outlet of the fitting.

All services shall be laid to drain with a minimum cover of 600 mm unless otherwise shown on the Drawings. Piping shall be as straight and direct as possible forming right angle with or parallel to wall and other piping.

All piping and fixtures shall be adequately protected during construction. All cut pipes shall have ends reamed and be free from burrs.

Pipes carrying cold water for drinking purposes shall be located so as not to be liable to heat gain or alternatively shall be effectively insulated from such gain.

All necessary precautions shall be taken to prevent water-hammer and should it occur it shall be rectified.

All piping shall be so installed that there is a clearance of at least 25 mm between the finished covering and adjoining work. All pipes at or in the ceilings shall be hung from the construction above and as close as possible to bottom of slab, beam etc. All risers shall be plumb and true, neatly spaced and parallel to walls and other pipes.

All pipes shall be so arranged as to be accessible for repairs and replacements without disturbing adjacent work. Central valves shall be located to give complete regulating control of all systems, plumbing fixtures and other equipment. All valves shall be easily accessible and no valves shall be installed with handles pointing down.

All pipes shall be quite free of each other and easily accessible for their full length where in ducts. In no instance whatever, are any pipes to be fixed behind other pipes and all shall be easily accessible from access openings. Access panel openings shall be suitably located at all stop taps on service lines and at inspection openings on bends and junctions in suitable locations to allow rodding of all waste and soil lines. Particular attention shall be given to location of inspection openings to soil pipes to closet pans to ensure adequate accessibility.

The Contractor, before installing any of his work, shall see that it does not interfere with clearances required for finish columns, pilasters, partitions and walls, as shown on the Drawings and details. If any work is so installed and if later develops that such details of design cannot be followed, the Contractor at his own expense shall make such changes in his work as are directed by the Project Manager’s Rep’s Representative and as will permit the installation of the architectural work shown on the plans and details.

Runs and locations of piping are shown on the Drawings. The Contractor shall be responsible for the correct setting out of the PVC piping sleeves for pipes through walls and floors and locations of PVC pipe brackets and the like, and shall prepare the required Working Drawings which shall be submitted to the Project Manager’s Rep’s Representative for approval prior to starting any construction work.
Variations from the original lay-out, location of valves, cleaning and other inspection openings shall be shown on the As-Built Drawings.

11.5.11 Rain water pipes and gutters

All rainwater pipes and gutters shall be asbestos cement pipe or UPVC pipes to 4576. Jointed and fixed in accordance with the manufacturer’s printed instructions. All rainwater pipes shall be perpendicular and fixed to the wall with approved brackets.

12 PAINTING AND OTHER COATINGS

12.1 General

Unless otherwise specified, the workmanship and quality of materials for painting shall comply with BS 6150;1991; "Code of Practice for Painting of Buildings" and BS 5493; 1977; "Code of Practice for Protection of Iron and Steel Structures Against Corrosion".

12.2 Paints

The Contractor shall submit certificates from an approved manufacturer giving the guarantee that the paint offered shall be conform the relevant standards (e.g. BS 5493), the Specifications, suitable for the locale climate and compatible with the surface of application. The manufacturer and types of paint shall not be changed unless prior approval is obtained from the Project Manager’s Rep. The Contractor shall use the advisory services of the paint manufacturer. Should any such advice conflict with these Specifications, the Contractor shall obtain written instructions from the Project Manager’s Rep before proceeding with the work. The paint manufacturer shall be allowed to inspect and check the preparation and painting during all stages of the Contract and to report to the Project Manager’s Rep.

All coats of paint for a coating system shall be compatible with each other and shall be of the same manufacturer unless otherwise approved by the Project Manager’s Rep.

Each consignment of paint shall be delivered in containers sealed by the manufacturer, accompanied by a certificate guaranteeing that the paint conforms to relevant Standards and Specifications. The date and results of tests and analysis performed during manufacturing shall be attached. The capacity of the containers shall not exceed 0.03 m³. The name of the manufacturer, type of paint, batch number, special storing conditions, etc. shall be clearly shown on each container. Containers shall remain unopened, apart from necessary sampling, until required for use and used in order of delivery.

Paint not used within the period specified on the containers or within 12 months of the date of manufacture, whichever is the less, shall be replaced.

Paint shall retain its properties during storage at Site and any paint which fails in this respect shall not be allowed to be used in the Works.

Livered, gelatinized, or otherwise deteriorated paints shall not be used.
12.3 Preparation and maintenance of surfaces

Preparation of the initial surface of the material to be coated shall be as described in the relevant material related clauses.

Immediately before any coat is applied the whole of the surface to be painted shall be thoroughly cleaned of all dust, loose paint or grease by washing down with fresh clean water and as necessary brushing with a bristle brush.

The Contractor shall examine all surfaces before applying any coats. No paint shall be applied to wet, acid, alkaline, damp, rough or greasy surfaces. No coating shall be applied to any surface before the Project Manager’s Rep has inspected the cleaned and prepared surface.

12.4 Painting workmanship and conditions

All works shall be carried out by skilled labour experienced in the use of materials specified.

All paints shall be thoroughly mixed until homogenous and, if necessary, be strained free from skins, lumps or sediment. Thinners and driers may only be added to enable the paint to comply with the specified application or drying requirements. Thinners and driers shall be compatible with the paint and shall not be used without approval of the Project Manager’s Rep and paint manufacturer.

To prevent loss of adhesion and solvent entrapment the paint manufacturer's instructions shall be followed particularly in respect of minimum and maximum periods between coats and temperature range for application. The methods of application of paint shall be subject to the approval of the Project Manager’s Rep and be in accordance with manufacturer's recommendations. Where spoiling of adjacent surfaces are likely to occur, and in case of paints containing lead, no spraying shall be permitted.

If brush or roller painted surfaces is not smooth, they shall be rubbed down and dusted off to obtain a smooth and mat surface to which the next coat will firmly adhere.

Rags, brushes and tools used in the preparation and painting of surfaces shall be cleaned with white spirit or a thinner as approved by the Project Manager’s Rep.

Paint film shall not have excessive or uneven thickness and the finished surface shall be free of defects. The final coat shall be smooth and free from defects, including those showing through from preceding coats.

At the end of every working period paints with a limited "pot life" shall be discarded and not be mixed with fresh paint.

Painting work shall not be exposed to direct sunlight. Prepared, primed or undercoated work shall not be left exposed for an undue period before completion of the painting process.
Fitting such as ironmongery, switches, electrical fittings, etc. not required to be painted shall be removed before the painting process is commenced and refitted after completion of painting.

After each coat is applied the Contractor shall test the paintwork. The contractor shall provide the Project Manager’s Rep with one day’s notice of the test. The maximum dry film thickness shall not exceed the minimum figure specified for the particular class of protection by more than 20 %. The Contractor shall be responsible for the provision of all equipment for testing the protective coatings and shall remedy all defects to the Project Manager’s Rep’s satisfaction.

The Contractor shall take measures to prevent that any paint coat in any way at any stage is damaged. If not withstanding such measures a paint coat is damaged, the Contractor shall immediately repair such damages to the satisfaction of the Project Manager’s Rep.

12.5 Protection and painting of metal

All the iron and steel works shall be painted except works embedded in concrete.

Before painting the steel surface shall be cleaned and de-rusted and be free of dust, grease, rust and other materials.

Except where specified otherwise, the following coating systems shall be applied on steelwork:

12.6 For steel in continuous contact with water;

One coat of two-zinc rich epoxy primer with a minimum film dry thickness of 25 micron Two coats of two pack high build coal tar epoxy paint, each coat with a minimum dry film thickness of 200 micron.

For all other steelwork the following system shall be used;

One coat of two-zinc rich epoxy primer with a minimum film dry thickness of 25 micron One or two coats of two pack high build epoxy coating pigmented with micaceous iron oxide, with a minimum dry film thickness of 150 micron. Two coats of two pack epoxy enamel of a color to be specified with a minimum dry film thickness of 50 micron per coat.

Protection and painting of concrete, plasters and blockwork

Concrete, plasters, blockwork and other cementitious surfaces shall be painted according to coating system "J".

The surfaces of concrete, rendering, plaster and blockwork which are specified or ordered to be painted shall be allowed to dry out after completion and shall then be treated with a fungicidal wash. Subject to the approval of the Project Manager’s Rep the fungicidal wash may be omitted if the first or priming coat of paint to be applied incorporates suitable fungicide.

The surfaces shall subsequently be painted with 2 coats of acrylic emulsion.
12.7 Colors
Colors shall be as ordered by the Project Manager’s Rep, generally with reference to BS 4800. Sample areas shall be prepared as required by the Project Manager’s Rep for purpose of ascertaining color, finish and workmanship and such areas shall be removed as directed.

Where two or more coats of paint with the same color are specified, the undercoats shall be tinted so as to differentiate between the coats. The final coat shall not be tinted.

15.8 Testing of paint Before ordering any materials for painting the Contractor shall give the Project Manager’s Rep opportunity to have samples thereof tested, proposed by the Contractor and approved by the Project Manager’s Rep, to establish that the painting system is capable of withstanding any handling or site conditions that are likely to occur. Test pieces shall be painted by the Contractor, separate for each type of paint If the Project Manager’s Rep so requires samples from the containers shall be taken and tested at any time after the delivery at the Site.

12.9 Galvanizing
Galvanizing of steelwork is to be done as described in this Clause and is indicated as Coating System "C".

Steelwork to be galvanized shall be cleaned from all weld spatters, slag, mill scale and other contamination. Removal of corrosion products and surface treatment immediately before galvanizing shall be done by pickling. Pickling shall be done in a solution of hydrochloric acid. The acid shall then be neutralized after which the steelwork shall be washed and dried. Finally the steelwork shall be dipped in the galvanizing bath.

Unless otherwise specified all steelwork shall be hot dip galvanized according to BS 729, after completion of all welding, drilling, grinding or trimming of the metal. Hand railings and other big steelwork items may be galvanized in sections. The galvanized surface shall be smooth and free from slag and other impurities.

Any damage to galvanizing due to transport or installation shall be made good at the Contractor's expense by a method approved by the Project Manager’s Rep.

12.10 Painting of galvanized surfaces
If galvanized surfaces as per system "C" or manufacture-galvanized surfaces of sheet, wire, doorframes, etc. are to be additionally painted this shall conform the requirements of this Clause, indicated as Coating System "D".

Galvanized surfaces shall be prepared or weathered before painting with an approved etch primer (other than a mordant containing copper), which shall be a two pack primer to be applied in accordance with the manufacturers instructions.
After drying of the etch primer the surface shall be thorough rinsed with clean fresh water and allowed to dry. The finishing shall consist of coats of two pack epoxy enamel of a color specified by the Project Manager’s Rep, with a dry film thickness of 50 micron per coat.

12.11 Protection and painting of softwood

The painting of softwood can be divided in two categories, both with their own coating system:

- visible softwood joinery and carpentry - System "E"
- concealed softwood joinery - System "F"

All softwood shall receive preservative treatment with water-borne preservative in accordance with BS 4072 to the tropical proofing scheme.

Softwood surfaces which will be visible and painted shall be cleaned, scoured and dusted down to a smooth surface. Holes, cracks and blemishes in exposed surfaces shall be stopped with putty, and knots shall be treated with an approved knotting. Priming shall be done with a solvent based wood primer complying with BS 5358. After priming the surface shall again be scoured and dusted down. Then the surface shall be painted with one undercoat and two gloss finishing coats of compatible oil based paints. The first gloss finishing coat shall be rubbed down on interior surfaces before the top coat is applied.

Softwood used for concealed or non-painted joinery shall be primed with one coat immediately after fabrication and preservation. The primer shall be lead-based complying with BS 2523. Holes, cracks and blemishes in exposed surfaces shall be stopped with putty, and knots shall be treated with an approved knotting. Contact surfaces with brick masonry or concrete shall be given a second coat of primer.

12.12 Protection of hardwood

The protection of hardwood shall be according to coating system "G".

All hardwood joinery shall receive preservative treatment with water borne preservative in accordance with BS4072 to the tropical proofing scheme. Hardwood surfaces shall not be painted, but shall be treated with a water-repellent penetrating varnish of exterior grade and gloss finish.

12.13 Protection of wood in water

Unless approved otherwise, timber for use in water or soil shall be treated according to coating system "H".

Under this system the timber shall be treated in a mixture of one part creosote to one part of crude fuel oil to give a final absorption of 0.054 m² perm³ of timber. The timber shall be completely immersed in a bath of cold mixture which shall then be
heated to a temperature of approximately 117 °C, and kept at this temperature for 40 minutes after which it shall be removed and stacked for drying.

12.14 Protection and painting of concrete, plasters and blockwork

Concrete, plasters, blockwork and other cementitious surfaces shall be painted according to coating system "J"

The surfaces of concrete, rendering, plaster and blockwork which are specified or ordered to be painted shall be allowed to dry out after completion and shall then be treated with a fungicidal wash. Subject to the approval of the Project Manager’s Rep the fungicidal wash may be omitted if the first or priming coat of paint to be applied incorporates suitable fungicide.

The surfaces shall subsequently be painted with 2 coats of acrylic emulsion.

12.15 Summary of coating systems

In the following table all coating systems as described in Clause "Painting and other Coatings" have been summarized.

**TABLE 15 - COATING SYSTEMS**

*Table 15(a) Summary of coatings specifications*

<table>
<thead>
<tr>
<th>System</th>
<th>Application</th>
<th>Description</th>
</tr>
</thead>
</table>
| A      | for steel in contact with water, soil or exposed to humid conditions | Blast cleaning to SA 2.5  
• One coat of two-pack zinc rich epoxy primer with a minimum dry film thickness of 25 micron  
• Two coats of two pack high build coal tar epoxy paint, each coat with a minimum dry film thickness of 200 micron to be applied within 48 hours after priming |
| B      | for other steel structures | Blast cleaning to SA 2.5  
• One coat of two-pack zinc rich epoxy primer with a minimum dry film thickness of 25 micron  
• One or two coats of two pack high build epoxy coating pigmented with micaceous iron oxide, with a total minimum dry film thickness of 150 micron  
• Two coats of two pack epoxy enamel of a color to be specified with a minimum dry film thickness of 50 micron per coat. |
| C      | for steel in special conditions and cast in concrete |  
• Removal of slag, scale and other impurities  
• Pickling in hydrochloric acid, neutralising, washing and drying  
• Hot dip galvanizing in accordance with BS 729 |
| D      | for galvanized steel | Not applicable |
**13 PUMPING EQUIPMENT**

**13.1 Scope**

This specification together with the requisition, purchase order/inquiry and data sheet covers the requirements to be met by Contractor in the design, fabrication, inspection, testing and construction conditions of pumps, drivers and power transmissions and other auxiliary equipment.

**13.2 Pump Selection**

Pump selection should be according to the Technical Design Calculation as indicated in the Final Design Report, attached as appendix vii.

**13.3 Design Specifications**

**13.3.1 General**

Pumps shall be guaranteed for capacity, head, power consumption and NPSH at the specified rated conditions.

Intake pumps for surface water duty shall be designed for pumping raw water with a high silt content, to be capable of passing 75m diameter solids and to avoid possible choking by weeds or other tough sinuous material.
Water velocities in the suction or delivery branches of a pump shall not exceed 3.5 m/s when the pump is operating within its specified duty range and within this working range there shall be no discernible noise due to hydraulic turbulence or cavitation within either the pump or its associated pipe-work and valves.

The pump efficiency shall be well maintained over the whole of the specified duty range, even if this necessitates the use of a larger motor to provide the peak power demand.

Pumps shall be arranged for priming by means of an adequate positive suction head in all possible operating conditions.

Pumps rated point for furnished impellers shall not be beyond the best efficiency point. Vendor shall make his endeavour to select the pumps having the best efficiency point nearest to the rated point.

The NPSH requirements of the pumps, based on the 2% output drop criterion shall be at least 1 m less than the NPSH available at every working condition.

The head/quantity characteristic of any pump shall be stable at all rates of flow between closed valve and open valve and shall be steep enough to permit satisfactory operation in parallel with other pumps under all conditions specified.

Effective means shall be provided for the collection of gland leakage water and piping it to a suitable floor drain.

13.3.2 Drivers

The speed of any main pump shall not exceed 3000 rpm without approval of the Project Manager’s Rep. Pumps shall be driven by electric motors, unless otherwise specified.

Motors shall have power ratings at least 125% of break power, including all losses through power transmissions at pump rated point.

13.3.3 Shaft and Shaft Sleeves

Shafts shall be made in one piece except for vertical pumps having a long shaft subject to the Employer’s approval, and shall be provided with sleeves securely locked to the shaft. When the size of the pumps makes the use of shaft sleeves impractical, the shaft shall be made of wear resistance material for packed pumps and of a corrosion resistance material for pumps with mechanical seal.

Pump shafts shall be forged from a material compatible with the impellers. If the pumps are fitted with packed glands, the shafts shall be provided with replaceable sleeves where they pass through the gland.

13.3.4 Shaft Sealing

Pumps may be fitted with mechanical seals in place of packed glands only if they have proved satisfactory over a long period when fitted to the design of pump in question and with prior approval. They shall be designed for easy adjustment and seal removal.
Where suction pressure is a vacuum, impellers shall be so arranged that stuffing box pressure is positive. Otherwise, the stuffing box shall be effectively sealed to be positive in pressure.

For conventional packing, lantern rings shall be used so that self-flushing can be made. External flushing will be specified on the data sheets if necessary. Ample space shall be provided for repacking without removing and dismantling any part, other than gland components and guards.

Where mechanical seals are used, flushing port shall be provided near the seal surface so as to remove heat effectively from the seal.

Hydraulically balanced seals shall be furnished for sealing pressure above 5 bar. For tandem type mechanical seals, throttle bushing shall be provided.

**13.3.5 Bearing and Bearing Houses**

Unless otherwise specified, all pump bearings shall have a design running life of not less than 100,000 hours. Bearings shall be designed for loading 20% in excess of calculated maximum loading and shall be suitable for reverse rotation at 150% rated speed or the maximum reverse speed the pump can reach in installed conditions when driven backwards by reverse flow, if this is greater.

Bearing housings and brackets may be of cast iron for any services.

Bearing housings shall be effectively sealed against the invasion of water or dust.

Bearing lubrication system and cooling system shall be selected for the service conditions, and shall be capable of operating continuously with the temperature at any bearing housing not exceeding 70°C or ambient temperature plus 30°C, whichever is lower.

Bearing cooling arrangements if used shall be designed on the closed-circuit principle. Open discharge of cooling water into the pumping station drainage system is not permissible.

Lubrication arrangements shall be designed to avoid any contamination of the pumped fluid.

**13.3.6 Nozzles and Miscellaneous Connections**

Each pump shall be complete with all necessary ancillary equipment and fittings to render the unit complete and ready for service. This shall include isolating valves, non-return valves, air-valves, cooling water pipe-work, gland leakage pipe-work, air release pipe-work, pressure gauges, gauge pipe-work, holding down bolts, access platforms and other items as appropriate.

Pump casings shall have flanged suction and discharge nozzles. Flanged connections shall be designed for bolting.

Flange ratings and facings will be specified on the data sheets by the Contractor.
The piping and equipment shall be designed and arranged for easy disassembly and maintenance. Orifice opening shall not be less than 1.5 mm in diameter.

13.3.7 Materials of Construction

The pump impeller, shafting, sleeves, wear rings, casing, etc. shall be of suitable material to cope with the pumped medium and the Contractor shall have satisfied himself that sufficient detail has been provided to make this assessment.

Typical materials of pump construction have been given in the following Clauses and are intended only as a general guide.

If the grade of materials of Manufacturer's selection is better than the specified one, Manufacturer's standard materials may be used with the Project Manager's Rep's approval.

Castings shall be sound and free of shrink or blow holes, scale, blisters and other similar injurious casting defects. Cast iron shall not be repaired by welding without specific approval of the Project Manager's Rep.

Casing corrosion allowances shall be 3 mm minimum for carbon and low alloy steels and 0 mm for high alloy steels and non-ferrous materials unless otherwise specified.

Gaskets shall be of anti-corrosion type.

Copper or its alloys shall not be used for any components of auxiliary piping without Project Manager’s Rep's approval.

13.3.8 Impellers

Impellers of the maximum or the minimum diameters in relation to size of casings shall not be used. Wearing rings shall be replaceable if furnished.

13.3.9 Couplings and Guards

Connections between horizontal pumps and drivers shall be made with suitable flexible type couplings. Spacer type couplings shall be furnished.

Removable coupling guards made of steel plate shall be supplied and mounted by Vendor for horizontal pumps. A limited end float coupling shall be provided when the drivers have no thrust bearings.

13.3.10 Critical Speeds

The rotating assemblies shall be statically and dynamically balanced and designed so that the first critical speed of a flexible shaft pump and its drive is at least 50% higher than the maximum operating speed.

The first lateral critical speed of a stiff-shaft pump shall be at least 10 % over the maximum operating speed. Where the rotating assemblies are small and any out of balance forces are negligible this requirement will not be necessary. The manufacturer is required to state whether balancing has been completed.

13.3.11 Pressure Lubrication System
A pressure lubrication system shall be furnished if specified by Employer or if recommended by Vendor. All oil containing pressure components shall be of carbon steel. Carbon steel oil pumps shall be pickled at Vendor’s shop. Casings of shaft-driven oil pumps may be made of cast iron.

The pressure lubrication system shall be incorporated into a base plate of the equipment.

13.3.12 Pump Performance Guarantee

The pump performance guarantee shall relate to the flow rate, the total head and the efficiency of the pump when tested at the manufacturer's works. The pump shall operate at its design point within the acceptance tolerances for flow rate and total head.

13.3.13 Marking and Painting

Nameplates and rotation arrows on pump drivers shall be 18-8 stainless steel or monel, attached by pins of similar material at a readily visible location.

The following data as a minimum shall be clearly stamped on the name plates:

- Item no.;
- Manufacturer's name;
- Pump serial number;
- Date of manufacture;
- Size and type;
- Rated capacity (m³/h);
- Rated pressure /head (m);
- Rated speed (rpm).

13.4 Packing and Preparation for Shipping

Vendor shall clean all components, and preserve and protect them on the basis that equipment and all accessories will be stored unprotected in the field for a minimum period of 6 months.

All openings shall be provided with substantial metal closures. All tapped openings shall be plugged.

All items shall be suitable packed, securely fastened and protected from damage during shipment.

No package or container shall contain items of plant intended to be incorporated in more than one part of the works.

Electrical plant shall be enclosed in sealed airtight packages with dehydrating salts before being placed in packing cases on shock absorbent materials and secured by fasten bolts.
13.5 Transportation

Equipment shall not be transported to job site as deck cargo without the Employer's approval.

Centrifugal pumps shall be shipped as assembled units with drivers, unless otherwise specified by the Project Manager’s Rep.

No equipment shall be released for shipment from Manufacturer's shop until it has been approved by the Employer.

13.6 Horizontal Multi-stage High Pressure Pump Set

The pump shall be horizontally mounted multi-stage centrifugal type complete with its motor and gearbox on a common base plate.

The axial loads shall be as far as possible hydraulically balanced. Where the pumped medium has a fine abrasive content axial hydraulic loads shall be balanced by an oil lubricated thrust bearing.

The dimensions of the pump shall be metric conforming to API 610 or its equivalent. Inlet flanges shall conform to BS 4504 and delivery flanges shall conform to BS 1560: Part 2.

The bedplate shall be of substantial fabricated steel construction with floor fixing bolt holes ready drilled. All holding down bolts, etc. shall be supplied with the unit.

The velocity at the entrance to the pump impeller shall not exceed 3.5 m/s.

Rotating assemblies of pumps shall be statically and dynamically balanced and shall be designed so that the first critical speed of the pump and its drive is at least 50% greater than the maximum operating speed.

The speed of any pump shall not exceed 3,000 rpm.

Glands may be fitted with suitable mechanical seals or conventional soft packing. The gland arrangement shall be designed for ease of adjustment or removal of the seal or packing material. Shafts shall be sleeved around the area of the gland when soft pack glands are used.

The pump shaft bearings shall be oil lubricated and an oil lubricated thrust bearing shall be included to prevent axial movement.

Lubrication arrangements shall be so designed that there is no contamination of the pumped fluid.

The pump impeller, shafting and wear rings shall be of suitable material to cope with the pumped medium and the Contractor shall have satisfied himself that sufficient detail has been provided to make this assessment.
The pump and associated pipework shall be, wherever possible, arranged such that air can be completely evacuated during priming. Where this is not possible, facilities shall be provided for the removal of the entrained air. Adequate facilities shall be provided for drainage of the pumps for inspection purposes.

Tappings shall be provided at both the suction and discharge flanges for pressure gauge equipment.

13.7 Pipework

All pipework associated with the plant shall be of the galvanized heavy gauge steel tubing type, to BS 1387: 1967. All bends, tees, unions and other fittings shall be of galvanized steel to BS 143 and shall be of the correct size and type for the steel tubing in use. Screwed or flanged joints may be incorporated. Pipes shall be flanged to BS 4504: PN 10 where required to make connections with plant items, and shall be designed for a pressure of not less than 3 x relief valve pressure blow point.

Pipework shall be of the nominal bore stated and indicated on the Drawings.

Pipework shall be installed horizontally and vertically but shall fall in the direction of air flow to facilitate draining of condensate. Automatic drains shall be fitted to prevent the accumulation of condensate at low points in the system. The nominal fall of the pipework shall be 1-in-80.

13.8 Pressure Relief Valves

Relief valves shall be of the poppet type. The valves shall be rated to pass at least 200% of the rated flow at the point of connection, at 150% of the working pressure.

The pressure setting of the valve shall be manually adjustable and secured with a brass padlock. The valve shall be adjusted to the Maximum Safe Working Pressure at the manufacturer's works and the setting secured with a brass padlock. A test certificate and duplicate keys shall be provided. A wire lock and lead seal, stamped with the pressure setting, may be used in place of the padlock.

13.9 Non-return Valves

Non-return valves shall allow uninterrupted flow in the required direction. On the reversal of flow the valve shall close instantly and provide an airtight seal.

The valves shall be sized to accommodate the stated maximum flows in the pipe to which they are fitted and at the working pressure stated.

They shall be suitable for mounting in a horizontal position.

Valves shall be of the multi-port frictionless element type to provide minimum turbulence and pressure drop.

13.10 Drain Valves
Automatic drain valves shall be of the float-operated plug type designed to automatically and continuously drain oil, water and other condensate from the pipework.

They shall be sized for continuous operation at the maximum stated working pressure.

Where shown on the Drawings, the drain valves shall incorporate a manual condensate drain facility.

13.11 Isolating Valves

All isolating valves shall be of the wedge gate type and shall be in compliance with BS 5150. Valves may be flanged or fitted with double union ends to suit the size and type of connecting pipework.

Valves shall be manually operated by means of a lever and shall be positioned so as to be readily accessible to the operator.

13.12 Pressure and Vacuum Gauges

Gauges shall comply with BS 1780 and shall, unless otherwise specified, be of not less than 100 mm diameter. Scales shall be calibrated in kg/cm² with zero representing atmospheric pressure. Lettering shall be black on a white background. Where the working fluid is of a dirty or corrosive nature, gauges shall be protected from the working fluid by a diaphragm or similar arrangement. All gauges shall be fully protected from dust and water ingress and shall be provided with a suitable isolation valve on the supply line adjacent to the gauge.

14 CHEMICAL PREPARATION AND DOSING PLANT

14.1 Hydrated Lime and Aluminum Sulphate Preparation and Dosing

Hydrated lime, supplied in the bagged powder, shall be made up as a slurry in suitably coated steel preparation tanks. Each tank shall include at least:

- powder feed hopper with cover;
- dust extraction vent with attached filter;
- 500mm man hole with cover;
- a motor driven slow speed paddle agitator;
- overflow to sewer;
- drain to sewer;
- service water supply nozzle;
- slurry discharge nozzle;
- level indicator with calibrated scale.

All lime slurry lines shall have provisions for flushing with service water.

Distributors at the dosing points shall be installed to provide even distribution of the hydrated lime slurry.
14.2 Vertical Tank Mixers
Mixers shall be suitable for operation in the chemical building adjacent to the lime handling area without additional enclosures or protection. They shall be rated for continuous operation and shall be a heavy duty industrial design.

Mixers may be designed for vertical or horizontal motor drives via a double reduction gearbox incorporating change gears. Change gears shall be readily accessible for removal and replacement. Gears shall be high precision match lapped spiral bevel or helical types designed in accordance with AGMA standards. Bearings shall be taper roller type with a B10 design life for not less than 30,000 hours. Gears and bearings shall be splash.

14.3 Pipework for Chlorine
All screwed pipework conveying chlorine or sulphur dioxide under pressure shall be constructed from solid drawn steel tube to BS 1387 with heavy fittings in malleable iron to BS 143 screwed to BS 21. Threaded joints shall be sealed using a jointing compound compatible with chlorine or sulphur dioxide as appropriate. PTFE tape shall not be used.

All flanged pipework conveying chlorine or sulphur dioxide gas under pressure shall be carbon steel hot finished seamless, cold drawn seamless or electric resistance welded to BS 3602 Class 23 or 27. Flanges shall be raised face drilled to BS 1560 Class 150, double fillet welded, stress relieved and radiographed. In the case of pipes of 25 mm diameter or less, magnetic particle examination may be substituted for radiography. Joint rings shall be 2 mm thick compressed asbestos fibre tabbed to BS 2815 Grade B and shall fit within the bolt circle. Prior to installation, the joint rings shall be impregnated or smeared with graphite compound or similar compound compatible with chlorine or sulphur dioxide.

Flexible tubes for final connections to drums or cylinders for gas withdrawal shall be copper externally plated with silver or cadmium or alternatively shall be Monel. The tubes shall be fitted with suitable screwed adaptors for making the connections to the drums or cylinders.

All pipework for chlorine or sulphur dioxide gas under vacuum shall be rigid high-impact uPVC to BS 3505 or BS 3506 with solvent welded joints and fittings complying with the relevant parts of BS 4346.

Pipework shall be adequately supported throughout its length. Sleeves shall be used where pipework passes through walls. All apertures shall be properly sealed with a chlorine and sulphur dioxide resistant compound.
Pipework within buildings shall not be run in floor ducts unless otherwise approved by the Project Manager’s Rep.

14.4 Valves for Chlorine

Isolating valves in pipework conveying chlorine or sulphur dioxide under pressure shall be interchangeable and specifically designed for chlorine or sulphur dioxide service as appropriate.

Valves shall be provided at each end of flexible connecting tubes to drums and cylinders and shall be needle valves having PN10 class forged bodies in silver plated brass with screwed end connections and shall be of glandless design with a nickel diaphragm. The valve shall be operated by means of a hand wheel.

All other isolation valves shall be sleeved plug valves having PN10 class forged bodies in carbon steel with integral end connections, tapered plug in Monel with pure PTFE sleeve and top seal arrangement with PTFE diaphragm and delta seal ring, back up metal diaphragm, floating thrust collar, electrostatic eliminator, four bolt cover and three point self-aligning plug adjustment. The valve design shall ensure that excess pressure in the plug and body cavity of the closed valve is relieved spontaneously towards the direction of high pressure. The valve shall be operated by a forged steel wrench with padlocking facility in the closed position or otherwise by power actuator as specified elsewhere.

Flanged valves shall have raised face flanges drilled to BS 1560 Class PN10.

All valves shall be supplied degreased and dried for chlorine service and maintained in this condition for inclusion in the Works.

A works test certificate is required for each valve covering hydrostatic testing of the shell and seat and air testing of the seat in accordance with BS 5146 Part 1. The gauge pressure for the air test shall be 10 bars.

14.5 Pipeline Identification

All pipework shall be banded with vinyl laminated identification tape to enable individual lines to be identified throughout their length. Bands shall also be applied above floor plates, on both sides of walls or bulkheads, on both sides of valves, at branches and adjacent to equipment connections.

The individual bands shall be 50 mm wide, colour coded generally in accordance with BS 1710 to indicate the fluid conveyed and shall have a flow direction arrow and lettering to signify the sampling or dosing point served and, where applicable, the function or the chemical.

Bands for toxic gas and chemical solution lines shall incorporate danger warning markers (black/yellow diagonal stripes) 50 mm wide giving a composite width of 150 mm.

Steel pipework carrying chlorine or sulphur dioxide shall be painted in the following colours to BS 381C in place of banding: • Chlorine pipework: Golden yellow, colour Nr 356
14.6 Protective clothing and safety equipment

Sets of PVC overalls, gloves, goggles and rubber boots all in medium sizes, obtained from an approved supplier, shall be provided as necessary.

14.7 Safety Showers and Eyewash

Safety showers shall be hand and treadle operated and shall continue until the valve is manually closed. The water shall be heated by trace tape or an immersion heater to between 25°C and 35°C under normal ambient conditions. The shower shall supply 90 to 140 l/min through a 60° spray angle at a minimum supply pressure of 2.2 bar. A header tank shall be provided where insufficient supply pressure is available.

15 ELECTRICAL WORKS

15.1 General

15.1.1 Regulations and standards

The electrical installation shall comply with all relevant statutory regulations and standards current at date of tender, unless otherwise indicated within this Specification. In general the following shall apply:


If no standard is specified, the relevant British Standard or, in the absence of such standard, International standard shall apply.

15.1.2 Abbreviations of electrical terms

For the purpose of this Specification the following abbreviations of electrical terms have been used:

L1 - red phase
L2 - yellow phase
L3 - blue phase
N - neutral
ac - alternating current
dc - direct current
A - amp
mA - milliamp
V - volt
kW - kilowatt
kWH - kilowatt hour
kVAr - kilovar
kVA - kilovolt amp
MVA - megavolt amp
Hz - hertz (cycles per second)
SP - single pole
SPN - single pole and neutral
DP - double pole
TP - triple pole
TPN - triple pole and neutral
SPSwN - Single pole and switched neutral
TPSwN - triple pole and switched neutral
MCB - miniature circuit breaker
MCCB - moulded case circuit breaker
RCD - residual current device
MCC - motor control centre

15.1.2 Polarity

The polarity of all electrical apparatus used for the Works specified shall be arranged as follows:

for two pole apparatus the phase of 'live' pole at the top (or left hand side) and the neutral or 'earthed' pole at the bottom (or right hand side), for three or four pole apparatus the phases in order of red, yellow, blue and neutral reading from top to bottom or left to right in the case of vertical and horizontal lay outs respectively and as viewed from the front.

All non flexible cables shall be so connected between main switchboards, distribution boards, plant and accessories so that the correct sequence or phase colors are preserved throughout the system.

All non flexible cable cores shall be identified with phase colors for three and four wire circuits. Single phase circuits shall be red and black.

15.1.3 Voltages and frequencies

Unless otherwise indicated in the Particular Specification, all apparatus and wiring shall be suitable for use with the Kenyan Standard Electrical Power Supply, which conforms to the EC standard of 3 phase, 4 wire, 415/220 volt, 50 Hz earthed neutral supply. The supply waveform shall be a sine wave.

Supplies for control, tripping, alarm and indication circuits shall be 24 V dc. Circuit breaker spring charging motors shall also operate at 24 V dc.
Control voltage within motor starters shall be 110 V ac. Extension of 110 V circuits outside the starter shall not be permitted except for the circuit to the emergency stop button, where fitted.

Tap changer motors and electrical panel heating and lighting shall operate at 230 V, single phase. All equipment operating at 230 V shall be fully shrouded and clearly labelled.

Where 230 V lighting and heating is used within a panel which otherwise contains equipment with a nominal operating voltage of 24 V, the 220 V equipment shall be insulated, sheathed and protected in accordance with standard practice for installing such equipment in buildings. No live terminals shall be accessible without the use of tools, no single-insulated wires shall be used, and no 220 V cables shall share cable trays or other routes with 24 V circuits.

All references to voltages shall relate to the nominal, or rated value of the supply.

15.1.4 Units of measurement

All information shall be in metric SI units. Where plant design exist in imperial units, the dimensions and tolerances of lay outs and terminal points shall be presented in SI units to a degree of accuracy which permits the precise matching of existing components.

15.1.5 Electricity supplies

The Contractor shall liaise with the relevant Utility Company to undertake any testing and inspection necessary for the electricity supplies to be connected when required. On completion of the tests and inspections, not less than two weeks prior to the power supply being required, the Contractor shall supply to the Project Manager’s Rep a copy of his Electrical Installation Completion Certificate and of the test certificates.

15.1.6 Electrical safety

The Contractor shall be responsible for the electrical safety of all equipment supplied and installed. Whilst any equipment is being installed or tested, the Contractor shall ensure that all necessary precautions are taken to safeguard personnel working on site. If necessary, this shall include erecting warning notices and fencing off areas which are considered to pose a risk.

The Contractor shall be responsible for ensuring that the electrical installation is carried out by competent personnel and that the work is carried out in accordance with standard procedures and test requirements. Before any piece of apparatus is energized it shall be thoroughly examined for the presence of dirt, water or other foreign bodies.

15.2 Switchboard construction

15.2.1 General

This section shall apply to the construction of all panels housing electrical apparatus, including but not limited to the following:
• switchboards;
• circuit breakers;
• control panels;
• monitoring or supervising panels;
• distribution boards - control panels;
• marshalling panels;
• interface panels; local control panels.

15.2.2 Safety

Access to any enclosure or compartment shall be possible only: when the circuit switch-disconnecter is open and connections within the compartment are isolated or; when connections within the compartment including any on the door or access cover, are fully shrouded to prevent accidental contact or; when connections within the compartment operate at a voltage not greater than 55 volts.

Where a test facility is provided for use with the door or cover open the provisions of (b) shall apply. Connections which may be live with the door or cover open shall be suitably labelled.

Bolted covers on compartments incorporating live connections shall bear a suitable warning label.

Labelled isolators, fuses or links shall be provided so that relays, controls and instruments may be isolated but keep other essential circuits energized.

18.2.3 General construction standard

Switchboards, cubicles and enclosures for electrical equipment shall be constructed in sheet steel not less than 2.0 mm thick and suitably braced to form a rigid structure. Exterior edges and corners shall be rounded and the use of externally visible assembly bolts or similar shall be avoided.

The design shall provide protection against dust, damp and entry of vermin. Gaskets shall be fitted to doors and removable panels. Ventilation and cooling shall be by natural air circulation. The enclosed equipment shall be designed to operate without forced ventilation under the ambient conditions specified or to be expected.

Unless specified otherwise, switchboards, cubicles and enclosures shall be floor-standing with lockable hinged front doors and bolted removable rear panels for access to live equipment such as busbars and terminals.

Each section shall be separately accessible without disturbance to other sections for maintenance and inspection. Live parts with voltages greater than 55 V to earth within the section shall either be isolated automatically when the section door is opened, or be fitted with insulating barriers to prevent accidental contact by personnel. Parts still live when the unit is isolated shall be labelled "Danger Live". Where integral fuse or MCB distribution boards are incorporated, access to fuse carriers and MCB's shall be possible without isolating the fuse or MCB distribution board. With the operator's door open and with fuses and MCB's in place, the degree of protection of such distribution boards shall be not less than IP20.
A clear access of not less than 1000 mm, and preferably 1500 mm, shall be given at the rear and both ends of the panel.

Controls and switches mounted on any control panel section of a switchboard shall be installed in the height range 750mm to 200mm; indicating instruments 900mm to 1800mm; recorders 900mm to 1400mm. This requirement shall not be applied to starters or feeder sections.

Switchboards shall be equipped with a power transformer and 2 No. 15 A, 110 Vac (+55 V) RCCB protected sockets, suitable for use with electric hand tools. Switchboards shall additional have 2 No. 13 A, 230 Vac RCCB protected sockets.

Each section or cubicle of the board shall be clearly labelled with the circuit name and number, and the reference number of the section. The panel shall have a name plate carrying the manufacturer's name, address, reference, and year of construction of the panel.

Cubicles and enclosures shall be earthed. Where a number of cubicles are bolted together, earthing shall be provided via a continuous high conductivity copper bar of minimum cross section 25mm x 6mm running the length of the panel. Terminals shall be provided for the connection of earthing from the metal cladding or armouring of incoming and outgoing cables. Holes shall be left at each end of the bar for connection to the main station earth and future extension. The bar shall be fault rated at not less than that of the associated equipment. Warning labels and instructions for earthing and isolating shall be fitted in each switch compartment. Front access doors shall open not less than 120° and shall be fitted with a locking handle and non-ferrous lift-off hinges which shall be captive when the door is closed. Locking combinations requiring different keys shall be approved before manufacture. The door shall be secured by captive screws or locking handles of sufficient number to ensure firm pressure on the door seal around the whole periphery. The door shall be mechanically prevented from opening before isolation of the live parts within. All doors shall be separately earthed to the main frame. Earthing via the door hinge will not be accepted.

Cables shall enter through 3mm thick undrilled removable steel or brass (for single core cables) gland plates mounted at least 250mm above switchboard base level. Access to both sides of gland plates for gland tightening shall be readily available. Gland plate knockouts will only be accepted for individually mounted starters and small power distribution boards.

Lifting eyeholes shall be provided at each top corner of each section of the switchboard and shall be removed and replaced with blanking bolts after installation.

Cubicles and enclosures for outdoor locations shall be fitted with lockable outside doors and a housing so designed that all controls, instruments and such like are fully enclosed and the whole assembly is weatherproof and vandal proof. The doors shall be fitted with stays to prevent overstraining of the hinge fixing, and allow fixing of the doors in the open position. Switchboards inside cubicles shall also be weatherproof to allow operation of the controls when the outside cubicle doors are open during inclement weather.
When specified, a double skin roof shall be fitted over the whole assembly to give added protection against direct sunlight.

LV enclosures shall be constructed with a protection ratings of at least the following:
for outdoor installation IP 65; for indoor installation IP 54.

Switchboard, cubicle and enclosure construction shall be capable of withstanding without damage the fault current of the system. HV enclosures shall be constructed to the latest Standards with IP ratings equal to those for LV enclosures.

Protective coatings shall be applied at the place of manufacture and before installation of its internal electrical fittings.

16.2.4 Switchboard small wiring

Switchboard wiring shall be carried out in 600/1000 V PVC insulated cable to BS6231. The conductors shall be stranded or flexible (where applicable); solid cores will not be accepted. The conductor size shall be not less than 1.5 mm² for control and indication circuits and not less than 2.5 mm² for CT secondary circuits.

Wiring within the switchboard shall be marked with ferrules at each end for identification. The letters and numbers used shall correspond with the switchboard wiring diagram.

The wiring color code shall be as follows:

- Phases - red, yellow, blue
- Neutral - black
- Control - blue (dc) and red (ac)
- Earth - green/yellow

The wiring shall be neatly laced and cleated to the switchboard structure or contained within purpose designed plastic trunking and arranged so that access to equipment is not impeded. Where trunking is used the ratio of effective cross sectional area of the cables shall be not greater than 40% of the trunking area. Where wiring passes through metalwork the access hole shall be fitted with a suitable grommet.

Every wire shall be identified by indelibly marked circular ferrules at each end. Slip-on, or 'u' type ferrules will not be accepted. Identification shall correspond with the wiring diagram.

Wiring between cubicles or panel sections shall be terminated on terminal blocks at each end.

Wiring onto hinged doors or plates which is subject to movement shall be run in flexible circular section trunking and shall be supported securely at both ends of the moving section. Adhesive fixings of the ends of the trunking will not be accepted.

Crimped flat blades shall be applied to all wire ends to ensure sound connection to terminal blocks and all circuit components.

Small wiring used for control, extra low voltage and instrument signals which are likely to be affected by interference shall be screened and/or spaced from each other and power cables to ensure no distortion or mal-operation.
16.2.5 Switchboard busbars and primary connections

All busbars and primary connections shall be of high conductivity copper and comply with the latest Standards. The mechanical and dielectric strengths of busbars and connection supports shall be able to withstand without damage the worst conditions of electrical surge which can occur on the installation. The busbars shall be capable of carrying full rated current continuously without exceeding temperature rise limits to the latest Standards.

The busbars, assemblies and connections of equipment shall be of a type which does not rely solely on air for insulation purposes. The covering material shall be non-deteriorating at the rated short-time maximum temperature of the busbars and shall have such thickness as is required to withstand rated line to line voltage between busbar and a conducting object on the exterior of the covering material for a period of not less than 60 seconds.

Where independent certification of busbar withstand and continuous rating is not available the Contractor shall include tests to demonstrate the suitability of the equipment.

Busbars and primary connections shall be housed in an air-insulated enclosure segregated by barriers. Direct access to live bars shall not be possible. Access to busbars and connections shall be only by removal of bolted covers. Suitable warning labels shall be provided externally on covers and internally on shutters. Busbars shall be identified by colored banks opened at not more than 1000mm and in each compartment.

Baffles shall be provided to prevent the accidental entry of tools, etc. whilst maintenance work is being carried out in the vicinity of the chambers.

Busbar systems shall have a short time rating not less than that of the associated switchgear. Busbars shall be extensible at both ends.

The conductors shall be separated and supported with the appropriate clearances in air or shall be otherwise adequately insulated or encapsulated.

16.3 Switchboard components

16.3.1 General

This section shall apply to components used in all panels housing electrical apparatus, including but not limited to the following:

- switchboards;
- motor control centres;
- circuit breakers;
- control panels;
- monitoring or supervisory panels;
- distribution boards;
- marshalling panels;
- interface panels;
- local control panels;

16.3.2 Indicating Instruments and Meters

All instruments and meters shall be flush mounted, 96mm x 96mm minimum size and of the same pattern and appearance throughout. They shall be back connected and be similarly protected to maintain the environmental protection standard of the equipment enclosure on which they are mounted. Those which perform similar duties shall be of uniform type and manufacture.

Indicating instruments shall have black marking on a white background, a full scale deflection of 270° and be fitted with an externally accessible zero adjuster.

They shall have no parallax error and their normal maximum reading shall be approximately 60% full scale deflection.

Ammeters in motor starter circuits shall be capable of withstanding the starting current and shall have a compressed overload scale. The scale shall be clearly marked with a red line indicating normal full load current.

Indicating instruments shall comply with BS 89 (IEC 51) and shall be of industrial grade accuracy, (+5%) unless otherwise specified.

Kilowatt-hour meters shall comply with the latest Standards and shall have an accuracy of +1% unless otherwise specified.

Where portable instruments are specified they shall be of sub-standard accuracy (+1%). Instruments shall be positioned between 1800 mm and 750 mm above finished floor level.

16.3.3 Indicator Lights

Indicator lights shall be of uniform type as far as possible, to minimize spares requirements. Glasses and bulbs shall be easily removable without the use of a tool.

Indicator lights shall be not less than 20 mm diameter and shall be of the projecting type so they can be seen from the front and side of the switchboard. They shall be visible under bright sunlight conditions.

The lights shall be under-run to give long life either by use of a resistor to limit voltage to 90% of normal value, or by using higher voltage lamps.

Alternatively the lights shall be transformer operated or battery operated where a battery is available.

Colors of indicator lights shall generally comply with the latest Standards. The diffuser glasses shall be colored and the bulbs shall be clear.

LED indicator lights shall not be used except where they form part of proprietary equipment.

All components, doors and removable covers shall be labelled. Fuse carriers shall also have labels which state the fuse rating to be fitted. Each cubicle door shall bear an
identification label (minimum letter size 8mm) and each switchboard and enclosure shall bear an overall identification label (minimum letter size 12mm).

Light colors shall comply with BS 4099 as follows:

- power on - white
- running - green
- tripped/alarm - red
- status (open, closed, etc.) - blue
- ready to start - blue
- warning (no imminent danger) - amber

### 16.3.4 Labels

All designating labels shall be of traffolyte or similar finished white with engraved letters and numbers filled with black and fixed by non-rusting screws.

Danger and warning labels shall be of similar material finished in yellow with red letters and numbers. Edges of labels shall be bevelled and lettering shall be at least 4mm high.

### 16.3.5 Push Buttons

Colors of push buttons shall generally comply with the latest Standards and in particular shall be as follows:

- stop, emergency stop - red
- start - green
- jogging/inching - black
- reset (when not also acting as stop) - blue
- lamp test - blue
- override/alarm accept - yellow

Emergency stop push buttons shall have enforced contact separation. They shall be connected in the control circuits so they trip the circuit under all conditions.

### 16.3.6 Terminal Blocks

Terminal blocks shall be of non-brittle material, screw-clamp, rail mounted type to VDE 0611. Pinch screw type blocks shall not be used.

At least 20% spare terminals shall be provided at all blocks.

Every terminal block shall have a clear plastic clip-on cover running the full length of the block to prevent accidental contact with live terminals.

Removable DIN rail terminals shall be provided for all wiring, mounted at an angle to provide ease of access, positioned not less than 150mm from gland plates, doors or covers.

Power, control, earth and end stop terminals shall be provided and terminals shall be grouped and separated by barriers according to their voltage level and function.
No more than two conductors may be connected to one side of a terminal. Outgoing cables shall be wired so that outgoing wiring is connected to one side only.

Terminal blocks shall be mounted vertically at the side of the enclosure and set obliquely towards the rear doors.

Every terminal block shall have a clear plastic clip-on cover running the full length of the block to prevent accidental contact with live terminals.

Blocks at different voltages or phases shall be grouped and labelled accordingly.

16.3.7 Test Terminal Blocks

Test terminal blocks shall be provided for secondary injection and testing of relays.

A metering block shall be provided for the connection of portable sub-standard instruments for plant testing. Test terminal blocks shall be provided with shorting links or be of a type suitable for use with portable testplug-in equipment.

16.3.8 Control, Auxiliary, and Selector Switches

Control and Selector Switches shall conform to the latest Standard.

Control Switches shall be of the three position type with a spring return action to a central neutral position. They shall be labelled.

Electrically operated circuit-breakers shall be fitted with a control switch labelled Open/N/Close. These shall be of the pistol grip type with a spring return to the neutral position. The switch shall be lockable in the neutral position.

Selector switches shall make before break and shall remain in the position selected and be lockable in that position. They shall have spade shaped handles and each position shall be labelled.

Contacts of all switches shall be shrouded.

A minimum of four spare auxiliary switches, two normally open and two normally closed shall be provided for each circuit breaker and contactor.

16.4 Switchboard Ancillary Equipment

The following ancillary articles shall be supplied with each switchboard. 2 pairs rubber gloves to the latest Standard according to rated voltage of switchboard; 2 no “treatment for electric shock” metal enamel instruction plate suitable for screen attachment; Operating handles, tools, spares and lubricants as specified elsewhere.

16.5 Voltage transformers

Voltage transformers shall comply with the latest Standards. The secondary winding shall produce an output line voltage of 110 V, three phase. The accuracy class and VA rating shall be as specified or shall match the requirements of all connected instruments and relays.

The primary circuit shall be protected by HRC fuses having a short-circuit rating of not less than that of the switchgear. The connections between the fuses and the
switchgear primary conductors shall be of sufficient cross section and be supported to withstand the short-circuit rating of the switchgear.

The secondary circuit shall be protected by HRC fuses mounted as close as possible to the secondary terminals. Fuses shall be accessible without the need for isolating the switchgear.

Isolatable voltage transformers shall have the facility for padlocking in the service position. Safety shutters shall automatically cover the busbar spouts when the transformer is withdrawn. Shutters shall have the facility for padlocking in the closed position.

**16.6 Current transformers**

Current transformers shall comply with the latest Standards and shall be of the wound-primary or barprimary type according to ratio required. All current transformers shall have a short-time current rating of not less than that of the switch panel in which they are incorporated. For bar-primary current transformers this rating shall be for a period of 3 seconds. For wound-primary patterns the rating shall preferably be for a period of 3 seconds but may be reduced to not less than 0.5 second subject to the Project Manager’s Rep ’s approval.

Identification labels shall be fitted giving type, ratio, rating, output and serial numbers.

Current transformers shall be of Class 1 accuracy for use with measuring instruments and Class 10P for use with protective relays.

Class 5P shall be used for combined overcurrent and earth fault protection of the inverse time overcurrent type.

The secondary windings of each set of star-connected three phase current transformers shall be earthed at one point only, via a bolted link.

Separate sets of CTs shall be used for metering and protection.

Shorting links shall be provided at test blocks.

**16.6.1 Control transformers**

Unless otherwise specified all contactor control circuit supplies shall be obtained from the 110 V secondary winding of a single phase integral control transformer.

Transformers shall be of the double wound pattern in accordance with the latest Standards and shall have an earth screen between primary and secondary windings. One leg of the secondary winding shall be earthed. The primary winding shall be protected by cartridge fuses, and the secondary winding shall be protected by a fuse and link.

A spare control transformer shall be provided with each new switchboard.

**16.6.2 Anti-condensation heaters**
Anti-condensation heaters shall be fitted to:

- wall mounted enclosures;
- individual floor mounted enclosures;
- each vertical section of single tier switchgear or control gear;
- each tier of multi-tier enclosures.

Each heater shall be controlled by its own thermostat, ON/OFF switch and fuses or MCB. Heaters in exposed positions shall be fitted with a safety guard.

Each section of the panel shall contain an anti-condensation heater, rotary isolating switch, and HRC fuse or appropriate protective device. A bus-wired single phase supply controlled by a calibrated adjustable thermostat shall energise all panel heaters.

16.7 Protective relays

16.7.1 General

Protective relays shall be mounted on the front of the switchgear or relay panel in such a position that operation and maintenance can be conveniently carried out. Auxiliary relays may be mounted inside a cubicle provided that they are readily accessible.

Each relay shall be contained in a dust proof case with a clear front cover. All metal bases and frames shall be earthed except where there are technical reasons where this is impracticable.

All relay contacts shall be capable of making the maximum current which can occur in the circuit without causing damage to the contacts.

Relays shall have provision for testing the operation and calibration without disconnecting the permanent wiring.

Flush, draw out type relays are preferred. Each relay shall have an indicator device to show when the relay has operated and if necessary, which phase element. Each indicator shall be hand resettable. Resetting devices shall not require the removal or opening of the relay. It shall not be possible to operate the relay without opening the case.

Where solid state relays are specified, these shall be of the module type comprising a number of plug in elements allowing interchange of functions. Each of the protection elements shall have adjustable controls for current and time settings as required. Solid state relays of a particular type shall have interchangeable protective elements with other similar relays supplied under this Contract.

All relays shall be provided with a name plate giving manufacturer, type, serial number, year of manufacture, ratings and connection diagram.

All relays using a DC auxiliary supply shall operate down to 60% of the nominal voltage and up to boost charge voltage of the battery.

Protection relays shall comply with the latest Standards where appropriate and shall conform to the following provisions:
16.7.2 Over current and earth fault protection
Relays shall be of the attracted armature or rotating disc type having instantaneous, inverse or very inverse definite minimum time, directional or non-directional characteristics as specified.

16.7.3 Under Frequency Relays
The setting range shall be variable between -10% and +2% from the rated frequency. Two different settings shall be provided to give alarm and trip facilities. A low pass filter unit shall be fitted where the harmonic distortion exceed 5% of the fundamental.

16.7.4 Under and over-voltage relays
Variable settings shall be provided as required together with a 0 to 5 second time delay.

16.7.5 DC trip relays
Relays shall be suitable for operating with the voltage reduced to 60% of normal.

16.8 Circuit breakers
16.8.1 High voltage circuit breakers
Circuit breakers shall be vacuum or SF6 type as specified. The equipment shall comply with the latest Standards as appropriate and be fully rated for the ambient conditions specified.

Circuit breakers shall be capable of clearing any fault condition which may occur on the system without damage to equipment or personnel.

Circuit breakers of the same pattern and rating shall be interchangeable.

Vacuum circuit breakers shall comprise separate vacuum interrupters designed to prevent welding of contacts and sharp current chopping during fault interruption or switching or motor loads.

All circuit breakers shall be provided with operating mechanisms as detailed in the specification, the selection being from the following types: independent manual spring; hand charged spring with electrical or manual release; motor charged spring with electrical release;

All operating mechanisms shall have mechanical 'ON' and 'OFF' indicators and a manual trip device fitted with means for locking. Hand charged and motor charged spring mechanisms shall have mechanical indicators to show 'SPRINGS CHARGED' and 'SPRINGS DISCHARGED'.

The operating mechanisms of hand charged and motor charged spring types shall be arranged so that release of the springs to close the circuit breaker can only be achieved by a deliberate action. It shall not be possible for vibration or mechanical shocks to release the charged springs. Motor charged spring mechanisms shall be arranged to that charging is initiated automatically following a discharge. The necessary limit stops and switches for the automatic control of the charging shall form
an integral part of the mechanism. The facility shall be provided to hand charge a motor charged spring mechanism.

Spring operated mechanisms shall be provided with volt-free contacts to give indication that the springs are charged.

To facilitate maintenance and the adjustment of contacts, it shall be possible to 'slow-close' the circuit breaker but this operation shall only be possible in the fully withdrawn position. Any operating handle or lever necessary shall be supplied.

All circuit breakers shall be provided with interlocks to ensure that: □ the circuit breaker cannot be racked into or out of the service or earth position whilst it is closed. Attempts to rack out a closed circuit breaker shall not cause it to trip; □ the circuit breaker can only be closed when fully engaged in the service, earth, or fully isolated positions; □ the circuit breaker cannot be closed in the service position without completing the auxiliary circuits between the fixed and moving portions; □ the circuit breaker cannot be 'slow-closed' except in the fully isolated position; □ with hand charged or motor charged spring mechanisms, the springs cannot be discharged until they have been fully charged or until the means for charging has been fully removed and disconnected; □ when the circuit breaker is closed in the earth position, tripping can be effected only by the manual device on the operating mechanism;

Where mechanical key interlocking is employed, tripping of a closed circuit breaker shall not occur if any attempt is made to remove the trapped key from the mechanism.

Circuit and/or busbar earthing shall be by the transfer circuit-breaker method without the requirements of any loose attachments. The earthing operation shall be completed by the closing of the circuit breaker by its normal operating means using local control. Selection of either circuit or busbar earthing shall be possible only after the circuit breaker has been fully isolated. Mechanical key interlocks shall remain operative when the circuit breaker is in either earthing position.

Facilities shall be provided on all incoming and feeder circuit breakers for earthing the circuit side. On at least one circuit breaker panel in any section of busbars, facilities shall be provided for busbar earthing.

A set of safety shutters shall be provided to cover each three phase group of stationary isolating contacts. The shutters shall be opened automatically by a positive drive from the circuit breaker moving portion and when closed shall prevent access to the stationary isolating contacts. When the circuit breaker is withdrawn each set shall be capable of being individually operated and of being padlocked in the closed position.

Shutters in bus-section units shall be colored red and shall be labelled with a large white arrow pointing in the direction of the section of busbars to which the contacts are connected.

Circuit breaker moving portions shall be fitted with positive guides to ensure correct alignment of the isolating contacts in both the service and the earth positions.

16.8.2 Low voltage circuit breakers
All 380V circuit breakers for incoming circuits, and bus section circuits on 380V switchboards and interconnector circuits shall be of the air break metal clad type complying with the requirements of the latest Standards.

Circuit breakers shall switch three phase poles. The neutral pole shall either be switched or established through a bolted link. Access to the link shall not be possible when the equipment is in the "Service Position".

Provision shall be made for easy access to the circuit breaker contacts for maintenance purposes.

Arc chutes shall be so arranged that the emission of hot gasses shall not damage any part of the equipment.

**16.8.3 Moulded case circuit breakers**

Moulded case circuit breakers (MCCBs) shall be manufactured to the latest Standards.

MCCBs shall have thermal overload and adjustable magnetic short circuit tripping devices with a tripfree mechanism to ensure that the contacts cannot be held closed against a fault. Contacts shall be silver tungsten tipped and shall operate with a wiping, arc resisting material and incorporate arc chutes based on the de-ionising principle.

MCCBs shall have a factory calibrated and sealed trip unit, interchangeable with similar units for varying the rating of the circuit breaker.

Where dust and damp proof enclosures are to be used, then the circuit breakers shall be fully enclosed in a case with a gasketted door. Circuit breakers mounted in a composite control panel shall be segregated from other equipment and have a matching purpose-made cover plate. Where possible, circuit breakers shall be mounted vertically and be arranged so that one breaker can be removed without interfering with other circuit breakers. The switch dolly and protruding face shall be engraved with the circuit rating and the ON and OFF positions.

Tripping due to overload or short-circuit shall be clearly indicated by the handle automatically assuming a position midway between the manual ON and OFF positions. To reset from the 'tripped' position, the dolly shall first pass through the OFF position. All phase poles shall operate simultaneously.

MCCB's used for short circuit protection (only) in motor starters shall provide instantaneous short circuit protection by means of an adjustable magnetic element on each pole. The adjustment knob(s) shall have the end and mid-setting points marked and adjustment shall follow a linear scale so that each point has a significant value within calibration tolerances. MCCB's shall not be used to provide thermal protection or switching of motors.

MCCB's shall be ambient temperature compensated. Compensation shall allow the breaker to carry rated current between 25°C and 50°C with tripping characteristics that are approximately the same throughout this temperature range.

**16.8.4 Miniature circuit breakers**
Miniature circuit breakers (MCBs) shall be manufactured and tested to the latest Standards.

MCBs shall have a short circuit rating of at least M4 and shall be Type 3 with a breaking capacity of 4.5 kA at 220/380 V unless otherwise specified.

The fault capacity of the MCB shall be not less than that of the switchboard. If this is not the case, back up HRC fuses shall be fitted. MCB’s for dc circuits shall provide a double break (one pole protected plus one switched).

16.9 Fused-switches and disconnecter combination devices

16.9.1 General

Fused switch disconnecters, switch-disconnecters and disconnecters, shall be rated at 500 V and shall be to the latest Standards.

Fuse switch disconnecters shall be of the air break triple pole or single pole and neutral type. They shall have not more than one fuse in any one pole. The neutral shall be either switched or taken through a removable link. If a switched neutral is required, the neutral shall be arranged to make first and break. A separate brass earth terminal shall be provided.

Operating mechanisms shall be of the independent spring type and fitted with mechanical ON and OFF indicators. Operating handles shall be of semi-flush or telescopic pattern to reduce front projection to a minimum.

Disconnecters shall be identical to fuse-switches but the fuse links shall be replaced by hard drawn high conductivity copper links.

Facilities for locking the operating handles by padlock shall be provided.

All switch-disconnecters shall be rated to make the full short circuit current of the system. Units used on distribution circuits shall be rated to break full load current and units used in motor starters shall be rated to break stalled motor current.

16.9.2 Fuses and links

Fuses shall comply with the latest Standards as appropriate.

Fuses and links shall be provided to enable any circuit to be isolated as necessary for maintenance and test purposes without isolating the whole panel. All fuses shall be of the cartridge type. Fuse carriers and solid link carriers and bases shall be made of plastic moulded insulating materials; ceramic materials will not be accepted. Accessible live connections shall be effectively shrouded and it shall be possible to change fuses and remove links with the circuit alive without danger of contact with live metal. The fuses shall be rated to give maximum protection to the apparatus in circuit and the rating shall be inscribed on the fuse label.

Earthing and neutral links in main supply circuits shall be solid copper bolted pattern.

Fuses and links functionally associated with the same circuit shall be mounted side by side.
16.9.3 Circuit protective conductors

An independent Circuit Protective Conductor shall be provided for each circuit and may comprise one or any of the following as appropriate:

- a separate core within a multicore cable;
- a separate conductor installed within a conduit or trunking. Steel conduit or trunking shall not be used as a circuit protective conductor;
- the metal sheath of an armoured cable. The sheath shall be bonded to the metalwork of the apparatus and to the apparatus earth bar if any;
- the copper sheath of a mineral insulated copper sheathed cable;
- an independent insulated copper conductor run adjacent to the circuit it protects.

Circuit protective conductors associated with the main circuits supplying switchboards and large electrical loads, i.e. motors in excess of 75 kW shall form a separate core of a multicore cable feeding the device or shall be an independent insulated copper conductor run adjacent to the supply cable. The size of the circuit protective conductor shall be calculated in such a manner as not to take into consideration the contribution of any other parallel or fortuitous earth paths.

The armouring of the supply cable shall not form the sole means of earthing a switchboard or large electrical load.

Where the cable armouring or sheath is used as the circuit protective conductor it shall be securely bonded at both ends to the metalwork of the apparatus and to an earth bar. Particular care shall be taken to ensure continuity across items of apparatus situated within a cable run and should the design of such items of apparatus not give adequate and lasting continuity through its structural body then additional earthing clips and conductors shall be provided to independently bond the cable sheaths together. Similarly additional earthing clips shall be provided to bond the cable sheaths/armour to any piece of apparatus fitted with a special earth terminal should the earth connection for the termination gland be inadequate. Any additional earthing clips shall be fitted within the apparatus wherever possible.

16.10 Distribution

1610.1 Local control stations

Local control stations shall be of heavy duty construction and where appropriate, constructed in accordance with safety and general construction equipment with the Clause entitled 'Switchboard, Cubicle and Enclosure Construction'. Local control stations shall be mounted directly onto the plant to be controlled, or be provided with a floor mounting tubular pedestal with provisions to accommodate the incoming cables.

Small covers shall be secured by screws or bolts and be totally removable. In larger sizes and where instruments are to be fitted, the covers shall be provided with heavy duty hinges.
The bottom face shall be arranged to accept, with adequate space for the use of spanners, gland terminations for the number of cables required.

Terminals shall be provided for interconnections arranged vertically at the side for easy access, and marked with identification numbers/letters corresponding with the associated diagrams.

Pendant type local control stations for cranes, hoists, etc. shall be of moulded neoprene or equivalent heavy, flexible, high impact strength materials. The station shall be connected by a long moulded-in cable strengthening sleeve, to minimise the possibility of cable fracture at the bending point. The enclosure shall be self-colored in safety yellow.

16.10.2 Marshalling boxes

Marshalling boxes shall be constructed of sheet steel with ample space for routing and terminating cables and cores.

Enclosure protection shall be the same as that for switchboards i.e.

Outdoor IP65
Indoor IP54

Every marshalling box shall be provided with the following:

- undrilled gland plate arranged for bottom entry;
- anti-condensation heater with thermostat and fuse;
- padlocking facility and padlock;
- earthing bar with terminal holes;
- door-switch operated internal light with fuse;
- labels for front door, fuses, terminal blocks, and terminals;
- transparent plastic covers on terminal blocks operating at greater than 24V;

16.11 Earthing

16.11.1 General

Earthing systems shall comply with the latest Code of Practice and IEE Wiring Regulations (16th Edition).

The metalwork of all items of electrical plant, electrical system neutral points, power and control cable armouring and screens, and extraneous metalwork including structural steelwork, pipework, fences and gates, shall be connected to the earthing installation.

Earth continuity in non-electrical plant shall normally be achieved via metal to metal faces, pipe flanges, metal hinges, and metal fixings. Earth straps to bond pipework sections shall be supplied where earth resistance is high or there is risk of corrosion or similar which could in the future increase resistance and affect earth continuity.

Perimeter fences shall be either bonded to the earthing system. Metal gates shall be bonded to the fence using flexible connections.
16.11.2 Installation

The earthing installation shall comprise an earth terminal, earth busbars, circuit earthing conductors, equipotential bonding conductors, main earthing conductor and earth electrodes. The circuit earthing and equipotential bonding conductors shall be of the radial, grid or ring form as dictated by the plant lay out.

The earthing installation shall be protected from mechanical damage and corrosion.

Joints in tape conductors shall be rivetted and soldered, brazed, clamped, bolted or exothermically welded. Non-corrosive flux shall be used for soldered joints. Clamped and bolted type joints shall be tinned and shall only be used above ground.

The interconnection of conductors below ground shall be by means of exothermic welding or brazing. Compression type lugs shall be provided for the termination of cables.

Earthing conductors shall be buried directly in the ground or secured to building structures, cable racks and trays using propriety fixings.

Where the soil is aggressive to copper, buried earthing conductors and joints shall be protected by an approved serving.

An equipotential bond shall be provided to all buried metal pipework at the point of entry into a building or chamber where electrical apparatus is installed. Electrical continuity across all pipe joints within the structure shall be ensured. Normally the connection of the pipe flanges will suffice, but where pipework incorporates a compression coupling (e.g. Viking-Johnson coupling), a bond shall be provided to any otherwise isolated section.

Cable armouring and screens shall be bonded to earth at both ends unless otherwise specified. Cable armour shall not be used as the sole earth protective conductor.

16.11.3 Conductors

Circuit and main earthing and equipotential bonding conductors shall be high conductivity copper tape or 1000V grade PVC insulated multi-stranded cable. PVC cable insulation shall be striped green/yellow. Cable lengths shall be continuous and intermediate jointing is not permitted.

The main bonding conductor shall be not less than 16mm² and supplementary bonding of non-electrical plant not less than 10 mm². All connections shall be made using compression type cable lugs, taped on completion to completely seal the lug and any bare copper from the atmosphere.

The surface to which earthing bonds are fixed shall be cleaned free from paint and other non-conducting material and coated with petroleum jelly.

16.11.4 Earth electrodes

Earth electrodes where used shall be solid copper or copper clad high tensile steel rods with a copper plate thickness of not less than 0.25mm. The outer diameter shall be not less than 16mm. The rod shall penetrate a minimum of one meter below ground.
level. Where multiple rods are used they shall be separated by a distance of not less than the driven length.

Earth rods shall have hardened tips and caps and be extendable.

Where soil conditions make the use of rod type electrodes impracticable a grid configuration may be used comprising horizontally buried bare high conductivity copper tape of dimensions 15mm x 4mm minimum. Tape shall be buried at a minimum depth of 600mm.

Each earth rod shall be provided with a clamp fabricated from non-ferrous metal for the connection of the earthing conductor. The connection shall be made in a concrete inspection chamber set flush with the finished ground level. The inspection chamber shall be permanently marked "ELECTRICAL EARTH".

Marker posts and plates shall be provided to mark the position of the electrodes and buried connections. The markers shall be similar to those provided for cable routes.

16.11.5 Main earth bar

Where specified, a main earth bar shall be installed in a convenient location. This shall comprise a high conductivity copper bar of sectional area at least that of the main earthing conductor. The earth bar shall be wall mounted, supported on insulators. The earth bar shall be complete with disconnecting links for test purposes, and connection points for the outgoing and incoming earth cables and tapes.

Earth studs shall have a minimum size of M8.

16.11.6 Main Earth Terminal

A main earth terminal shall be installed in an approved location adjacent to the incoming supply to a building. This shall be labelled and comprise a 50 mm x 6 mm minimum cross section copper bar supported on porcelain barrel type insulators and wall mounted. The bar shall be of sufficient length to accommodate bolted earth bonding connections from transformers, major items of plant and electrical switchgear, building structural steelwork, concrete reinforcement, the earth electrode system and the lightning protection system. The earthing conductor shall be clearly marked as such and shall be accessible for disconnection to facilitate testing of the earth electrode system. For small installations an earthing terminal comprising a single brass stud of 12 mm minimum diameter shall be acceptable with the approval of the Project Manager’s Rep.

16.11.7 Tests at site

On completion of the earthing installation the Contractor shall measure the resistance of each electrode installation and of each complete earthing system to the general body of the ground. All other tests stipulated in the Reference Standards, shall also be carried out.

The resistance to earth of each complete earthing network shall not exceed one ohm.

16.12 Neutral earthing resistors (transformers and generators)
16.12.1 General
The resistors shall comply with the relevant parts of the latest Standards and shall be formed from continuous grids or strips of chrome aluminium steel or equivalent material.

16.12.2 Material temperature
The material shall have a temperature coefficient of less than 1.2% increase in resistance per 100°C rise over the operating temperature range, a high resilience against breakage and be free from any flaw likely to cause local overheating. The resistors shall be assembled into standard units having an inherent inductance of less than 10 degrees phase shift between current and voltage when operating on a 50 Hz supply.

16.12.3 Temperature switch
A temperature switch shall be provided within the resistor enclosure to detect uncleared earth faults or faults within the resistor.

16.12.4 Interconnections
Interconnections between tiers shall be of plated copper connectors bolted to stainless steel terminals.

16.12.5 Resistance
The resistance units shall be clamped securely in tiers by mica insulated bolts so as to prevent loops or grids coming into contact due to short-circuit forces. The resistance tiers shall be mounted in a box formation between pressed steel and frames, adequate allowance being made for any thermal expansion.

The resistance units shall be mounted in drip proof enclosures with protective classification of IP23. All protective and supporting steelwork shall be plated with zinc.

16.12.6 Terminals
Terminals shall be provided for the connection of external cables and these shall support the cables or interconnecting copper work firmly holding them well clear of other parts. Cables shall not be run above hot resistance material.

16.13 Lightning protection
Where buildings or sections of the plant are to be protected against lightning or static charges, an earthing system shall be provided. The installations shall be carried out in accordance with the latest Standard.

The down connectors shall be of hard drawn high conductivity copper of 25mm x 3mm section. The tape shall be fixed to the outside of the structure by means of standoff saddles. Where indicated, connections shall be made to the concrete
reinforcing. The route of the tapes and the fixings shall be approved by the Project Manager’s Rep before installation.

Where the conductors specified shall be PVC insulated to prevent corrosion and to blend with the building fabric.

A test link shall be installed in each down conductor adjacent to the earth rod at a height of 1200 mm above ground level. The overall resistance of the earth termination system to earth shall not exceed 10 ohms. If this requirement is not met the number of earth electrodes shall be increased or they shall be interconnected until a value of 10 is attained. After this resistance value is obtained, the lightning protection system shall be bonded to the main earthing system.

Earth rods and connection chambers provided for the lightning protection system shall be in accordance with the requirements of rods for the earthing system.

16.14 Cables and wires

16.14.1 General

Cables and wires shall be supplied by an approved manufacturer and where possible the same manufacturer shall be used for all cables and wires. Each drum or coil of cable shall be accompanied by a certificate stating the manufacturer’s name, rating of cable, result and date of tests. Cables manufactured more than 12 months before delivery will not be accepted.

All cables shall be delivered with cable ends effectively sealed. When a cable is cut from a drum both ends shall be immediately sealed to prevent ingress of moisture. Cables shall not be transported to site in loose coils but a number of short lengths of cable may be transported on the same drum. The Contractor shall be wholly responsible for the purchase and/or hire costs of all cable drums and for the removal of these drums from site after use.

Cables and wires shall be adequately rated for current carrying capacity under normal and short time.

The Contractor shall ensure that cable and wires associated with the power distribution and control systems throughout the Works are adequately rated for their use. When assessing the rating and cross section of any cable or wire, the following factors shall be taken into account:

Maximum voltage drop permissible; Type and magnitude of load; Fault level and duration related to circuit protection relays and fuses; Overcurrent setting of relays; Route length and disposition of cables; Ambient temperature; Method of laying;

The design current of any circuit shall exceed the full load current of the supplied device by at least 10%. The voltage drop for any circuit from origin of the installation (i.e. supply authority's terminals) and the load under steady state conditions shall not
exceed 4% of the nominal voltage. Under motor starting conditions the corresponding voltage drop shall not affect the operation of the motor controls or the ability of the motor to start and run effectively and in any event shall not exceed 10%. The Contractor when sizing cables for the remote operation of shunt trip coils shall take due account of the voltage drop caused by the momentary current surge taken at the instant of energization.

The Contractor shall submit cable schedules for approval detailing ratings, sizes, lengths, method of installation and function of all individual cables.

Cables complying with BS, IEC, or approved equivalent standards will be accepted provided that all cables which are supplied for a specific operating voltage are to the same national standard. Each cable shall be in accordance with a standard which relates to its application.

Standards specified in the following clauses indicate the type of cables which may be used in the design. If the Contractor wishes to use cables to an alternative standard then details of current carrying capacity, derating factors, etc., shall be submitted to the Project Manager’s Rep for approval.

16.14.2 High voltage power cables

XLPE/SWA/PVC - semi-conducting conductor screen, cross linked polyethylene insulation, stranded copper conductors, core screen of semi-conducting compound, semi-conducting tape, and metallic layer, extruded PVC bedding, galvanized steel wire armoured, flame retardant red PVC sheathed overall, suitable for use on an earthed system of the voltage specified. Cables shall comply with the latest Standards.

16.14.3 Medium/low voltage power cables

XLPE/SWA/PVC - cross linked low density, polyethylene insulated, stranded copper conductors, extruded PVC bedding, galvanized steel wire armoured, flame retardant black PVC sheathed overall, suitable for use on an earthed system at a rated voltage of 0.6/1kV or 1.9/3.3kV as specified. Conductor temperature shall not exceed 90°C for continuous operation and 250°C for short circuit. Cables shall comply with the latest Standards.

PVC/SWA/PVC - PVC insulated, extruded PVC bedding, galvanized steel wire armoured, flame retardant black PVC sheathed overall, stranded copper conductors suitable for operation on a system at a rated voltage of 0.6/1kV. Conductor temperature shall not exceed 70°C for continuous operation. Cables shall comply with the latest Standards.

PVC/PVC - PVC insulated, extruded PVC bedding, flame retardant PVC sheathed overall, stranded copper conductors suitable for operation on a system at a rated voltage of 0.6/1kV. Maximum conductor temperature shall not exceed 70°C. Cables shall comply with the latest Standards.
PVC - PVC insulated single core copper conductor rated at 450/750 V. Insulation shall be phase colored. Conductor temperature shall not exceed 70°C for continuous operation. Cables shall comply with the latest Standards.

Copper conductors shall be used throughout. Cores of cross-sectional area greater than 1.5 mm² shall be stranded. Lighting wiring shall be of a minimum cross-section of 1.5 mm². Small power and control cables shall be of a minimum cross-section of 1.5 mm².

16.14.4 Flexible cables and cords
General purpose-PVC insulated stranded copper conductors white PVC sheathed overall, rated at 300/500 V in accordance with the latest Standards.

16.14.5 Analogue signal cables
Cables shall be PVC or polyethylene insulated, twisted pair laid with individual or collective screen, tape bound with extruded PVC bedding, galvanized steel wire armouring and overall PVC sheath. Conductors shall be multistrand copper, 24/0.2 mm (0.75 mm²) or as specified. Solid cores shall not be permitted. The cables shall be rated at 300/500 V and shall comply with the latest Standards.

Cables with a collective screen only are permitted for use where the signal is a high level carrier (e.g. 420 mA dc) and the route length is not greater than 30 m. Where the route length exceeds 30 m or the signal is low level (e.g. from a strain gauge) cables shall have both individual and collective screens.

16.14.6 Digital signal and control cables
Where the signal is based on a supply not greater than 24 V dc and the maximum ON-state loop current does not exceed 20 mA, then analogue type cables shall be used. Where the voltage and/or current exceeds these limits the cables shall comply with one of the following specifications:

PVC/SWA/PVC - PVC insulated, extruded PVC bedding, galvanized steel Wire armoured, flame retardant black PVC sheathed overall, stranded copper conductors suitable for operation on a system at a rated voltage of 0.6/1kV. Conductor temperature shall not exceed 70°C for continuous operation. Cables shall comply with the latest Standards.

PVC/PVC - PVC insulated, extruded PVC bedding, flame retardant PVC sheathed overall, stranded copper conductors suitable for operation on a system at a rated voltage of 0.6/1kV. Conductor temperature shall not exceed 70°C for continuous operation. Cables shall comply with the latest Standards.

Internal wiring of control panels shall be of a minimum cross-section of 1.0 mm², flexible and stranded.

Instrumentation and control cabling shall be of a minimum cross-section 1.5 mm² for outdoor use and 1.0 mm² for indoor use.

16.14.7 Cable labelling
At each end of each cable, in a uniform and visible position a label shall be fixed on the cable to indicate the site cable number and route, and the number and size of conductors. Labels shall be made of PVC, brass, aluminium, lead or copper strip, engraved and retained by suitable non-rusting or non-corroding binding wire passing through two fixing holes, one at either end of the label. If the cable gland is not normally visible, then the label shall be fixed inside the panel by means of screws.

Three phase power cable cores shall be identified A, B, C or color coded red, yellow, blue so that the correct three phase sequence is preserved throughout the system. Single phase power cable cores shall be color coded red, black.

Control cables shall have individual cores identified by means of suitable permanent ferrules bearing the same number at both ends.

Each cable and core shall bear the same number at both ends of the cable and core respectively. Terminals shall bear permanent identification as follows:

- Power terminations - color, number or letter
- Control terminations - letter or number or both

16.15 Cable installation

16.15.1 General

Non-sheathed single insulated wire shall only be installed in galvanized steel conduit or trunking.

Cables with sheaths but without any form of armouring shall only be installed in protected indoor locations such as floor ducts, conduits, or covered cables trays and ladders.

Cables with underground quality PVC sheaths and steel wire armouring may be installed in all locations including being direct buried in the ground, pulled into underground ducts or clipped direct to a surface or uncovered cable tray.

Single core cables shall not be used unless absolutely necessary (e.g. feeder cables from transformers to switchboards). Where the installation method requires armouring this shall be of the non-magnetic type formed from hard drawn aluminium strip or wire. No single core cables shall be direct buried in the ground.

Where cables are run together in the same tray, trench or conduit they shall be suitably derated or spaced to maintain current rating. Crossovers shall be avoided where possible. Large power cables (e.g. those carrying in excess of 50 A), and signal cables shall be run separately to minimise interference.

Where a number of cables are terminated in equipment, they shall finally approach the equipment from a common direction. Top and bottom entry methods shall not be mixed in the same panel.
Cables shall be complete with all saddles, cleats, hangers, brackets, trays, ladders, ties, nuts, bolts, screws, washers, packing, ducts, sand, concrete covers, marker tape and route marker posts as may be necessary to complete the installation.

Marker tape shall be placed in the ground above cables laid underground either direct buried or in ducts. The tape shall be 150 mm wide, yellow with black printing "DANGER-ELECTRIC CABLES".

All cables of less than a complete drum length shall be installed without joints except where approved by the Project Manager’s Rep.

Unless unavoidable, cables shall not be installed in areas of direct sunlight. Where it is necessary, sunshields constructed to the approval of the Project Manager’s Rep shall be supplied and installed.

Cables shall be installed in such a way that the minimum bending radii are not reduced when installed or during installation. Cables shall not be installed in ambient temperatures below that recommended by the cable manufacturer.

Cables grouped together shall have an insulation capable of withstanding the highest voltage present in the group.

Cables shall be laid in a manner such that any electrical interference between cables have no detrimental effect on the life and operation of equipment installed within the installation. As a general rule the following minimum clearances shall be adhered to where ever practical:

There shall be a minimum separation of 600 mm between HV power and all other cables and 300 mm between all other categories. These separations are minimum and special circumstances such as the presence of high current flows, or harmonic content may necessitate larger separation distances. Where practical a separate cable support system shall be provided for power and non-power cables. Where this is not practical a separation of 150 mm shall be maintained between power and non-power cables when run on the same support system. In order to make economic use of the cable support system, cables shall be arranged in groups of 50 mm maximum overall diameter. These groups shall be securely tied to the cable support system at intervals not exceeding 900 mm for horizontal runs and 300 mm intervals on vertical runs. In order to make the most economic use of cable ladder/tray and duct capacity, multicore cabling shall be utilised in order to connect instrumentation groups by using suitably located sub-distribution junction boxes. The junction boxes shall be suitable for the area in which they are to be installed and for the type of circuit. They shall be readily accessible for maintenance and clearly labelled junction boxes shall be constructed of steel or GRP and provide degree of protection IP 55. Separate cables shall be used for digital and analogue signals at all times. Digital and analogue signals shall be segregated within junction boxes.

18.15.2 Submissions by the contractor

Submissions which the Contractor is required to make in relation to the cable installation shall include, where relevant, the following:
Drawings and Schedules; Block diagrams to show control cabling systems with each cable and terminal equipment being identified as in the cable schedules. Cable route and layout drawings

For those items which are underground these drawings shall include the following:

Route plans for all cables, cable ducts, and cable trenches; Sectional views of all cable ducts, trenches etc. for each different section throughout the route; The position of all marker posts, joints, draw pits etc. Route plans and section views for all cable trays and cable runs.

Cable schedules, which shall detail the cable number, type, voltage, size, route, length, and number of cores. Control cable schedules shall detail the connected and spare core numbers, diagram numbers of connected equipment, core ferrule and terminal reference numbers.

18.15.3 Data and calculations

Manufacturers catalogues and data sheets for all cables and fittings. Cable sizing calculations

Test certificates for all witnessed and routine tests carried out at the manufacturer's works and at site.

16.15.4 Installation direct in the ground

Power cables of rated voltage up to 1000 V shall be buried at a depth of 500 mm to the cable centre. Power cables of rated voltage above 1000 V up to and including 12 kV shall be buried at a depth of 1000 mm to the cable centre. The depth of laying shall only be varied due to the presence of other cables or services. The laying of cables at excessive depth will not be accepted. Unless unavoidable, cables shall not be routed below pipes.

On cross roads the cable shall be run through uPVC duct as specified hereafter.

The bottom of excavated trenches shall be free of sharp stones and other obstacles and shall be covered with sand or fine sifted soil compacted to a depth of 50mm.

Cables shall be unrolled from the drums in such a manner as to avoid loops and kinks, and care shall be taken when laying or pulling into ducts to avoid damage to the outer sheath by drawing over sharp obstacles, edges, or stones. Cables pulled in either by machine or by hand shall be pulled in using rollers to prevent contact between the cable and the ground.

Cables shall be snaked into the trenches to avoid tension in the cables during backfilling or from subsequent settlement. Trenches will be provided with a layer of 75mm of sifted soil before laying of the cable. After laying, cables shall be covered to a minimum depth of 75mm of compacted sand or sifted soil and shall have a layer of protective concrete cable tiles laid above. The tiles shall overlap the cables at both sides with minimal 50mm.
Where cables of different voltages are laid together at the same depth, vertical cable tiles shall be used to segregate the cables.

Control, instrumentation and communication cables shall be laid not closer than 1000 mm to high voltage cables.

16.15.5 Installation in Underground Ducts

Underground ducts shall be constructed of impact resistant uPVC and shall be laid at a minimum depth of 500 mm (to the duct centre). The duct shall be surrounded by not less than 75 mm of sieved sand on all sides. At road crossings, uPVC ducts of minimum diameter 100 mm shall be laid at a minimum depth of 1000 mm (to the duct centre). The duct shall be surrounded by not less than 150 mm of concrete on all sides.

When installing cables in ducts the following measures shall be observed:

- cables shall be pulled in a straight line;
- rollers shall be positioned at the ends of the ducts both at the drawing in and drawing out points over which the cables are to be drawn;
- uPVC ducts and cables sheaths shall be coated with an approved lubricant;
- the maximum distance between draw-pits shall be the guaranteed minimum length of cable on each drum, making allowance for jointing;
- adequate space shall be allowed in each draw-pit for the installation and jointing of cables; the pulling rope shall be guided by rollers;
- only one large cable shall be drawn into each duct;
- where more than one small cable is to be pulled into the duct, all cables shall be pulled in simultaneously.

Whenever a duct is laid in the ground, a draw wire or man-made fiber rope shall be pulled in and at least 1000 mm excess length shall be left at each end.

18.15.6 Sealing cable entries into buildings

Where cables pass in or out of duct entries into or within buildings, these entries together with any spare ducts shall be effectively sealed against the ingress of moisture. The sealing method shall have a fire resistance of not less than 30 minutes.

16.15.7 Marking of underground cables

The location of all underground cables shall be identified by:

- engraved plates fixed to the exterior surface of the walls of buildings 300 mm above ground level, directly above the point where cables pass through the wall;
- marker posts on road verges, etc. at intervals of not more than 100 m and at all junctions and changes of direction along the route;
- marker posts at 10 m intervals within an enclosed site and at all junctions and changes of direction along the route.

Marker posts shall be of concrete, not less than 200 mm high and shall have an enamelled metal plate affixed giving the details of the cable the below including the
depth and voltage rating. A drawing or sample of a typical marker post shall be submitted to the Project Manager’s Rep for approval.

16.15.8 Installation in cable trunking

Cable trunking shall be manufactured from hot dipped galvanised mild steel of thickness not less than 1.25 mm. The trunking shall have two return flanges for rigidity. Where necessary, additional strengthening straps shall be fitted internally. The cover shall overlap the trunking and be made of the same gauge steel. All bends, tees and intersections shall be of the gusset type and shall, wherever possible, be purpose made by the manufacturer and of a matching design to the main trunking. Retaining straps shall be fitted to hold cables within the trunking when the cover is removed. Barriers formed from continuous sheet steel with the bottom edge welded to the trunking shall be installed where it is necessary to segregate cables.

The size of the trunking shall be adequate for the number of cables to be installed together with 50% spare capacity. Trunking shall have minimum dimensions of 50 mm x 50 mm.

Internal connecting sleeves shall be fitted across joints in the trunking and earth continuity ensured by bonding each section of trunking to a continuous earth wire.

Non-flammable fire barriers shall be inserted where the trunking passes through walls or floors. Conduit connections to trunking shall be made by flanged couplers and internal brass bushes. Trunking shall be supported at intervals not greater than 2 m horizontally or 2.5 m vertically. Crossings over expansion joints shall be made in flexible conduit.

Whenever trunking is cut or drilled the bared sections shall immediately be given a coat of zinc rich cold galvanising paint. Cable and trunking runs shall be determined by the Contractor and agreed by the Project Manager’s Rep before any work is started. A clearance of not less than 150 mm shall be maintained between the trunking and plumbing or mechanical services.

Trunking systems erected outside a building shall be weatherproof.

16.15.9 Installation in troughs and trenches

Where the building structure incorporates purpose built covered trench systems, power distribution cables may be laid on the floor of the trench. Control and instrumentation cables shall be segregated and installed on cable trays or ladders fixed to the walls of the trench.

Where the building structure incorporates general service trenches containing pipework, chemical lines and other services, all cabling shall be segregated from other services and run on cable tray or ladder fixed to the trench walls. Crossovers shall be kept to a minimum and cabling shall be taking above wet service pipework.

16.15.10 Cable tray and ladder

Cable trays and ladders shall be of hot dip galvanized perforated steel or PVC coated of thickness not less than 1 mm for trays up to 100 mm width, not less than 1.25 mm
for trays from 100 mm to 150 mm width, and not less than 1.5 mm for trays from 150 mm to 300 mm width. Cable tray and supports shall be manufactured in accordance with the latest Standards.

Cable tray and ladder supports shall be of ample strength to maintain rigid support to the fully laden cable tray along its entire length. All brackets and tray work shall be suitable for withstanding the normal weight of the cables fixed to it together with a temporary weight of 125 kg.

Wherever possible, cable trays shall be installed in full lengths without cutting. Where tray is cut or drilled the bared sections shall be dressed and immediately be given a coat of zinc-rich cold galvanising paint. Similarly for PVC coated trays, the bared sections shall be immediately sprayed using a PVC aerosol.

16.15.11 Installation in buildings

Cables to be run on walls, ceilings, or other structures shall be supported on tray or ladder racks, or enclosed in conduit or trunking.

All cables shall be neatly run vertically or horizontally parallel to adjacent walls, beams or other structural members.

Cable hangers, cleats, saddles, brackets and similar supporting devices shall be of an approved type and of adequate strength for the cables they are supporting. They shall be treated to withstand site conditions without corroding. Self-locking plastic buckle clips and strapping shall not be used.

Hangers shall be spaced according to recommendations in the IEE Wiring Regulations. Allowance shall be made for expansion and contraction of the cables.

16.15.12 Cable installation in conduit

Conduits shall be either galvanized heavy gauge steel screwed type or light-gauge steel non-screwed type steel. Accessories shall either be malleable cast iron or pressed steel.

A space factor of 40% shall not be exceeded, and in any case conduit of less than 20 mm diameter will not be permitted. The tubing is to be perfectly smooth inside and out and free from imperfections. Both ends of every length of tubing shall be reamed with all sharp edges removed before erection.

Where conduits converge, adapter boxes shall be used. Conduits shall be connected by means of male brass bushes and couplings. Where conduits are greater than 25 mm, straight through joint boxes shall be of the trough type.

Where conduit or fittings are attached to equipment casings, the material of the casing shall be tapped for a depth of not less than 10 mm or male bushes and flanged couplings may be used.

Hexagonal lock nuts shall be used at running joints and shall seat firmly and evenly onto mating faces. Lock nuts shall not be used at non-running joints.
All junction boxes, draw-in boxes, and inspection fittings shall be placed so that the cables can be inspected, withdrawn and re-wired during the life of the installation.

Generally not more than two bends or offsets or one coupling will be permitted without a suitable inspection accessory. Fish wires shall not be left in conduits during erection. The whole of the installation shall be arranged for a loop-in type of system with joints being carried out at switches, isolators or appliance fittings.

Ends of conduits which are liable to be left open for any length of time during building operations shall be plugged to prevent the ingress of dirt and covers shall be fitted on all boxes.

Generally, conduits shall not cross expansion joints of buildings. Where they cannot be installed in any other manner, a galvanized flexible conduit shall be used across the expansion joint. A total of 150 mm movement shall be allowed.

16.16 Cable Terminations and Joints

16.16.1 Power Cable

Power cables shall be terminated in suitable boxes arranged for bolting to switchgear, motor starters and motors. Each cable entry into a terminal box shall be made through a suitable gland.

Boxes shall be of adequate proportions to accommodate all cable fittings including stress cones or other means of insulation grading. Boxes shall be openable for inspection without disturbing the gland plate, cable or termination.

Where air insulated terminations are used, the cable crutch shall be protected by a heat-shrink trifurcating sleeve.

Cores shall have either crimped lugs or sleeves to match either post terminals or bolted clamp terminals.

Glands for armoured cables shall provide a positive armour clamp to the box or switchgear coating. This clamp shall completely support the cable weight so that no tension is applied to the termination. The clamp shall also provide earth continuity and be of adequate size to withstand the full fault current of the system for one second.

Where single core glands are required, these shall be non-magnetic. The gland plate shall also be of a non-magnetic material. Removable connections for bonding across the gland insulation shall be provided. The gland insulation shall withstand a test of 2 kV ac for one minute.

Glands shall seal the inner and outer cable sheaths against ingress or dirt and moisture and provide mechanical support. All glands shall be provided with an earthing tag.

Where cable glands are exposed to the weather these shall be protected by heat shrink or purpose moulded sleeves covering the gland continuously from the cable sheath to the gland neck.
Where the apparatus enclosure classification requires sealed cable gland entries, sealing shall be achieved by using threaded cable gland holes and polytetrafluoroethylene (PTFE) tape.

16.16.2 Multicore or control cable terminations

A sufficient number of terminals shall be provided to terminate all cable cores. For control and auxiliary wiring an additional 20% of this number shall be provided as spares.

Terminal blocks for terminating up to and including 35mm² cable shall securely clamp the conductor, without damage, between two plates by means of a captive screw; pinch screw type terminal blocks shall not be used.

For cables above 35mm², stud or bolted terminals shall be used, each cable core being fitted with a suitable lug.

Not more than one core of internal or external wiring shall be connected on any one terminal. Where duplication of terminal blocks is necessary, purpose made solid links shall be incorporated in the design of the terminal blocks.

Terminals which remain energized when the main equipment is isolated shall be suitably screened and labelled.

Terminal blocks for different voltages or circuit type shall be segregated into groups and distinctively labelled. Plant which has to be dismantled for maintenance shall have multicore cable terminations made of throughglands onto an adaptable box. The box shall have terminal blocks, and connections shall be made to the equipment by single core wires and flexible waterproof plastic conduit. A separate earth core shall link the box to the equipment.

16.16.3 Joints

Through joints shall only be allowed on long cable runs outside buildings. Where such joints are necessary in thermoplastic and elastomeric cables, the cables shall be jointed with epoxy or acrylic raisin cold setting compound, which has been premeasured and prepacked ready for use. The boxes shall be of split, moulded plastic type with filling vents for compound. Bonding straps shall be fitted with armour clamps across the joint and inspected by the Project Manager’s Rep prior to filling the box with compound. Wrapped pressure type joints will not be accepted.

Conductor cores shall be jointed number-to-number or color-to-color.

16.17 Small power and lighting installations

16.17.1 Distribution boards
Distribution boards shall be of folded sheet steel enclosed construction, braced to form a rigid structure. Doors shall be lockable, hinged and gasketted to give a damp and dustproof enclosure. The degree of protection shall be IP43 (indoors and IP55 (outdoors).

The busbars shall be mounted on non-hygroscopic insulators, completely shrouded or PVC insulated, colored to denote the appropriate phase. The current rating of the busbars shall be not less than the sum of the maximum current rating of all outgoing circuits. A neutral bar shall be provided with a separate terminal for each circuit.

A separate earth terminal block shall be provided with a separate terminal for each circuit. Distribution boards shall have a fault rating at least that of the system for one second. Removable top and bottom undrilled gland plates shall be provided with a brass earthing stud.

A switch fuse or isolator shall be connected on the incoming side of the board. The device shall be triple pole and neutral with over current protection.

Each outgoing circuit including spare ways shall be protected by an HRC fuse or miniature circuit breaker (MCB). HRC fuse bases and carriers shall be of non-hygroscopic insulation.

Barriers shall be fitted over all live parts and spaces between phases. Each distribution board shall have a permanent circuit identification chart mounted on the inside of the front door.

Boards for use on dc systems shall be double pole types with fuses on the incomer.

**16.17.2 Bulk switching contactors**

Bulk switching contactors (e.g. for large lighting or heating loads controlled from a single switch) shall be of the air break electromagnetic type. The contactors shall be continuously rated for the duty specified, shall have a utilization category AC1, and an intermittent duty class 0.3 with the characteristic mechanical endurance of that class. The current ratings specified shall be eight hour rated duty.

Contactors shall be single or triple pole as required, each type with a neutral terminal. Contactors shall be fitted with a continuously rated operating coil having both terminals brought out.

Enclosures shall be similar to those of distribution boards and shall have a degree of protection not less than IP52.

**16.17.3 Socket outlets**

Domestic pattern socket outlets shall comply with the latest Standards. Industrial pattern socket outlets shall comply with the latest Standards.

In areas having plaster, tiled or other decorative finish, socket outlets shall be fitted flush with the finished area. In all other areas fittings shall, unless otherwise specified, be surface mounted.
**16.17.4 Lighting switches**

Internal lighting switches shall be supplied complete with box, cover plate and fixing screws. They shall be surface mounted metal clad type with aluminium or steel finished box.

At multi-switch positions, the switches shall be contained in multi-gang boxes.

External lighting switches shall be of the metal clad, galvanized and weatherproof pattern with rotary action. They shall be surface mounted.

**16.17.5 Internal lighting**

Lighting shall be complete with all supports, suspensions, flexible cables, pendants and plugs. They shall be connected to the main circuit wiring with heat resisting flexible cables of a minimum core size of 24/0.20 mm.

Protective classification shall be IP42.

The earthing of all lighting shall be by a separate core in the connecting flex or cable, securely bonding the earth terminal on the fitting to that of the interconnecting cables.

Where adjacent lighting are connected to different phases of the supply, a label shall be fitted internally, warning of the presence of the phase-to-phase voltage.

Lighting shall not transmit load to suspended ceilings unless the ceiling and lighting is of integrated design with the appropriate supports.

Where high bay discharge lighting are suspended from the structural ceiling, the connection between the fitting and fixed wiring shall be by plug and socket.

Lamp holders for flexible pendants shall be of the all-insulated skirted pattern with cord grips.

The fixings, connection boxes and other parts of the lighting shall be erected at times to suit the building program. The glassware, diffusers, shades, lamps and tubes shall not be fitted until all building work is complete. Fittings shall be left clean inside and outside and ready for use.

**16.18 Types of Lighting**

**16.18.1 Fluorescent**

Diffusers shall be of flame retardant extruded acrylic or GRP material. They shall be either opal or prismatic pattern as specified.

A gasket shall be fitted between the diffuser and the body to form an effective seal. The lighting comply with the latest Standards.

**16.18.2 Incandescent lights**

Recessed down lighter lights shall be constructed from an aluminium alloy reflector and housing with adequate top ventilation holes. An adjustable position, porcelain BS lamp holder shall be incorporated, pre- wired with heat resistant cable. Re-lamping shall be from below only.
Surface incandescent lights shall be of the while opal glass type suitable for wall or ceiling mountings.

16.18.3 External Lighting

All external lights shall be of the totally enclosed fully weatherproof pattern with vandal-proof polycarbonate diffusers having a minimum degree of protection IP55.

Security lighting systems shall be designed to be inaccessible to intruders.

Bulkhead lights shall have a cast aluminium alloy body, polycarbonate diffuser, gasket and porcelain lampholder.

16.18.4 Lamp holders

All lamp holders shall be fitted with a lamp of a type and size specified by the manufacturer or as stated on the drawings.

16.19 Wiring

Internal wiring shall be carried out using single core PVC insulated cable installed in surface run conduit or trunking and shall be fixed to walls of structured steelwork.

The copper conductor size shall be not less than 1.5 mm² for circuits feeding lighting or fixed apparatus or less than 2.5 mm² for socket outlet circuits.

No conduit serving a single phase socket outlet, lighting point or switch shall contain more than one supply phase.

17 MISCELLANEOUS

17.1 Paint and painting

All paint, including primers, undercoats and finishings, polish, emulsion etc., to be used shall be obtained ready for use from the manufacturer approved by the Engineer.

The Contractor shall order direct from the manufacturer and only fresh paint will be allowed to be used.

All paints shall be of the qualities, i.e. exterior, interior etc., types and colors scheduled. All coats of paint system shall be obtained from the same manufacturer, shall be ordered for use together and as far as practicable, shall be ordered on one order in sufficient quantity for the whole of the work, particularly in the case of the finishing color. Where more than one of the three systems (gloss, semi-gloss or flat) is in use, these paints shall be used in strict accordance with their accompanying printed instructions.

The Contractor shall use only paints delivered to the site in original sealed containers, not exceeding five liter capacity, stamped and bearing the manufacturer’s name of mark, the specification number, method of application (e.g. brushing) colour, quantity, batch number and date of manufacture, and expiry. Contractor’s stocks shall not be accepted unless expressly approved by the Engineer’s Representative.
The paint, which will be subject to sampling and testing, shall be used exactly as received, after adequate stirring, without the addition of thinners, driers, or adulterating materials of any kind. All tints and shades (including colours of undercoats) shall be selected and approved by the Engineer’s Representative and the Contractor shall allow in his prices for executing the painting work in colour schemes, to be prepared from a wide range of colours.

All paints described as oil paint shall be alkyd paint.

No painting on exterior work shall be carried out in wet weather or upon surfaces which are not thoroughly dry. Painting shall not proceed in dusty conditions. Each coat of paint shall be thoroughly dry and shall be rubbed down with glass paper before a subsequent coat is applied. Adequate care must be taken to protect surfaces of paintwork, still wet.

Lead based priming paints for steelwork shall conform to B.S. 2521 and 2523.

18 RECONDITIONING AND SERVICING OF EXISTING MACHINERY AND SWITCHGEAR

18.1 Reconditioning

Reconditioning, in some cases called overhauling, of existing machinery shall include complete dismantling, cleaning and inspection, replacement of all defective and worn components, re-assembly, adjustment and testing. Only basic elements like pump casings, engine blocks, crank shafts, fuel pumps, engine/piston heads, shall remain.

Fuel pumps, turbo chargers etc. shall be fully reconditioned.

Reconditioned machinery shall be considered new machinery and the performance of this machinery shall be equal to that of new machinery under the same condition.

18.2 Servicing

18.2.1 Service of Existing Machinery

Only, if distinctively specified, is the Contractor allowed to service existing machinery. Service of existing machinery shall include:

- Check and replacement if required by the Project Manager’s Rep of gland packing or mechanical seal;
- Check and replacement if required by the Project Manager’s Rep of mechanical seal;
- Check and adjustment of alignment;
- Check of machinery lubricating system, minor repairs and replacement of oil;
- Check and repair of minor leakage’s;
- Check, repair and replacement of valve spindles and hand wheels;
- Check and replacement if required by the Project Manager’s Rep of air filter and muffler;
- Check and replacement if required by the Project Manager’s Rep of machinery bearings;
• Check and replacement if required by the Project Manager’s Rep of coupling studs and buffer rubbers and if necessary the coupling halves.

18.2.2 Spares for Existing Pumps and Blowers

Where otherwise specified a set of spares for an existing pump or blower shall include any of the following items applicable to the particular model in addition to any other wearing parts listed by the manufacturer:

- Shaft Sleeves;
- Glands;
- Bearings;
- Lantern Rings;
- Deflectors;
- Casing Rings;
- Oil Seals;
- Pressure gauges;
- Air Vents;
- Gaskets;
- Gland Packing or Mechanical Seal;
- Rings;
- Circlips;
- Coupling Buffers;
- Air filters.

Any additional minor items such as bolts, nuts, pins, studs and clips shall also be provided.

Additional main components such as shafts, complete drive coupling assemblies or impellers shall only be included where specifically listed in the Bill of Quantities.

Any parts found not to require replacement on dismantling shall be handed over to the maintenance staff of the waterworks.

18.3 Electric Motors

If an electric motor is rewound the insulation resistance has to comply with the value which shall be calculated. In case the motor is not to be rewound and this value cannot be obtained the windings is to damp and must be dried in an oven. The oven temperature should be 90°C for 12-16 hours, where upon it should be raised to 105°C for a further 6-8 hours.

Motors shall be thoroughly cleaned of dust, oil, grease and any other grime.

In case of slipring motors with the carbon brushes in continuous contact with the slip-rings, the brush and slip-ring gear should be cleaned. All carbon brushes shall be replaced by appropriate carbon brushes of the correct grade as specified by the
manufacturer of the electric motor. If necessary, the slip-rings shall be machined on a lathed and honed to a smooth surface.

18.3.1 Stripping down Checking and Scheduling of Overhaul works

Where instructed by the Project Manager’s Rep, the Contractor shall dismantle and check the condition of all main wearing components of the generator and submit a Report including a schedule of works and detailed quotation for a complete overhaul.
SECTION VII: DRAWINGS

DRAWSNGS PROVIDED

<table>
<thead>
<tr>
<th>No</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
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<td>None</td>
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</table>
SECTION VIII: BILL OF QUANTITIES
## BILL OF QUANTITIES

### MILIMA TATU WATER SUPPLY PROJECT

#### BILL No. 1

### PRELIMINARIES AND GENERAL ITEMS

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Unit</th>
<th>Quantity</th>
<th>Rate Kshs.</th>
<th>Amount Kshs.</th>
</tr>
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<tbody>
<tr>
<td><strong>Preliminary Items</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Allow for provision of Insurance of Works and Contractor's Equipment in accordance with the General Conditions of Contract</td>
<td>Item</td>
<td>L.S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2</td>
<td>Allow for provision of Third Party Insurance (including Employer's Property) all in accordance with the General Conditions of Contract.</td>
<td>Item</td>
<td>L.S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3</td>
<td>Allow for provision of Insurance against Accident to Workmen in accordance with the General Conditions of Contract.</td>
<td>Item</td>
<td>L.S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.4</td>
<td>Prepare and install as specified a project sign board</td>
<td>No</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td>The contractor shall provide at his own risk and cost all necessary water and electricity for the works</td>
<td>Item</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>General Items</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1.6</td>
<td>Allow amount for upkeep of the Resident Engineer and supervisory staff on site</td>
<td>P.C sum</td>
<td>1</td>
<td></td>
<td>800,000</td>
</tr>
<tr>
<td>1.7</td>
<td>Allow for transport costs, vehicle maintenance and drivers allowances for the employer's site agents for the duration of project</td>
<td>P.C sum</td>
<td>1</td>
<td></td>
<td>200,000</td>
</tr>
<tr>
<td>1.8</td>
<td>Contractor's overheads and attendance items upon 1.6 and 1.7</td>
<td>%</td>
<td>0.2</td>
<td></td>
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</tr>
</tbody>
</table>

**Total Bill No. 1 - Preliminary and General Items**

### REHABILITATION OF MILIMA TATU WATER SUPPLY

#### BILL 2

### WORKS

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>DESCRIPTION</th>
<th>UNIT</th>
<th>QUANTITY</th>
<th>RATE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Trench and backfill pipeline</td>
<td>m</td>
<td>3000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>Supply, lay and test HDPE 2” Rolls pipe class D (100m length)</td>
<td>Roll</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Quantity</td>
<td></td>
<td></td>
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<tr>
<td>---</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.3</td>
<td>Supply install and test Grundfos submersible pump complete with accessories capable of delivering 8m3/hr of water to 115m head be installed to a borehole of 90m depth. The Control genset / Solar panels room is 60m from the borehole. The pumping unit to have all accessories, draw pipes, cables</td>
<td>No. 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.4</td>
<td>Supply, install and test Lister petter Genset or equivalent complete with all accessories with control switch (complete unit) with capacity to supply power to the pumping unit in item 2.3</td>
<td>No. 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td>Supply, install and Lorentz PS7K2 Controller or equivalent for controlling the pumping system monitoring of the operating states and incorporates the following alarm functions, overcurrent, undervoltage, over speed, over temperature, reverse polarity, and low water.</td>
<td>No. 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.6</td>
<td>Solar modules: 125W, 12V Multi-crystalline PV solar modules to provide a maximum of 9000W output and are serve capacity over the rated power requirements of the pump of 7500W</td>
<td>No. 72</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td>Provide Solar System Accessories and installation sundries to meet the pump requirement including 40m 2.5mm² core U/G cable and 40m 1.5mm² core U/G cable for well probe sensor; 1 well probe sensor and 120m well probe sensor cable; 90m 1.5mm² core flat PVC submersible cable; Float switch and 800m 1.5mm² core U/G cable for float switch; 30m 6mm 2 twin flat earth road among other related accessories for solar support structure and fencing</td>
<td>LS 1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.6 Supply material, fabricate solar support structure not less than 5m high of 75 x 75 4mm square steel hollow section stand spaced not more than 2m each direction, with 50 x 50 x 4mm square steel hollow section horizontal members spaced not more than 2m. The panels to be supported on 40 x 40 x 3mm square steel hollow section. Allow for struts of 50 x 50 x 4mm square steel hollow section for each space on the top 2m height. The structure to be on concrete not less than 1m from ground level. The whole structure to be painted.

2.7 Supply and fix the following

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.7.1</td>
<td>2&quot; Gate valve (Pegler)</td>
<td>5</td>
</tr>
<tr>
<td>2.7.2</td>
<td>3/4&quot; x 1m Complete with tap and other fittings G.I stand pipe</td>
<td>1</td>
</tr>
<tr>
<td>2.7.3</td>
<td>2&quot; G.I union socket</td>
<td>2</td>
</tr>
<tr>
<td>2.7.4</td>
<td>2&quot;x3/4&quot; G.I Reducing bush</td>
<td>3</td>
</tr>
<tr>
<td>2.7.5</td>
<td>2&quot; G.I nipple</td>
<td>4</td>
</tr>
<tr>
<td>2.7.6</td>
<td>G.I 2&quot; bend</td>
<td>3</td>
</tr>
<tr>
<td>2.7.7</td>
<td>2&quot; HDPE coupling</td>
<td>120</td>
</tr>
<tr>
<td>2.7.8</td>
<td>2&quot; G.I Elbow</td>
<td>3</td>
</tr>
<tr>
<td>2.7.9</td>
<td>2&quot; Tee HDPE</td>
<td>3</td>
</tr>
<tr>
<td>2.7.10</td>
<td>2&quot; Adaptors HDPE</td>
<td>240</td>
</tr>
<tr>
<td>2.7.11</td>
<td>Tangit jointing</td>
<td>litres</td>
</tr>
<tr>
<td>2.7.12</td>
<td>2&quot; Socket GI</td>
<td>5</td>
</tr>
<tr>
<td>2.7.13</td>
<td>2&quot; GI Pipe class B</td>
<td>5</td>
</tr>
<tr>
<td>2.7.14</td>
<td>2&quot; Tee GI</td>
<td>10</td>
</tr>
<tr>
<td>2.7.15</td>
<td>Rehabilitation of existing water kiosks of 3 x 3m (Plastering, Replacement of 1No single leaf door and 1No steel window)</td>
<td>4</td>
</tr>
</tbody>
</table>

2.8 Add 10% contingency
Note:
Reference to section 82 of the Public Procurement and Asset Disposal Act 2015

"The tender sum as submitted and read out during the tender opening shall be absolute and final and shall not be the subject of correction, adjustment or amendment in any way by any person or entity."
SECTION IX: TENDER FORMS
A. Form of Tender

[Date]

To:

We offer to execute the [name and identification number of contract] in accordance with the Conditions of Contract accompanying this Tender for the Contract Price of [amount in numbers], [amount in words] [name of currency].

The Contract shall be paid in the following currencies:

<table>
<thead>
<tr>
<th>Currency</th>
<th>Percentage payable in currency</th>
<th>Rate of exchange: one foreign equals [insert local]</th>
<th>Inputs for which foreign currency is required</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The advance payment required is:-

<table>
<thead>
<tr>
<th>Amount</th>
<th>Currency</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td></td>
</tr>
</tbody>
</table>

We accept the appointment of [name proposed in Tender Data Sheet] as the adjudicator.  
or
We do not accept the appointment of [name proposed in Tender Data Sheet] as the Adjudicator, and propose instead that [name] be appointed as Adjudicator, whose daily fees and biographical data are attached.

We are not participating, as Tenders, in more than one Tender in this Tendering process other than alternative Tenders in accordance with the Tendering documents.

Our firm, its affiliates or subsidiaries, including any subcontractors or suppliers for any part of the contract has not been declared ineligible by the Kenya Government under Kenya’s laws or any other official regulations.

This Tender and your written acceptance of it shall constitute a binding Contract between us.

We understand that you are not bound to accept the lowest or any Tender you receive.

We hereby confirm that this Tender complies with the Tender validity and Tender Security required by the Tendering documents and specified in the Tender Data Sheet.

Authorized Signature: __________________________________________

Name and Title of Signatory: _____________________________________

Name of Tenderer: _______________________________________________

Address: _______________________________________________________

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Appendix to Tender

Schedule of Adjustment Data

[In Tables A, B, and C, below, the Tenderer shall (a) indicate its amount of local currency payment, (b) indicate its proposed source and base values of indices for the different foreign currency elements of cost, (c) derive its proposed weightings for local and foreign currency payment, and (d) list the exchange rates used in the currency conversion. In the case of very large and/or complex works contracts, it may be necessary to specify several families of price adjustment formulae corresponding to the different works involved.]

Table A. Local Currency

<table>
<thead>
<tr>
<th>Index code</th>
<th>Index description</th>
<th>Source of index</th>
<th>Base value and date</th>
<th>Tenderer’s related currency amount</th>
<th>Range of weighting Proposed by the Procuring Entity</th>
<th>Tenderer’s proposed weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonadju---stable</td>
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<td></td>
<td></td>
<td></td>
<td>a: _____*</td>
<td>a: _____*</td>
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<td>b: ----- to -------*</td>
<td>b: -------</td>
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<td>c: ------- to -------*</td>
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<td>e: -------</td>
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<td>etc.</td>
<td>etc.</td>
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</table>

| | Total | 1.00 |
Table B. Foreign Currency

**State type**: .................... [If the Tenderer wishes to quote in more than one foreign currency, this table should be repeated for each foreign currency.]

<table>
<thead>
<tr>
<th>Index code</th>
<th>Index description</th>
<th>Source of index</th>
<th>Base value and date</th>
<th>Tenderer’s related source currency in type/amount</th>
<th>Equivalents in Foreign Currency 1</th>
<th>Range of weighting Proposed by the Procuring Entity</th>
<th>Tenderer’s proposed weighting</th>
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<tbody>
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<td>—</td>
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<td>etc.</td>
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<td>etc.</td>
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<td></td>
<td></td>
<td></td>
<td>Total</td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>
Table C. Summary of Payment Currencies

For ………………………..[insert 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 Procuring Entity should insert the names of each Section of the Works.]

<table>
<thead>
<tr>
<th>Name of payment currency</th>
<th>A Amount of currency</th>
<th>B Rate of exchange (local currency per unit of foreign)</th>
<th>C Local currency equivalent C = A x B</th>
<th>D Percentage of Net Tender Price (NBP) ( \frac{100 \times C}{NBP} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local currency</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foreign currency #1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foreign currency #2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foreign currency #</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net Tender Price</td>
<td></td>
<td></td>
<td>100.00</td>
<td></td>
</tr>
<tr>
<td>Provisional sums</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>expressed in local</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>currency</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TENDER PRICE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Authorized Signature: __________________________________________

Name and Title of Signatory: ______________________________________

Name of Tenderer: ________________________________________________

Address: ________________________________________________________
B. Tender-Securing Declaration (Mandatory)

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

Tender No.: [insert number of Tendering process]

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

To: [insert complete name of Procuring Entity]

We, the undersigned, declare that:

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

We accept that we will automatically be suspended from being eligible for Tendering in any contract with the Procuring Entity for the period of time of [insert number of months or years] starting on [insert date], if we are in breach of our obligation(s) under the Tender conditions, because we;

a) Have withdrawn our Tender during the period of Tender validity specified in the Form of Tender; or

b) Having been notified of the acceptance of our Tender by the Procuring Entity during the period of Tender validity,

   (i). Fail or refuse to execute the Contract, if required, or

   (ii). Fail or refuse to furnish the Performance Security, in accordance with the ITT.

We understand this Tender Securing Declaration shall expire if we are not the successful Tenderer, upon the earlier of;

1) Our receipt of your notification to us of the name of the successful Tenderer; or

2) Thirty days after the expiration of our Tender.

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

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

Duly authorized to sign the Tender for and on behalf of: [insert complete name of Tenderer]

Dated on ____________ day of __________________, _______

Corporate Seal (where appropriate)
C. Confidential Business Questionnaire

1 Individual Tenderer or Individual Members of joint Ventures

1.1 Constitution or legal status of Tenderer: [attach copy]
   Place of registration: [insert]
   Principal place of business: [insert]
   Power of attorney of signatory of Tender: [attach]
   Registration certificate [attach] current Business License [attach]

1.2 Total annual volume of construction work performed in two years, in Kenyan shillings as specified in the Tender Data Sheet; [insert]

1.3 Work performed as prime Contractor on works of a similar nature and volume over the last two years or as specified in the Tender Data Sheet in Kenyan Shillings. Also list details of work under way or committed, including expected completion dates.

<table>
<thead>
<tr>
<th>Project name and country</th>
<th>Name of client and contact person</th>
<th>Contractors Participation</th>
<th>Type of work performed and year of completion</th>
<th>Value of contract</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.4 Major items of Contractor’s Equipment proposed for carrying out the works. List all information requested below. Refer also to sub-Clause 12.3 of the Instructions to Tenderers.

<table>
<thead>
<tr>
<th>Item of equipment</th>
<th>Description, make, and age (years)</th>
<th>Condition (new, good, Poor) and number available</th>
<th>Owned, leased (from whom?) or to be purchased (from whom?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.5 Qualifications and experience of key personnel proposed for administration and execution of the Contract. Attach biographical data. Refer also to sub-Clause 12.3 of the Instructions to Tenderers and Sub-Clause 10.1 of the General Conditions of Contract.
<table>
<thead>
<tr>
<th>Position</th>
<th>Name</th>
<th>Years of Experience (general)</th>
<th>Years of experience in proposed position</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.6 Proposed sub-contractor and firms involved. Refer to Clause 7 of General Conditions of Contract.

<table>
<thead>
<tr>
<th>Sections of the Works</th>
<th>Value of subcontract</th>
<th>Subcontractor (name and address)</th>
<th>Experience in similar work</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.7 Financial reports for the number of years specified in the Tender Data Sheet.

1.8 Evidence of access to financial resources to meet the qualification requirements: cash in hand, lines of credit, etc. List below and attach copies of support documents.

1.9 Name, address, and telephone, e-mail address, and facsimile numbers of banks that may provide references if contracted by the Procuring Entity.

1.10 Information on current litigation in which the Tenderer is involved.
1.11 Statement of compliance with the requirements of sub-Clause 3.2 of the Instructions to Tenderers.

1.12 Proposed Program (work method and schedule). Descriptions, drawings, and charts, as necessary, to comply with the requirements of the Tendering documents.

2. Joint Ventures

2.1 The information listed in 1.1 – 1.11 above shall be provided for each partner of the joint venture.

2.2 The information in 1.12 above shall be provided for the joint venture.

2.3 Attach the power of attorney of the signatory (ies) of the Tender authorizing signature of the Tender on behalf of the joint venture.

2.4 Attach the Agreement among all partners of the joint venture (and which is legally binding on all partners), which shows that:

(a) all partners shall be jointly and severally liable for the execution of the Contract in accordance with the Contract terms;

(b) one of the partners will be nominated as being in charge, authorized to incur liabilities, and receive instructions for and on behalf of any and all partners of the joint venture; and

(c) the execution of the entire Contract, including payment, shall be done exclusively with the partner in charge.

3. Additional Requirements

3.1 Tenderers should provide any additional information required in the Tender Data Sheet or to fulfil the requirements of sub-Clauses 12.1 of the Instructions to Tenderers, if applicable.
D. Integrity Declaration

UNDERTAKING BY TENDERER ON ANTI – BRIBERY POLICY / CODE OF CONDUCT AND COMPLIANCE PROGRAMME

1. Each Tenderer must submit a statement, as part of the Tender documents, in either of the two given formats which must be signed personally by the Chief Executive Officer or other appropriate senior corporate officer of the Tendering company and, where relevant, of its subsidiary in the Kenya. If a Tender is submitted by a subsidiary, a statement to this effect will also be required of the parent company, signed by its Chief Executive Officer or other appropriate senior corporate officer.

2. Tenderers will also be required to submit similar No-bribery commitments from their subcontractors and consortium partners; the Tenderer may cover the subcontractors and consortium partners in its own statement, provided the Tenderer assumes full responsibility.

3. 
   a) Payment to agents and other third parties shall be limited to appropriate compensation for legitimate services.
   
   b) Each Tenderer will make full disclosure in the Tender documentation of the beneficiaries and amounts of all payments made, or intended to be made, to agents or other third parties (including political parties or electoral candidates) relating to the Tender and, if successful, the implementation of the contract.
   
   c) The successful Tenderer will also make full disclosure [quarterly or semi-annually] of all payments to agents and other third parties during the execution of the contract.
   
   d) Within six months of the completion of the performance of the contract, the successful Tenderer will formally certify that no bribes or other illicit commissions have been paid. The final accounting shall include brief details of the goods and services provided that they are sufficient to establish the legitimacy of the payments made.
   
   e) Statements required according to subparagraphs (b) and (d) of this paragraph will have to be certified by the company's Chief Executive Officer, or other appropriate senior corporate officer.

4. Tenders which do not conform to these requirements shall not be considered.

5. If the successful Tenderer fails to comply with its No-bribery commitment, significant sanctions will apply. The sanctions may include all or any of the following:

   a) Cancellation of the contract;
   
   b) Liability for damages to the public authority and/or the unsuccessful competitors in the Tendering possibly in the form of a lump sum representing a pre-set percentage of the contract value (liquidated).

6. Tenderers shall make available, as part of their Tender, copies of their anti-Bribery Policy/Code of Conduct, if any, and of their-general or project - specific - Compliance Program.
7. The Government of Kenya has made special arrangements for adequate oversight of the procurement process and the execution of the contract, and has invited civil society and other competent Government Departments to participate in the oversight. Those charged with the oversight responsibility will have full access to all documentation submitted by Tenderers for this contract, and to which in turn all Tenderers and other parties involved or affected by the project shall have full access (provided, however, that no proprietary information concerning a Tenderer may be disclosed to another Tenderer or to the public).
ANTI-CORRUPTION DECLARATION COMMITMENT/ PLEDGE

(Sections 39, 40, 41, 42, 43 & of the PPD Act, 2005)

I/We/Messrs…………………………………………………………………………………………
of Street, Building, P O Box……………………………………………………………………
……………………………………………………………………………………………………….
Contact/Phone/E mail…………………………………………………………………………
declare that Public Procurement is based on a free and fair competitive Tendering process
which should not be open to abuse.

I/We ………………………………………………………………………………………………..
declare that I/We will not offer or facilitate, directly or indirectly, any inducement or reward
to any public officer, their relations or business associates, in connection with
Tender/Tender No …………………………………………………………………………………
for or in the subsequent performance of the contract if I/We am/are successful.

Authorized Signature................................................................................................

Name and Title of Signatory......................................................................................
E. Letter of Acceptance

[Letter head paper of the Procuring Entity]

[date]

To: [name and address of the Contractor]

This is to notify you that your Tender dated [date] for execution of the [name of the Contract and identification number, as given in the Contract Data Sheet] for the Contract Price of the equivalent of [amount in numbers and works] [name of currency], as corrected and modified in accordance with the Instructions to Tenderers is hereby accepted by us.

We confirm that [insert name proposed by the procuring entity] to be the Adjudicator.

We accept that [name proposed by Tenderer] be appointed as Adjudicator.

Or

We do not accept that [name proposed by Tenderer] be appointed as adjudicator, and by sending a copy of this letter of acceptance to [insert the name of the Appointing Authority], we are hereby requesting [name], the Appointing Authority, to appoint the adjudicator in accordance with Clause 44.1 of the Instructions to Tenderers.

You are hereby instructed to proceed with the execution of the said works in accordance with the Contract documents.

Please return the contract dully signed.

Authorized Signature: ________________________________

Name and Title of Signatory: ________________________________

Name of Agency: ________________________________

Attachment: Form of Contract
F. Form of Contract Agreement

This Agreement, made the [day] day of [month], [year] between [name and address of Procuring Entity] (hereinafter called “the Procuring Entity”) and [name and address of Contractor] (hereinafter called “the Contractor”) of the other part.

Whereas the Procuring Entity is desirous that the Contractor execute [name and identification number of contract] (hereinafter called “the Works”) with the objectives of [insert functional objectives of the works] and the Procuring Entity has accepted the Tender by the Contractor for the execution and completion of such works and the remedying of any defects therein in the sum of [contract price in words and figures] (hereinafter called “Contract Price”).

NOW THIS AGREEMENT WITNESSES AS FOLLOWS:

1. In this Agreement, words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to, and they shall be deemed to form and be read and construed as part of this Agreement;

2. In consideration of the payments to be made by the Procuring Entity to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Procuring Entity to execute and complete the Works and remedy any defects therein in conformity in all respects with the provisions of the Contract;

3. The Procuring Entity hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects wherein 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.

In Witness whereof the parties thereto have caused this Agreement to be executed the day and year first before written.

The Common Seal of ________________________________

Was hereunto affixed in the presence of: ________________________________

Signed, Sealed, and Delivered by the said ________________________________

In the presence of: ________________________________

Tendering Signature of Procuring Entity ________________________________

Binding Signature of Contractor ________________________________
SECTION X: FORMS OF SECURITY
A. Tender Security (Bank or Insurance Guarantee)  
(Optional)  

[If required, the Bank or Insurance Company/Tenderer shall fill in this Guarantee form in accordance with the instructions indicated in brackets.]  

[insert bank’s or insurance company’s name, and address of issuing branch or office]  

Beneficiary: [insert name and address of Procuring Entity]  

Date: [insert date]  

TENDER GUARANTEE No.: [insert number]  

We have been informed that [insert name of the Tenderer; if a joint venture, list complete legal names of partners] (hereinafter called "the Tenderer") has submitted to you its Tender dated [insert date] (hereinafter called "the Tender") for the execution of [insert name of Contract] under Invitation for Tenders No. [insert IFT number] (“the IFT”).  

Furthermore, we understand that, according to your conditions, Tenders must be supported by a Tender Guarantee.  

At the request of the Tenderer, we [insert name of bank or insurance company] hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of [insert amount in figures expressed in the currency of the Purchaser’s Country or the equivalent amount in an international freely convertible currency] ([insert amount in words]) upon receipt by us of your first demand in writing accompanied by a written statement stating that the Tenderer is in breach of its obligation(s) under the Tender conditions, because the Tenderer;  

  a) Has withdrawn its Tender during the period of Tender validity specified by the Tenderer in the Form of Tender; or  
  b) Does not accept the correction of errors in accordance with the Instructions to Tenderers (hereinafter “the ITT”) of the IFT; or  
  c) Having been notified of the acceptance of its Tender by the Procuring Entity during the period of Tender 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 ITT.  

This Guarantee shall expire;  

  a) If the Tenderer is the successful Tenderer, upon our receipt of copies of the Contract signed by the Tenderer and of the Performance Security issued to you by the Tenderer; or  
  b) If the Tenderer is not the successful Tenderer, upon the earlier of;
(i) Our receipt of a copy of your notification to the Tenderer that the Tenderer was unsuccessful, or

(ii) Thirty days after the expiration of the Tenderer’s Tender.

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

_____________________________

[signature(s) of authorized representative(s) ]
B. Performance Bank or Insurance Guarantee [Unconditional]

[The Bank or Insurance Company/successful Tenderer providing the Guarantee shall fill in this form in accordance with the instructions indicated in brackets, if the Procuring Entity requires this type of security.]

[insert bank’s or insurance company’s name, and address of issuing branch or office]

Beneficiary:  [insert name and address of Procuring Entity]

Date:  [insert date]

PERFORMANCE GUARANTEE No.:  [insert Performance Guarantee number]

We have been informed that [insert name of Contractor] (hereinafter called "the Contractor") has entered into Contract No. [insert reference number of the Contract] dated 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, a Performance Guarantee is required.

At the request of the Contractor, we [insert name of Bank or Insurance Company] 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]), 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 accompanied by a written statement stating that the Contractor is in breach of its obligation(s) under the Contract, without your needing to prove or to show grounds for your demand or the sum specified therein.

We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.

We further agree that no change, addition or other modification of the terms of the Contract or of the Works to be performed there under or of any of the Contract documents which may be made between you and the Contractor shall in any way release us from any liability under this Guarantee, and we hereby waive notice of any change, addition, or modification.

This guarantee shall expire not later than thirty days from the date of issuance of the Taking-Over Certificate.

[signature(s) of an authorized representative(s) of the Bank or Insurance Company]
C. Bank or Insurance Guarantee for Advance Payment

[Bank’s or Insurance Company’s Name and Address of Issuing Branch or Office]

Beneficiary: ___________________ [Name and Address of Procuring Entity]

Date: __________________

ADVANCE PAYMENT GUARANTEE No.: __________________

We have been informed that [name of Contractor] (hereinafter called "the Contractor") has entered into Contract No. [reference number of the contract] dated _____ with you, for the execution of [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 [amount in figures] (__) [amount in words] is to be made against an advance payment guarantee.

At the request of the Contractor, we [name of Bank or Insurance Company] 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 Contractor is in breach of its obligation under the Contract because the Contractor used the advance payment for purposes other than the costs of mobilization in respect of the Works.

We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed thereunder or of any of the Contract documents which may be made between ______________________ [name of Procuring Entity] and the Contractor, shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

No drawing may be made by you under this guarantee until we have received notice in writing from you that an advance payment of the amount listed above has been paid to the Contractor pursuant to the Contract.

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 ____, 2___, whichever is earlier. Consequently, any demand for payment under this guarantee must be received by us at this office on or before that date.
Yours truly,
Signature and seal: __________________________________________
Name of Bank or Insurance Company: _______________________
Address: _________________________________________________
Date: ___________________________________________________
SECTION XI: APPLICATION TO PUBLIC PROCUREMENT ADMINISTRATIVE REVIEW BOARD
FORM RB 1

REPUBLIC OF KENYA
PUBLIC PROCUREMENT ADMINISTRATIVE REVIEW BOARD

APPLICATION NO……………OF……………20………

BETWEEN
……………………………………………………….APPLICANT
AND
…………………………………RESPONDENT (Procuring Entity)

Request for review of the decision of the…………… (Name of the Procuring Entity) of ……………dated the…day of ……………20…in the matter of Tender No……………of ……………20…

REQUEST FOR REVIEW

I/We……………………………, the above named Applicant(s), of address: Physical address…………….Fax No……Tel. No……..Email ……………, hereby request the Public Procurement Administrative Review Board to review the whole/part of the above mentioned decision on the following grounds , namely:-

1.
2.
etc.

By this memorandum, the Applicant requests the Board for an order/orders that: -

1.
2.

Etc.

SIGNED ………………. (Applicant)

Dated on…………….day of ……………/…20…

FOR OFFICIAL USE ONLY

Lodged with the Secretary Public Procurement Administrative Review Board on ……………
day of ……………20………..

SIGNED

Board Secretary