LIMURU WATER AND SEWERAGE COMPANY LIMITED

NAIROBI - NAKURU – MAU SUMMIT PPP ROAD PROJECT

Project Name:

RELOCATION OF WATER AND SEWERAGE INFRASTRUCTURE ALONG THE PROJECT ROAD

SECTION I: RIRONI – MAGUMU FLYOVER AND RIRONI – MUTARAKWA

BIDDING DOCUMENT

Tender No: LIWASCO/001/KENHA/2020/21

DATE: ……30TH MARCH, 2021……..

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PART 1 – BIDDING PROCEDURES

Section I. Invitation to Tender

INVITATION TO TENDER

DATE:

Tender reference no. LIWASCO/001/KENHA/2020/21

TENDER NAME: RELOCATION OF WATER AND SEWERAGE INFRASTRUCTURE ALONG RIRONI – MAGUMU FLYOVER AND RIRONI – MUTARAKWA (SECTION I OF NAIROBI – NAKURU – MAU SUMMIT HIGHWAY (A8)

1.1 The Government of Kenya (GoK) through its road implementing agency Kenya National Highways Authority (KeNHA) has embarked upon a Public Private Partnership (PPP) process under the Kenyan 1st mover roads PPP programme to develop the Nairobi – Nakuru – Mau Summit Highway (A8) PPP Project on Design, Build, Finance, Operate, Maintain and Transfer (DBFOMT) framework. Among the requirements for Financial Close and subsequent commencement of the road works to be met by GoK is the provision of a right of way free from encumbrances, which requires relocation of water and sewerage infrastructure within the project road reserve.

1.2 In order to carry out the relocation works, the road project has been divided into 4No sections within the jurisdiction of the various Water Service Providers (WSP) as follows:

Road Section	Road Section Name	Approx. Length (Km)	Water Service Provider
I	Rironi – Magumu Flyover and Rironi – Mutarakwa	32	Limuru Water and Sewerage Company
II	Magumu Flyover – Gilgil Weighbridge and Mtarakwa – Mai Mahiu-Naivasha.	89	Naivasha Water and Sanitation Company Limited
III	Barnabas - Njoro Turn Off	102	Nakuru Water and Sanitation Services Company Limited
IV	Gilgil Weighbridge - Barnabas and Njoro Turnoff - Mau Summit	130	Nakuru Rural Water and Sanitation Company Limited

1.3 Limuru Water and Sewerage Company invites bids from eligible bidders registered with the National Construction Authority (NCA) in Category NCA 3 (also registered with the Ministry of Water and Sanitation) for the relocation of water and sewerage infrastructure for Section I: Rironi – Magumu Flyover and Rironi – Mtarakwa to be funded by the GoK involving the following:

a) Relocation of approximately 11 Km water transmission pipeline comprising various diameters between DN 50 and DN 315

b) Driling and Equipping of a Borehole

1.4 A Bidder may either be a single entity, or a partnership of two entities, or a joint venture. A Bidder shall submit only 1 (one) Bid for the relocation works and shall not be allowed to submit another Bid, either as a single entity, or a partnership or a joint venture as the case may be in relation to this tender and other tenders advertised by the other three Water Services Providers as highlighted in Section 1.2 on the Nakuru – Nairobi – Mau Summit PPP Project.

1.5 A complete set of tender documents may be downloaded by interested tenderers at the Limuru water and Sewerage company website , www.limuruwater.go.ke

1.6 A Mandatory site visit and a pre - bid meeting shall be organized by the Employer as specified in the tender documents and shall be undertaken in compliance to the Covid – 19 Regulations.

1.7 Bidders are advised to forward any questions or clarifications on the tender to the following emails address provided in the tender document

1.8 All interested Bidders are required to continually check the Employer's website for any Tender addendum or clarifications that may arise before submission date.

1.9 Prices quoted should be net inclusive of all taxes, must be in Kenya shillings and shall remain valid for **120** days from the Bid Submission date.

1.10 Completed tender documents are to be enclosed in plain sealed envelopes marked with Tender name and reference number and deposited in the Tender Box at **Limuru Water Services and Sewerage Company, Maji Centre near the government offices, Opposite Limuru Health Centre** and addressed to

Managing Director
Limuru Water and Sewerage Company
P.O Box 1286-00217
LIMURU, KENYA

to be received on or befor**30th March 2021, 12.00pm** East African Time.

1.11 Tenders will be opened immediately thereafter in the presence of Tenderers or their representatives who choose to attend at the Limuru Water and Sewerage Company Offices Board Room

Managing Director
Limuru Water and Sewerage Company

Section II. Instructions to Bidders

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Section II. Instructions to Bidders

A. General

1. Scope of Bid

1.1 In connection with the Invitation for Bids indicated in the Bid Data Sheet (BDS), the Employer, as indicated in the BDS, issues these Bidding Documents for the procurement of Works as specified in Section IX, Works Requirements. The name and identification are provided in the BDS.

1.2 Throughout these Bidding Documents:

(a) the term "in writing" means communicated in written form and delivered against receipt;

(b) except where the context requires otherwise, words indicating the singular also include the plural and words indicating the plural also include the singular; and

(c) "day" means calendar day.

2. Fraud and Corruption

2.1 The government requires that the bidders, suppliers, sub-Contractor, and supervisors observe the highest standards of ethics during the execution of such contracts. In this pursuit of this policy, the government;

Defines for the purpose of this provision, the terms set forth below as follows:

i) "corrupt practice" means the offering, giving ,receiving, or soliciting of anything of value to influence the action of the public official in the procurement process or in the execution, and

ii) "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 Employer, and includes collusive practices among bidders (prior to or after bid submission) designed to establish bid prices at artificial, non-competitive levels and to deprive the Employer the benefits of free and open competition

The Employer Shall reject a proposal for award if it determines that the bidder recommended for award has engaged in corrupt or fraudulent practices in competing for the contract, and
The Employer Shall declare a firm ineligible, either indefinitely or for a stated period of time, to be awarded a government contract if it at any time it is determined that the firm has engaged in corrupt or fraudulent practices in competing for, or in executing, a government financed contract

3. Eligible Bidders

3.1. This invitation to bid is open to all bidders who are legally registered or incorporated in the Republic of Kenya as of the time of bid submission. Registration with the National Construction Authority (NCA) as a Contractor is mandatory.

3.2. Bidders shall not have a conflict of interest. Bidders shall be considered to have conflict of interest, if they participated as a consultant in the preparation of the design, documentation or technical specifications of the works that are the subject of this bidding other than as far as required by the Employer.

3.3. A firm that is under a declaration of eligibility by the Employer in accordance with clause 3, at the date of submission of the Bid or thereafter, shall be disqualified.

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

B. Contents of Bidding Documents

4. Sections of Bidding Documents

4.1 The Bidding Documents include all the Sections indicated below, and should be read in conjunction with any Addenda issued in accordance with ITB 7.

PART 1 Bidding Procedures

- Section I: Invitation to Bidders
- Section II. Instructions to Bidders (ITB)
- Section III. Bid Data Sheet (BDS)
- Section IV. Evaluation Criteria and Qualification Criteria
- Section V. Bidding Forms

PART 2 Conditions of Contract and Contract Forms

- Section VI. General Conditions (GC)
- Section VII. Particular Conditions (PC)
- Section VIII. Annex to the Particular Conditions - Contract Forms

PART 3 Works Requirements

- Section IX. Specification/Works Requirements
- Section X: Drawings
- Section XI: Bills of Quantities

4.2 The Employer is not responsible for the completeness of the Bidding Documents and their addenda, if they were not obtained directly from the source stated by the Employer in the Invitation for Bids.

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

5. Clarification of Bidding Documents

5.1 The prospective bidder requiring any clarification of the bidding documents may notify the Employer in writing or by cable, (hereinafter the term cable is deemed to include telex, email and facsimile) at the Employer's mailing address indicated in the BDS.

The Employer will respond in writing to any request for clarification received not later than **Fourteen (14) days** prior to bid submission date. The employer shall publish its response at the Website provided in the BDS no later than **Seven (7) days** to bid submission date.

5.2 The Bidder is advised to visit and examine the Site of Works and its surroundings and obtain for itself on its own responsibility all information that may be necessary for preparing the bid and entering into a contract for construction of the Works. The costs of visiting the Site shall be at the Bidder's own expense.

5.3 The Bidder and any of its personnel or agents will be granted permission by the Employer to enter upon its premises and lands for the purpose of such visit, but only upon the express condition that the Bidder, its personnel, and agents will release and indemnify the Employer and its personnel and agents from and against all liability in respect thereof, and will be responsible for death or personal injury, loss of or damage to property, and any other loss, damage, costs, and expenses incurred as a result of the inspection.

6. Site Visit, Pre-Bid Meeting

6.1 The bidders' designated representatives are invited to attend a **mandatory** site visit and pre- bid meeting, which will take place as indicated in the BDS. The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.

The bidders' representatives who are present shall sign a register evidencing their attendance. The Client will jointly carry out the pre-bid meeting with the pretender site visit.

6.2 The bidder is requested as far as possible to submit any questions in writing or by cable, to reach the Employer not later than five (5) days before the meeting. It may not be practicable at the meeting to answer questions received late, but questions and responses will be transmitted in accordance with the Minutes of the meeting, including the text of the questions raised and the responses given together with

any responses prepared after the meeting, will be transmitted without delay to all bidders who would have attended the meeting. Any modification of the bidding documents listed in Sub-Clause 4.1, which may become necessary because of the pre-bid meeting shall be made by the Employer exclusively through the issue of an Addendum pursuant to Clause 7 or through the minutes of the pre-bid meeting.

7. Amendment of Bidding Documents

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

7.2 Any addendum issued shall be part of the Bidding Documents and shall be communicated through Website provided in the BDS.

7.3 To give prospective Bidders reasonable time in which to take an addendum into account in preparing their bids, the Employer may extend the deadline for the submission of bids, pursuant to ITB 19.1

C. Preparation of Bids

8. Cost of Bidding

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

9. Language of Bid

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

10. Documents Comprising the Bid

10.1 The Bid shall comprise the following:

(a) Letter of Bid and Appendix to Bid

(b) completed schedules as required, including priced Bill of Quantities, in accordance with ITB 11 and 12;

(c) Bid Security, in accordance with ITB 16;

(d) alternative bids, if permissible, in accordance with ITB 12;

(e) written confirmation authorizing the signatory of the Bid to commit the Bidder, in accordance with ITB 17;

(f) documentary evidence in accordance with ITB 14 establishing the Bidder's continued qualified status or, if post-qualification applies, as indicated in accordance with ITB 3.4, the Bidder's qualifications to perform the contract if its Bid is accepted;

(g) Technical Proposal in accordance with ITB 14; and

(h) any other document required in the BDS.

10.2 In addition to the requirements under ITB 10.1, bids submitted by a JVA shall include a copy of the Joint Venture Agreement entered

into by all partners. Alternatively, a Letter of Intent to execute a Joint Venture Agreement in the event of a successful bid shall be signed by all partners and submitted with the bid, together with a copy of the proposed agreement.

11. Letter of Bid and Schedules

11.1 The Letter of Bid and Schedules, including the Bill of Quantities, shall be prepared using the relevant form*s* furnished in Section V, Bidding Forms. The forms must be completed without any alterations to the text, and no substitutes shall be accepted except as provided under ITB 21. All blank spaces shall be filled in with the information requested.

12. Alternative Bids, Bid Prices and Discounts

12.1 The bidder shall submit one offer, which complies fully with the requirements of the bidding documents.

Each bidder shall submit only one bid. A bidder who submits or participates in more than one bid will be disqualified.

A price or rate shall be entered in indelible ink against every item in the Bills of Quantities with the exception of items, which already have Prime Cost or Provisional sums affixed thereto. The bidders are reminded that no "nil" or "included" rates or "lump-sum" discounts will be accepted. The rates for various items should include discounts if any. Bidders who fail to comply will be disqualified.

13. Currencies of Bid and Payment

13.1 The currency(ies) of the bid and the currency(ies) of payments shall be **as specified in the BDS**.

14. Documents Comprising the Technical Proposal

14.1 The Bidder shall furnish a Technical Proposal including a statement of work methods, equipment, personnel, schedule and any other information as stipulated in Section V, in sufficient detail to demonstrate the adequacy of the Bidders' proposal to meet the work requirements and the completion time.

15. Period of Validity of Bids

15.1 Bids shall remain valid for the period **specified in the BDS** after the bid submission deadline date prescribed by the Employer in accordance with ITB 19. A bid valid for a shorter period shall be rejected by the Employer as non responsive.

15.2 In exceptional circumstances, prior to the expiration of the bid validity period, the Employer may request Bidders to extend the period of validity of their bids. The request and the responses shall be made in writing. If a bid security is requested in accordance with ITB 16, it shall also be extended for twenty-eight (28) days beyond the deadline of the extended validity period. A Bidder may refuse the request without forfeiting its bid security. A Bidder granting the request shall not be required or permitted to modify its bid, except as provided in ITB 18.3.

16. Bid Security

16.1 The Bidder shall furnish as part of its bid, either a Bid-Securing Declaration or a bid security **as specified in the BDS**, in original form and, in the case of a bid security, in the amount and currency **specified in the BDS**.

16.2 The bid security shall be in the form of unconditional bank guarantee from a reputable bank selected by the bidder and located in Kenya. The bid security shall remain valid for a period of thirty (30) days beyond the original validity period for the bid, and beyond any period of extension subsequently requested under ITB 19.2

16.3 If a bid security is specified pursuant to ITB 16.1, any bid not accompanied by a substantially responsive bid security or Bid-Securing Declaration shall be rejected by the Employer as non responsive.

16.4 If a bid security is specified pursuant to ITB 16.1, the bid security of unsuccessful Bidders shall be returned as promptly as possible upon the successful Bidder's furnishing of the performance security pursuant to ITB 36.

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

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

(a) if a Bidder withdraws its bid during the period of bid validity specified by the Bidder on the Letter of Bid or

(b) if the successful Bidder fails to:

(i) sign the Contract in accordance with ITB 35; or

(ii) furnish a performance security in accordance with ITB 36.

16.7 The bid security or the Bid-Securing Declaration of a JVA shall be in the name of the JVA that submits the bid. If the JVA has not been legally constituted into a legally enforceable JVA at the time of bidding, the bid security or the Bid-Securing Declaration shall be in the names of all future partners as named in the letter of intent referred to in ITB 10.2

16.8 If a bid security is **not required in the BDS** pursuant to ITB 16.1, and

(a) if a Bidder withdraws its bid during the period of bid validity specified by the Bidder on the Letter of Bid Form, except as provided in ITB 15, or

(b) if the successful Bidder fails to sign the Contract in accordance with ITB 35; or furnish a performance security in accordance with ITB 36;

the Employer may, **if provided for in the BDS**, declare the Bidder disqualified to be awarded a contract for a period of time **as stated in the BDS**.

17. Format and Signing of Bid

17.1 The Bidder shall prepare one original of the documents comprising the bid as described in ITB 4.1 and clearly mark it "ORIGINAL." In addition, the Bidder shall submit copies of the bid, in the number **specified in the BDS** and clearly mark them "COPY." In the event of any discrepancy between the original and the copies, the original shall prevail.

17.2 The original and all copies of the bid shall be typed or written in indelible ink and shall be signed by a person duly authorized to sign on behalf of the Bidder. This authorization shall consist of a written confirmation **as specified in the BDS** and shall be attached to the bid. The name and position held by each person signing the authorization must be typed or printed below the signature. All pages of the bid where entries or amendments have been made shall be signed or initialed by the person signing the bid.

17.3 A bid submitted by a JVA shall comply with the following requirements:

(a) Unless not required in accordance with ITB 10.2, be signed so as to be legally binding on all partners and

(b) Include the Representatives's authorization referred to in ITB 10.1 , consisting of a power or attorney signed by those legally authorized to sign on behalf of the JVA.

17.4 Any inter-lineation, erasures, or overwriting shall be valid only if they are signed or initialed by the person signing the bid.

D. Submission and Opening of Bids

18. Sealing and Marking of Bids

18.1 The Bidder shall enclose the original and all copies of the bid, duly marking the envelopes as "ORIGINAL" and "COPIES." These envelopes containing the original and the copies shall then be enclosed in one single envelope.

18.2 The inner and outer envelopes shall:

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

(b) be addressed to the Employer in accordance with ITB 18.1;

(c) bear the specific identification of this bidding process indicated in the BDS 1.1;

18.3 If all envelopes are not sealed and marked as required, the Employer will assume no responsibility for the misplacement or premature opening of the bid, but this should not constitute the gronds for rejection of the bid.

19. Deadline for Submission of Bids

19.1 Bids must be received by the Employer at the address and no later than the date and time **indicated in the BDS**. **When so specified in the BDS**, bidders shall have the option of submitting their bids electronically. Bidders submitting bids electronically shall follow the electronic bid submission procedures **specified in the BDS**.

19.2 The Employer may, at its discretion, extend the deadline for the submission of bids by amending the Bidding Documents in accordance with ITB 7, in which case all rights and obligations of the Employer and Bidders previously subject to the deadline shall thereafter be subject to the deadline as extended.

20. Late Bids

20.1 The Employer shall not consider any bid that arrives after the deadline for submission of bids, in accordance with ITB 19. Any bid received by the Employer after the deadline for submission of bids shall be declared late, rejected, and returned unopened to the Bidder.

21. Withdrawal, Substitution, and Modification of Bids

21.1 A Bidder may withdraw, substitute, or modify its bid after it has been submitted by sending a written notice, duly signed by an authorized representative, and shall include a copy of the authorization in accordance with ITB 10.1, (except that withdrawal notices do not require copies).

21.2 Bids requested to be withdrawn in accordance with ITB 21.1 shall be returned unopened to the Bidders.

21.3 No bid may be withdrawn, substituted, or modified in the interval between the deadline for submission of bids and the expiration of the period of bid validity specified by the Bidder on the Letter of Bid or any extension thereof.

22. Bid Opening

22.1 The Employer shall open the bids in public, in the presence of Bidders` designated representatives who choose to attend at the address, date and time **specified in the BDS**. Any specific electronic bid opening procedures required if electronic bidding is permitted in accordance with ITB 19.1, shall be **as specified in the BDS.**

22.2 The bids shall be opened one at a time, reading out: the name of the Bidder; the Bid Price(s), the presence or absence of a bid security, if required; and any other details as the Employer may consider appropriate. No bid shall be rejected at bid opening except for late bids, in accordance with ITB 20.1.

22.3 The Employer shall prepare a record of the bid opening that shall include, as a minimum: the name of the Bidder; the Bid Price and the presence or absence of a bid security, if one was required.

E. Evaluation and Comparison of Bids

23. Confidentiality

23.1 Information relating to the evaluation of bids and recommendation of contract award shall not be disclosed to Bidders or any other persons not officially concerned with such process until information on Contract award is communicated to all Bidders.

23.2 Any attempt by a Bidder to influence the Employer in the evaluation of the bids or Contract award decisions may result in the rejection of its bid.

23.3 Notwithstanding ITB 23.2, from the time of bid opening to the time of Contract award, if any Bidder wishes to contact the Employer on any matter related to the bidding process, it may do so in writing.

24. Clarification of Bids

24.1 To assist in the examination, evaluation, and comparison of the bids, and qualification of the Bidders, the Employer may, at its discretion, ask any Bidder for a clarification of its bid. Any clarification submitted by a Bidder that is not in response to a request by the Employer shall not be considered. The Employer's request for clarification and the response shall be in writing. No change in the prices or substance of the bid shall be sought, offered, or permitted.

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

25. Deviations, Reservations, and Omissions

25.1 During the evaluation of bids, the following definitions apply:

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

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

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

26. Determination of Responsiveness

26.1 The Employer's determination of a bid's responsiveness is to be based on the contents of the bid itself, as defined in ITB10.

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

(a) if accepted, would

(i) affect in any substantial way the scope, quality, or performance of the Works specified in the Contract; or

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

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

(c) has arithmetic errors in the bills of quantities

26.3 The Employer shall examine the technical aspects of the bid submitted in accordance with ITB 14, Technical Proposal, in particular, to confirm that all requirements of Section IX, Works Requirements have been met without any material deviation, reservation or omission.

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

27. Nonmaterial Nonconformities

27.1 Provided that a bid is substantially responsive, the Employer may waive any nonconformities in the bid that do not constitute a material deviation, reservation or omission.

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

28. Margin of Preference

28.1 **Unless otherwise specified in the BDS**, a margin of preference shall not apply.

29. Evaluation of Bids

29.1 The Employer shall use the criteria and methodologies listed in this Clause 29. No other evaluation criteria or methodologies shall be permitted.

29.2 To evaluate a bid, the Employer shall consider the following:

(a) the bid price, excluding Provisional Sums and the provision, if any, for contingencies in the Summary Bill of Quantities, but including Daywork items, where priced competitively;

(b) the evaluation criteria indicated in Section IV: Evaluation and Qualification Criteria;

29.3 The estimated effect of the price adjustment provisions of the Conditions of Contract, applied over the period of execution of the Contract, shall not be taken into account in bid evaluation.

29.4 If the bid, which results in the lowest Evaluated Bid Price, is seriously unbalanced or front loaded in the opinion of the Employer, the Employer may require the Bidder to produce detailed price analyses for any or all items of the Bill of Quantities, to demonstrate the internal consistency of those prices with the construction methods and schedule proposed. After evaluation of the price analyses, taking into consideration the schedule of estimated Contract payments, the Employer may require that the amount of the performance security be increased at the expense of the Bidder to a level sufficient to protect the Employer against financial loss in the event of default of the successful Bidder under the Contract.

30. Comparison of Bids

30.1 The Employer shall compare all substantially responsive bids in accordance with ITB 26.2 to determine the lowest evaluated bid.

31. Qualification of the Bidder

31.1 The Employer shall determine to its satisfaction whether the Bidder that is selected as having submitted the lowest evaluated and substantially responsive bid either continues to meet (if prequalification applies) or meets (if postqualification applies) the qualifying criteria specified in Section IV, Evaluation and Qualification Criteria.

31.2 The determination shall be based upon an examination of the documentary evidence of the Bidder's qualifications submitted by the Bidder, pursuant to ITB 14.1.

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

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

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

F. Award of Contract

33. Award Criteria

33.1 Subject to ITB 32.1, the Employer shall award the Contract to the Bidder whose offer has been determined to be the lowest evaluated bid and is substantially responsive to the Bidding Document, provided further that the Bidder is determined to be qualified to perform the Contract satisfactorily.

34. Notification of Award

34.1 Prior to the expiration of the period of bid validity, the Employer shall notify the successful Bidder, in writing, that its bid has been accepted. The notification letter (hereinafter and in the Conditions of Contract and Contract Forms called the "Letter of Acceptance") shall specify the sum that the Employer will pay the Contractor in consideration of the execution and completion of the Works (hereinafter and in the Conditions of Contract and Contract Forms called "the Contract Price") and the requirement for the Contractor to remedy any defects therein as prescribed by the Contract. At the same time, the Employer shall also notify all other Bidders of the results of the bidding and shall publish in Public Procurement Information Portal identifying the bid and the following information:

(i) name of each Bidder who submitted a Bid;
(ii) bid prices as read out at Bid Opening;
(iii) name and evaluated prices of each Bid that was evaluated;
(iv) name of bidders whose bids were rejected and the reasons for their rejection; and
(v) name of the successful Bidder, and the Price it offered, as well as the duration and summary scope of the contract awarded.

34.2 The Employer shall promptly respond in writing to any unsuccessful Bidder who, after notification of award in accordance with ITB 34.1, requests in writing the grounds on which its bid was not selected.

35. Signing of Contract

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

35.2 Within fourteen (14) days of receipt of the Contract Agreement, the successful Bidder shall sign, date, and return it to the Employer.

36. Performance Security

36.1 Within fourteen (14) days days of the receipt of notification of award from the Employer, the successful Bidder shall furnish the performance security in accordance with the General Conditions of Contract, subject to ITB 26, using the Performance Security Form included in Section V

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

Section III. Bid Data Sheet

A. Introduction	
ITB 1.1	The number of the Invitation for Bids is : **LIWASCO/001/KENHA/2020/21**
ITB 1.1	The Employer is: **Limuru Water and Sewerage Company Limited**
ITB 1.1	The name of the NCB is: **LIWASCO/001/KENHA/2020/21** The number and identification of lots (contracts) comprising this NCB is: **N/A**
ITB 1.1	The name of the Project is: **RELOCATION OF WATER AND SEWERAGE PIPES ALONG THE PROJECT ROAD SECTION I: RIRONI – MAGUMU FLYOVER AND RIRONI – MUTARAKWA**
ITB 4.1 (a)	The individuals or firms in a joint venture or association **shall be** jointly and severally liable.
B. Bidding Documents	
ITB 5.1	For **clarification purposes** only, the Employer's address is: **Managing Director** *Limuru Water and Sewerage Company* *P.O. Box 1286-00217* *LIMURU* Telephone: 0725 054 212 Facsimile number: N/A Electronic mail address: proc@limuruwater.go.ke
ITB 6.1	A Pre-Bid meeting **shall** take place at the following date, time and place:19th March, 2021 at 10:00 a.m EAT
C. Preparation of Bids	
ITB 9.1	The language of the bid is: **English**
ITB 10.1 (h)	The Bidder shall submit with its bid the following additional documents: • Schedule of Proposed Personnel (See Technical Proposal forms PER-1 and PER-2) • Schedule of Equipment to be used on the Contract (See Technical Proposal Forms) • Site Organization Chart • Method Statement • Mobilization Schedule • Construction Schedule – should be presented as a Ghant Chart • Schedule of Cash Flow – should be based on the outline Programme for execution of the whole of the Works

	• Schedule of Material / Equipment Suppliers for the following Key Materials / Equipment: (i) HDPE Pipes and assorted fittings (ii) Air Valves/SluiceValves (iii) Water Meters / Strainers (iv) GI Pipes
ITB 12.1	Alternative bids **shall not be** permitted.
ITB 13.1	The currency (ies) of the bid and the payment currency (ies) shall be in **Kenya Shillings**.
ITB 15.1	The bid validity period shall be **120** days.
ITB 16.1	A bid security **is** required. A Bid-Securing Declaration **is not** required. The amount and currency of the bid security shall be **2% of the Tender Sum in Kenya Shillings**
ITB 17.1	In addition to the original of the bid, the number of copies is: **Three (3)**
ITB 17.2	The written confirmation of authorization to sign on behalf of the Bidder shall consist of: ***(a) Documentation to demonstrate the authority of the signatory to sign the Bid such as a Power of Attorney; and*** ***(b) In the case of Bids submitted by an existing or intended JV an undertaking signed by all parties (i) stating that all parties shall be jointly and severally liable, if so required in accordance with ITB 4.1(a), and ITB 17.3 (b) nominating a Representative who shall have the authority to conduct all business for and on behalf of any and all the parties of the JV during the bidding process and, in the event the JV is awarded the Contract, during contract execution.***
D. Submission and Opening of Bids	
ITB 19.1	For **bid submission purposes** only, the Employer's address is : Managing Director, Limuru Water and Sewerage Co. Ltd P.O. Box 1286-00217 LIMURU, KENYA Street Address: : **(***Maji Center, Opp. Limuru Health Center***)** City: *Limuru* Country: **Kenya** **The deadline for bid submission is:** Date: : **(30th March, 2021** Time: : **(***12:00 P.m EAT***)** Bidders **shall not** have the option of submitting their bids electronically. If bidders have the option of submitting their bids electronically, the electronic

	bidding submission procedures shall be: **N/A** Bids should be submitted in sealed envelopes as follows: (i) The Bidder shall seal the Original and Copies of the Bid in an Inner Envelope duly marking the cover of the Bid in INK as **"ORIGINAL"** and **"COPY"**. The Inner Envelope shall be addressed to the Employer's address given above and bear the following identification: **BID FOR:** **Project Name: RELOCATION OF WATER AND SEWERAGE INFRASTRUCTURE ALONG THE PROJECT ROAD SECTION I: RIRONI – MAGUMU FLYOVER AND RIRONI – MUTARAKWA** **Tender No. LIWASCO/001/KENHA/2020/21** **DO NOT OPEN BEFORE 12.00 P.M East African Time ON ……** (Bidder to insert date of Tender Opening) In addition the inner envelope shall indicate the name and address of the Bidder to enable the Tender to be returned unopened in case it is declared "late" pursuant to Clause 23 of Instructions to Bidders. (ii) The sealed Inner Envelope shall be enclosed in an Outer Envelope which shall be addressed to the Employer's address given above and bearing the following identification: **BID FOR:** **Project Name: RELOCATION OF WATER AND SEWERAGE INFRASTRUCTURE ALONG THE PROJECT ROAD SECTION I: RIRONI – MAGUMU FLYOVER AND RIRONI – MUTARAKWA** **Tender No. LIWASCO/001/KENHA/2020/21** (Bidder to insert date of Tender Opening) **The outer envelope shall not contain any inscriptions which reveals the identity of the Bidder**. If the outer envelope is not sealed and marked as above, the Employer will assume no responsibility for the misplacement or premature opening of the Bid. A Bid opened prematurely for this cause will be rejected by the Employer and returned to the Bidder.

ITB 22.1	The bid opening shall take place at: Limuru Water and Sewerage Company P.O. Box 1286-00217 **LIMURU, KENYA** Street Address: **Maji Center, Opp. Limuru Health Center** City: **Limuru** Country: **Kenya** Date: : **30TH March, 2021.** Time: : **12.00 PM East African Time** If bidders have the option of submitting their bids electronically, the electronic bid opening procedures shall be: **N/A**
E. Evaluation, and Comparison of Bids	
ITB 28.1	A margin of preference **shall not** apply.

Section IV. Evaluation and Qualification Criteria

This section contains all the criteria that the Employer shall use to evaluate bids and qualify Bidders if the bidding was not preceded by a prequalification exercise and postqualification is applied. In accordance with ITB 34 and ITB 36, no other methods, criteria and factors shall be used. The Bidder shall provide all the information requested in the forms included in Section 4 (Bidding Forms).

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1. Evaluation

In addition to the criteria listed in ITB 26 the following criteria shall apply:

1.1 Adequacy of Technical Proposal

Evaluation of the Bidder's Technical Proposal will include an assessment of the Bidder's technical capacity to mobilize key equipment and personnel for the contract consistent with its proposal regarding work methods, scheduling, and material sourcing in sufficient detail and fully in accordance with the requirements stipulated in Section IX (Employer's Requirements).

2. Qualification

Factor	2.1 Eligibility					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture, Consortium or Association			
			All partners combined	Each partner	At least one partner	
2.1.1 Conflict of Interest	No- conflicts of interests as described in ITB 3.2.	Must meet requirement	Existing or intended JV must meet requirement	Must meet requirement	N / A	Letter of Bid

Factor	2.2 Historical Contract Non-Performance					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture, Consortium or Association			
			All partners combined	Each partner	At least one partner	
2.2.1 History of non-performing contracts	Non-performance of a contract did not occur within the last **Five (5)** years prior to the deadline for application submission, based on all information on fully settled disputes or litigation. A fully settled dispute or litigation is one that has been resolved in accordance with the Dispute Resolution Mechanism under the respective contract, and where all appeal instances available to the bidder have been exhausted.	Must meet requirement by itself or as partner to past or existing JV	N / A	Must meet requirement by itself or as partner to past or existing JV	N / A	Form CON - 2
2.2.2 Pending Litigation	All pending litigation shall in total not represent more than **Hundred Percent (100%)** of the Bidder's net worth and shall be treated as resolved against the Bidder.	Must meet requirement by itself or as partner to past or existing JV	N / A	Must meet requirement by itself or as partner to past or existing JV	N / A	Form CON – 2

Factor	2.3 Financial Situation					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture, Consortium or Association			
			All partners combined	Each partner	At least one partner	
2.3.1 Historical Financial Performance	Submission of audited financial statement, for the last **Three [3]** years to demonstrate the current soundness of the bidders financial position and its prospective long term profitability.	Must meet requiremen	N / A	Must meet requirement	N / A	Form FIN – 3.1 with attachments
2.3.2. Average Annual Turnover	Minimum average annual turnover of **Kshs. 200,000,000 (Kenya Shillings Three Hundred Million) or equivalent in a freely convertible currency,** calculated as total **certified** payments received for contracts in progress or completed, within the last **Three (3)** years	Must meet requirement	Must meet requirement	Must meet **atleast Fifty percent (50%)** of the requirement	N / A	Form FIN –3.2

Factor	2.3 Financial Situation					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture, Consortium or Association			
			All partners combined	Each partner	At least one partner	
2.3.3. Financial Resources	The Bidder must demonstrate access to, or availability of, financial resources such as liquid assets, lines of credit, and other financial means, other than any contractual advance payments to meet: (i) the following cash-flow requirement: **Cash Flow of Kshs. 100,000,000 (Kenya Shillings One Hundred Million),** and (ii) the overall cash flow requirements for this contract and its concurrent commitments.	Must meet requirement	Must meet requirement	Must meet **fifty percent (50%)** of the requirement	N/A	Form FIN –3.3

Factor	*2.4 Experience*					
Sub-Factor	***Criteria***					***Documentation Required***
	Requirement	***Bidder***				
		Single Entity	***Joint Venture, Consortium or Association***			
			All partners combined	***Each partner***	***At least one partner***	
2.4.1 General Experience	Experience under contracts in the role of contractor, subcontractor, or management contractor for at least the last **Five (5)** years prior to the applications submission deadline	Must meet requirement	N / A	N / A	Must meet requirement	Form EXP-4.1
2.4.2 Specific Experience	(a)Participation as contractor, management contractor, or subcontractor, in at least **Three similar (3)** contracts within the last **Five (5)** years, each with a value of at least **Kshs. 150,000,000 (Kenya Shillings One Hundred and Fifty Million** that have been successfully and substantially completed (attach completion cerificates) and that are similar to the proposed Works. The similarity shall be based on the physical size, complexity or methods/technology	Must meet requirement	Must meet requirements for all characteristics	N / A	Must meet requirement for all characteristic	Form EXP 2.4.2(a)

Factor	*2.4 Experience*					
Sub-Factor	***Criteria***					***Documentation Required***
	Requirement	***Bidder***				
		Single Entity	***Joint Venture, Consortium or Association***			
			All partners combined	***Each partner***	***At least one partner***	
2.4.2 Specific Experience	b) For the above or other contracts executed during the period stipulated in 2.4.2(a) above, a minimum experience in the following key activities: **a) Experience in Laying of Water Supply and Sewer Pipelines** Contractor should have laid uPVC / Ferrous Pipes/HDPE, size between 100mm for uPVC and upto 1000mm dia. and above.	Must meet requirements	Must meet requirements	N / A	Must meet requirements	Form EXP-2.4.2(b)

2.5 Personnel

The Bidder must demonstrate that it will have the personnel for the key positions that meet the following requirements:

No.	Position	Total Work Experience (years)	In Similar Works Experience (years)
1	Project Manager – 1 Nr. Person	15	5
2	Site Agent – 1 Nr. Person	10	5
3	Deputy Site Agent – 1Nr. Person	8	5
4	Pipeline Engineer (Civil Engineer) – 1 Nr. Person	8	5
5	Foreman (Pipelaying, Testing) – 2Nr. Persons	8	5
6	Engineering Surveyor – 2Nr. Persons	5	2
7	CAD Technician 1Nr.Persons	5	3

The Bidder shall provide details of the proposed personnel and their experience records in the relevant Forms included in Section V, Bidding Forms.

2.6 Equipment

The Bidder must demonstrate that it will have access to the key Contractor's equipment listed hereafter:

No.	Equipment Type and Characteristics	Minimum Number required
1	7 / 10 ton Tipper Lorry	2
2	Concrete Mixers (0.4m^3)	3
3	Concrete Vibrator (50mm)	3
4	Pick-Up	3
5	Rock Breakers	2
6	Mechanical Pressure Testing Equipment	2
7	Back Hoe Excavator	3
8	Portable De-Watering Pumps	2
9	Crane – 25 Tons	1
10	Excavator, 0.4 m^3, > 70 kW	2
11	Excavator, 0.4 m^3, < 70 kW	2
12	Crane able to lift 15tons	1

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

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Bid Submission Sheet

Date: _____
NCB No.:
Tender No: LIWASCO/001/KENHA/2020/21
Invitation for Bid No.: _____

To: The Managing Director,
Limuru Water and Sewerage Company
P.O. Box 1286-00217
LIMURU, KENYA

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Bidding Document, including Addenda issued in accordance with Instructions to Bidders (ITB);

We offer to execute in conformity with the Bidding Document the following Works:
RELOCATION OF WATER AND SEWERAGE PIPES ALONG THE PROJECT ROAD SECTION I: RIRONI – MAGUMU FLYOVER AND RIRONI – MUTARAKWA

(b) **Contract No. LIWASCO/001/KENHA/2020/21**

(c) The total price of our Bid is:

Including Duties and Taxes:
KShs. _____ (figures) Kenya Shillings
_____
_____(words);

(d) Our bid shall be valid for a period of _____ days from the date fixed for the bid submission deadline in accordance with the Bidding Document, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

(e) If our bid is accepted, we commit to obtain a performance security in accordance with the Bidding Document;

(f) We, including any subcontractors or suppliers for any part of the contract, do not have any conflict of interest in accordance with ITB 3.2;

(g) We are not participating, as a Bidder or as a subcontractor, in more than one bid for this tender or any other tender under **Nairobi-Nakuru-Mau Summit PPP Project (Relocation of water and sewerage infrastructure)**.

(h) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive.

(i) We hereby certify that we have taken steps to ensure that no person acting for us or on our behalf will engage in bribery.

Name _____ In the capacity of _____

Signed _____

Duly authorized to sign the bid for and on behalf of _____

Dated on _____ day of _____

Appendix to Bid

Schedule of Adjustment Data

Not Used (Not Applicable)

Table B. Foreign Currency (FC)

Not Applicable

Table C. Summary of Payment

For ……..[insert name of Section of the Works]

Description	**Amount in Kenya Shillings**
Amount in Bid Submission Form	
Less V.A.T	
Less Provisional Sums and Contigency	
Net Bid Price	

Technical Proposal

Technical Proposal

- **Site Organization**
- **Method Statement**
- **Mobilization Schedule**
- **Construction Schedule**
- **Equipment**
- **Others**

In addition to the above the Bidder shall submit with its bid the following additional information / documents:

- Schedule of Projected Cash Flow – should be based on the outline Programme for execution of the whole of the Works
- Schedule of Material/Equipment Suppliers for the following key materials/equipment:

  (i) Ferrous Pipes
  (ii) HDPE Pipes
  (iii) uPVC Pressure Pipes
  (iv) Valves (Air, Sluice, Gate)
  (v) Water Meters / Strainers

Site Organization

Bidder to provide brief descrition of Site Organization, including Organization Chart showing duties and responsibilities, lines of reporting and hierarchy including any suppliers. Chart should clearly show details of Project Management and Planning and details of Bidder's Health Safety and Environmental Management.

Failure to provide adequate details may result in rejection of the Bid.

Method Statement

The Bidder shall provide a Method Statement with his Bid showing how he proposes to execute the Works, including but not limited to:

1. Hoarding of site
2. Occupational Health and Safety
3. Environmental Management
4. Contractor's Offices, Camp, Welfare and Storage Facilities
5. Public Safey / Public Relations
6. Project Planning and Management
7. Construction of Pipelines, including protection / support of deep trench excavation faces
8. Traffic Management including working in streets which have to remain open to traffic and in narrow spaces
9. Excavation, both in hard and soft
10. Interconnection between existing and new Distribution Mains including allowing for continuity of water supply and sewer diversion whilst the interconnection is being carried out
11. Any other Method Statement required by specific items in the Bills of Quantities

Failure to provide adequate details may result in rejection of the Bid.

Mobilization Schedule

The Bidder shall indicate the times required for mobilization including, where necassary, importation into Kenya of Key Ítems of plant and equipment to be used in the Works, Establishment of Site Offices and other Facilities, Mobilization of Staff and Labour, etc.

Failure to provide adequate details may result in rejection of the Bid.

Construction Schedule

This should be an outline Programme for execution of the whole of the Works and should be presented as a Ghant Chart.

Form EQU: Equipment

The Bidder shall provide adequate information to demonstrate clearly that it has the capability to meet the requirements for the key equipment listed in Section IV, Evaluation and Qualification Criteria. A separate Form shall be prepared for each item of equipment listed, or for alternative equipment proposed by the Bidder.

Item of equipment		
Equipment information	Name of manufacturer	Model and power rating
	Capacity	Year of manufacture
Current status	Current location	
	Details of current commitments	
Source	Indicate source of the equipment ☐ Owned ☐ Rented ☐ Leased ☐ Specially manufactured	

Omit the following information for equipment owned by the Bidder.

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

Personnel

Form PER-1: Proposed Personnel

Bidders should provide the names of suitably qualified personnel to meet the specified requirements stated in Section IV. The data on their experience should be supplied using the Form below for each candidate.

1.	**Title of position***
	Name
2.	**Title of position***
	Name
3.	**Title of position***
	Name
4.	**Title of position***
	Name
5.	**Title of position***
	Name
6.	**Title of position***
	Name
7.	**Title of position***
	Name
8.	**Title of position***
	Name

*As listed in Section IV.

Form PER-2: Resume of Proposed Personnel

Name of Bidder

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

Summarize professional experience over the last 20 years, in reverse chronological order. Indicate particular technical and managerial experience relevant to the project.

From	**To**	**Company / Project / Position / Relevant technical and management experience**

Bidder's Qualification

To establish the qualifications to perform the Contract in accordance with Section IV (Evaluation and Qualification Critiria), the bidder shall provide the information requested in the corresponding information sheets included hereunder.

Form ELI - 1: Bidder Information Sheet

Bidder Information	
Bidder's legal name	
In case of JV, legal name of each partner	
Bidder's country of constitution	
Bidder's year of constitution	
Bidder's legal address in country of constitution	
Bidder's authorized representative (name, address, telephone numbers, fax numbers, e-mail address)	

Attached are copies of the following original documents.

- ❑ 1. In case of single entity, articles of incorporation or constitution of the legal entity named above, in accordance with ITB 4.1 and 4.2.
- ❑ 2. Authorization to represent the firm or JV named in above, in accordance with ITB 17.3
- ❑ 3. In case of JV, letter of intent to form JV or JV agreement, in accordance with ITB 4.1.

Form ELI - 2: JV Information Sheet

Each member of a JV must fill in this form

JV / Specialist Subcontractor Information	
Bidder's legal name	
JV Partner's or Subcontractor's legal name	
JV Partner's or Subcontractor's country of constitution	
JV Partner's or Subcontractor's year of constitution	
JV Partner's or Subcontractor's legal address in country of constitution	
JV Partner's or Subcontractor's authorized representative information **(name, address, telephone numbers, fax numbers, e-mail address)**	
Attached are copies of the following original documents. ❑ 1. Articles of incorporation or constitution of the legal entity named above, in accordance with ITB 4.1 and 4.2. ❑ 2. Authorization to represent the firm named above, in accordance with ITB 17.3.	

Form CON – 2: Historical Contract Non-Performance

[The following table shall be filled in for the Bidder and for each partner of a Joint Venture]

Bidder's Legal Name: _____
Date: _____
Joint Venture Party Legal Name: _____
Project Name: _____
Page _____ of _____ pages

Non-Performing Contracts in accordance with Section IV, Qualification Criteria and Requirements			
☐ Contract non-performance did not occur during the 5 years specified in Section IV, Qualification Criteria and Requirements, Sub-Factor 2.2.1. ☐ Contract(s) not performed during the 5 years specified in Section IV, Qualification Criteria and Requirements, requirement 2.2.1			
Year	**Non performed portion of contract**	**Contract Identification**	**Total Contract Amount (current value, Kshs equivalent)**
		Contract Identification: Name of Employer: Address of Employer: Reason(s) for non performance:	
Pending Litigation, in accordance with Section IV, Qualification Criteria and Requirements			
☐ No pending litigation in accordance with Section IV, Qualification Criteria and Requirements, Sub-Factor 2.2.2. ☐ Pending litigation in accordance with Section IV, Qualification Criteria and Requirements, Sub-Factor 2.2.2 as indicated below.			
Year	**Outcome as Percentage of Total Assets**	**Contract Identification**	**Total Contract Amount (current value, Kshs equivalent)**
		Contract Identification: Name of Employer:*]* Address of Employer: Matter in dispute:	

Form FIN-1: Financial Situation

Each Bidder or member of a JV must fill in this form

	Financial Data for Previous 3 Years [Kshs]		
	Year 1:	**Year 2:**	**Year 3:**
Information from Balance Sheet			
Total Assets			
Total Liabilities			
Net Worth			
Current Assets			
Current Liabilities			
Information from Income Statement			
Total Revenues			
Profits Before Taxes			
Profits After Taxes			

❑ Attached are copies of audited financial statements for the last three years, as indicated above, complying with the following conditions.

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

Form FIN-2: Average Annual Construction Turnover

Each Bidder or member of a JV must fill in this form

Annual Turnover Data for the Last 3 Years (Construction only)			
Year	**Amount Currency**	**Exchange Rate**	**Kshs**
	Average Annual Construction Turnover		

The information supplied should be the Annual Turnover of the Bidder or each member of a JV in terms of the amounts billed to clients for each year for work in progress or completed, converted to Kshs at the rate of exchange at the end of the period reported.

Form FIN-3: Financial Resources

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

No.	Source of financing	Amount (Kshs)
1		
2		
3		

Form FIN-4: Current Contract Commitments / Works in Progress

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

Name of contract	Employer, contact address	Value of outstanding work (Kshs)	Estimated completion date	
1.				
2.				
3.				
4.				
5.				
etc.				

Form of Bid Security

(Bank Guarantee)

Note: The bidder shall complete this form of Bank guarantee. No other Form of Bid Security will be accepted. Bidders who fail to comply with this requirement will be disqualified.

WHEREAS [*Name of bidder*]. ……

……

(herein after called "the Bidder") has submitted his bid dated

……..……..... for the

RELOCATION OF WATER PIPES AND SEWERAGE INFRASTRUCTURE ALON THE PROJECT ROAD SECTION I: RIRONI – MAGUMU FLYOVER AND RIRONI – MUTARAKWA
Tender No: LIWASCO/001/KENHA/2020/21

, hereinafter called "the bid"

KNOW ALL MEN by these presents that we [*Name of Bank*]

……

……

of [Name of Country]

……

having our registered offices at

……
(hereinafter called the Bank) are bound unto the Managing Director, Limuru Water and sewerage Company, (hereinafter called "the Employer") in the sum of

(in words Kshs)…….

……

(In figures Kshs)……

for which payment will be well and truly made to the said Employer the Bank binds itself, its successors and assigns by these presents.

SEALED with the common Seal of the said Bank this …..…… day of 20……..

THE CONDITIONS of this obligation are:

If the bidder withdraws his Bid during the period of bid validity specified by the Bidder on the Bid Form; or

If the Bidder having been notified of the acceptance of his bid by the Employer during the period of Bid Validity

(i) fails or refuses to execute the Form of Agreement in accordance with the Instructions to Tenderers when required or

(ii) fails or refuses to furnish the Performance Security, in accordance with the Instructions to Bidders.

We undertake to pay to the Employer up to the above amount upon receipt of his first written demand, without the Employer having to substantiate his demand, provided that in his demand the Employer will note that the amount claimed by him is due to him owing to the occurrence of any of the above conditions, specifying the occurred condition or conditions.

This guarantee will remain in force up to and including thirty days after the date of expiration of the bid validity, as stated in the Instructions to Bidders.

At the request of the Employer the Bid validity period may be extended by mutual agreement between the Employer and the Bidder and we undertake to extend the validity of this surety accordingly without you having to inform us of such an extension of the Bid validity period if within this period the Bidder has been notified of the acceptance of his Bid. This Surety shall remain valid up to the time the Contract Agreement has been executed.

SIGNATURE AND SEAL OF THE BANK

……..

NAME OF SIGNATORY ……DATE……

NAME OF THE WITNESS ……..

SIGNATURE OF THE WITNESS …… DATE ……

ADDRESS OF THE WITNESS …….

PART 2 – CONDITIONS OF CONTRACT AND CONTRACT FORMS

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Section VI. General Conditions (*GC*)

RELOCATION OF WATER AND SEWERAGE INFRASTRUCTURE ALONG THE PROJECT ROAD:
SECTION I: RIRONI – MAGUMU FLYOVER AND RIRONI – MUTARAKWA

Contract No: LIWASCO/001/KENHA/2020/21

General Conditions

1. General Provisions

1.1 Definitions

In the Conditions of Contract ("these Conditions"), which include Particular Conditions, Parts A and B, and these General Conditions, the following words and expressions shall have the meanings stated. Words indicating persons or parties include corporations and other legal entities, except where the context requires otherwise.

1.1.1 The Contract

1.1.1.1 "Contract" means the Contract Agreement, the Letter of Acceptance, the Letter of Tender, these Conditions, the Specification, the Drawings, the Schedules, and the further documents (if any) which are listed in the Contract Agreement or in the Letter of Acceptance.

1.1.1.2 "Contract Agreement" means the contract agreement referred to in Sub-Clause 1.6 [Contract Agreement].

1.1.1.3 "Letter of Acceptance" means the letter of formal acceptance, signed by the Employer, of the Letter of Tender, including any annexed memoranda comprising agreements between and signed by both Parties. If there is no such letter of acceptance, the expression "Letter of Acceptance" means the Contract Agreement and the date of issuing or receiving the Letter of Acceptance means the date of signing the Contract Agreement.

1.1.1.4 "Letter of Tender" means the document entitled letter of tender or letter of bid, which was completed by the Contractor and includes the signed offer to the Employer for the Works.

1.1.1.5 "Specification" means the document entitled specification, as included in the Contract, and any additions and modifications to the specification in accordance with the Contract. Such document specifies the Works.

1.1.1.6 "Drawings" means the drawings of the Works, as included in the Contract, and any additional and modified drawings issued by (or on behalf of) the Employer in accordance with the Contract.

1.1.1.7 "Schedules" means the document(s) entitled schedules, completed by the Contractor and submitted with the Letter of Tender, as included in the Contract. Such document may include the Bill of Quantities, data, lists, and schedules of rates and/or prices.

1.1.1.8 "Tender" means the Letter of Tender and all other documents which the Contractor submitted with the Letter of Tender, as included in the Contract.

1.1.1.9 "Bill of Quantities", "Daywork Schedule" and "Schedule of Payment Currencies" mean the documents so named (if any)

which are comprised in the Schedules.

1.1.1.10 "Contract Data" means the pages completed by the Employer entitled contract data which constitute Part A of the Particular Conditions.

1.1.2 Parties and Persons

1.1.2.1 "Party" means the Employer or the Contractor, as the context requires.

1.1.2.2 "Employer" means the person named as employer in the Contract Data and the legal successors in title to this person.

1.1.2.3 "Contractor" means the person(s) named as contractor in the Letter of Tender accepted by the Employer and the legal successors in title to this person(s).

1.1.2.4 "Engineer" means the person appointed by the Employer to act as the Engineer for the purposes of the Contract and named in the Contract Data, or other person appointed from time to time by the Employer and notified to the Contractor under Sub-Clause 3.4 [Replacement of the Engineer].

1.1.2.5 "Contractor's Representative" means the person named by the Contractor in the Contract or appointed from time to time by the Contractor under Sub-Clause 4.3 [Contractor's Representative], who acts on behalf of the Contractor.

1.1.2.6 "Employer's Personnel" means the Engineer, the assistants referred to in Sub-Clause 3.2 [Delegation by the Engineer] and all other staff, labour and other employees of the Engineer and of the Employer; and any other personnel notified to the Contractor, by the Employer or the Engineer, as Employer's Personnel.

1.1.2.7 "Contractor's Personnel" means the Contractor's Representative and all personnel whom the Contractor utilises on Site, who may include the staff, labour and other employees of the Contractor and of each Subcontractor; and any other personnel assisting the Contractor in the execution of the Works.

1.1.2.8 "Subcontractor" means any person named in the Contract as a subcontractor, or any person appointed as a subcontractor, for a part of the Works; and the legal successors in title to each of these persons.

1.1.2.9 "DB" means the person or three persons appointed under Sub-Clause 20.2 [Appointment of the Dispute Board] or Sub-Clause 20.3 [Failure to Agree on the Composition of the Dispute Board]

1.1.2.10 "FIDIC" means the Fédération Internationale des Ingénieurs-Conseils, the international federation of consulting engineers.

1.1.2.11 "Bank" means the financing institution (if any) named in the Contract Data.

1.1.2.12 "Borrower" means the person (if any) named as the borrower in the Contract Data.

1.1.3 Dates, Tests, Periods and Completion

1.1.3.1 "Base Date" means the date 28 days prior to the latest date for submission of the Tender.

1.1.3.2 "Commencement Date" means the date notified under Sub-Clause 8.1 [Commencement of Works].

1.1.3.3 "Time for Completion" means the time for completing the Works or a Section (as the case may be) under Sub-Clause 8.2 [Time for Completion], as stated in the Contract Data (with any extension under Sub-Clause 8.4 [Extension of Time for Completion]), calculated from the Commencement Date.

1.1.3.4 "Tests on Completion" means the tests which are specified in the Contract or agreed by both Parties or instructed as a Variation, and which are carried out under Clause 9 [Tests on Completion] before the Works or a Section (as the case may be) are taken over by the Employer.

1.1.3.5 "Taking-Over Certificate" means a certificate issued under Clause 10 [Employer's Taking Over].

1.1.3.6 "Tests after Completion" means the tests (if any) which are specified in the Contract and which are carried out in accordance with the Specification after the Works or a Section (as the case may be) are taken over by the Employer.

1.1.3.7 "Defects Notification Period" means the period for notifying defects in the Works or a Section (as the case may be) under Sub-Clause 11.1 [Completion of Outstanding Work and Remedying Defects], which extends over twelve months except if otherwise stated in the Contract Data (with any extension under Sub-Clause 11.3 [Extension of Defects Notification Period]), calculated from the date on which the Works or Section is completed as certified under Sub-Clause 10.1 [Taking Over of the Works and Sections].

1.1.3.8 "Performance Certificate" means the certificate issued under Sub-Clause 11.9 [Performance Certificate].

1.1.3.9 "day" means a calendar day and "year" means 365 days.

1.1.4 Money and Payments

1.1.4.1 "Accepted Contract Amount" means the amount accepted in the Letter of Acceptance for the execution and completion of the Works and the remedying of any defects.

1.1.4.2 "Contract Price" means the price defined in Sub-Clause 14.1 [The Contract Price], and includes adjustments in accordance with the Contract.

1.1.4.3 "Cost" means all expenditure reasonably incurred (or to be incurred) by the Contractor, whether on or off the Site, including overhead and similar charges, but does not include profit.

1.1.4.4 "Final Payment Certificate" means the payment certificate issued under Sub-Clause 14.13 [Issue of Final Payment Certificate].

1.1.4.5 "Final Statement" means the statement defined in Sub-Clause 14.11 [Application for Final Payment Certificate].

1.1.4.6 "Foreign Currency" means a currency in which part (or all) of the Contract Price is payable, but not the Local Currency.

1.1.4.7 "Interim Payment Certificate" means a payment certificate issued under Clause 14 [Contract Price and Payment], other than the Final Payment Certificate.

1.1.4.8 "Local Currency" means the currency of the Country.

1.1.4.9 "Payment Certificate" means a payment certificate issued under Clause 14 [Contract Price and Payment].

1.1.4.10 "Provisional Sum" means a sum (if any) which is specified in the Contract as a provisional sum, for the execution of any part of the Works or for the supply of Plant, Materials or services under Sub-Clause 13.5 [Provisional Sums].

1.1.4.11 "Retention Money" means the accumulated retention moneys which the Employer retains under Sub-Clause 14.3 [Application for Interim Payment Certificates] and pays under Sub-Clause 14.9 [Payment of Retention Money].

1.1.4.12 "Statement" means a statement submitted by the Contractor as part of an application, under Clause 14 [Contract Price and Payment], for a payment certificate.

1.1.5 Works and Goods

1.1.5.1 "Contractor's Equipment" means all apparatus, machinery, vehicles and other things required for the execution and completion of the Works and the remedying of any defects. However, Contractor's Equipment excludes Temporary Works, Employer's Equipment (if any), Plant, Materials and any other things intended to form or forming part of the Permanent Works.

1.1.5.2 "Goods" means Contractor's Equipment, Materials, Plant and Temporary Works, or any of them as appropriate.

1.1.5.3 "Materials" means things of all kinds (other than Plant) intended to form or forming part of the Permanent Works, including the supply-only materials (if any) to be supplied by the Contractor under the Contract.

1.1.5.4 "Permanent Works" means the permanent works to be executed by the Contractor under the Contract.

1.1.5.5 "Plant" means the apparatus, machinery and other equipment intended to form or forming part of the Permanent Works, including vehicles purchased for the Employer and relating to the construction or operation of the Works.

1.1.5.6 "Section" means a part of the Works specified in the Contract Data as a Section (if any).

1.1.5.7 "Temporary Works" means all temporary works of every kind (other than Contractor's Equipment) required on Site for the execution and completion of the Permanent Works and the remedying of any defects.

1.1.5.8 "Works" mean the Permanent Works and the Temporary Works, or either of them as appropriate.

1.1.6 Other Definitions

1.1.6.1 "Contractor's Documents" means the calculations, computer programs and other software, drawings, manuals, models and other documents of a technical nature (if any) supplied by the Contractor under the Contract.

1.1.6.2 "Country" means the country in which the Site (or most of it) is located, where the Permanent Works are to be executed.

1.1.6.3 "Employer's Equipment" means the apparatus, machinery and vehicles (if any) made available by the Employer for the use of the Contractor in the execution of the Works, as stated in the Specification; but does not include Plant which has not been taken over by the Employer.

1.1.6.4 "Force Majeure" is defined in Clause 19 [Force Majeure].

1.1.6.5 "Laws" means all national (or state) legislation, statutes, ordinances and other laws, and regulations and by-laws of any legally constituted public authority.

1.1.6.6 "Performance Security" means the security (or securities, if any) under Sub-Clause 4.2 [Performance Security].

1.1.6.7 "Site" means the places where the Permanent Works are to be executed including storage and working areas and to which Plant and Materials are to be delivered, and any other places as may be specified in the Contract as forming part of the Site.

1.1.6.8 "Unforeseeable" means not reasonably foreseeable by an experienced contractor by the Base Date.

1.1.6.9 "Variation" means any change to the Works, which is instructed or approved as a variation under Clause 13

[Variations and Adjustments].

1.2 Interpretation

In the Contract, except where the context requires otherwise:

(a) words indicating one gender include all genders;

(b) words indicating the singular also include the plural and words indicating the plural also include the singular;

(c) provisions including the word “agree,” “agreed” or “agreement” require the agreement to be record in writing;

(d) “written” or “in writing” means hand-written, type-written, printed or electronically made, and resulting in a permanent record; and

(e) the word “tender” is synonymous with “bid”, and “tenderer” with “bidder” and the words “tender documents” with “bidding documents”

The marginal words and other headings shall not be taken into consideration in the interpretation of these Conditions.

In these Conditions, provisions including the expression "Cost plus profit" require this profit to be one-twentieth (5%) of this Cost unless otherwise indicated in the Contract Data.

1.3 Communications

Wherever these Conditions provide for the giving or issuing of approvals, certificates, consents, determinations, notices, requests and discharges, these communications shall be:

(a) in writing and delivered by hand (against receipt), sent by mail or courier, or transmitted using any of the agreed systems of electronic transmission as stated in the Contract Data; and

(b) delivered, sent or transmitted to the address for the recipient’s communications as stated in the Contract Data. However:

(i) if the recipient gives notice of another address, communications shall thereafter be delivered accordingly; and

(ii) if the recipient has not stated otherwise when requesting an approval or consent, it may be sent to the address from which the request was issued.

Approvals, certificates, consents and determinations shall not be unreasonably withheld or delayed. When a certificate is issued to a Party, the certifier shall send a copy to the other Party. When a notice is issued to a Party, by the other Party or the Engineer, a copy shall be sent to the Engineer or the other Party, as the case may be.

1.4 Law and Language

The Contract shall be governed by the law of the country or other jurisdiction stated in the Contract Data.

The ruling language of the Contract shall be that stated in the Contract Data.

The language for communications shall be that stated in the Contract Data. If no language is stated there, the language for communications shall be the ruling language of the Contract.

1.5 Priority of Documents

The documents forming the Contract are to be taken as mutually explanatory of one another. For the purposes of interpretation, the priority of the documents shall be in accordance with the following sequence:

(a) the Contract Agreement (if any),

(b) the Letter of Acceptance,

(c) the Tender,

(d) the Particular Conditions – Part A,

(e) the Particular Conditions – Part B

(f) these General Conditions

(g) the Specification,

(h) the Drawings, and

(i) the Schedules and any other documents forming part of the Contract.

If an ambiguity or discrepancy is found in the documents, the Engineer shall issue any necessary clarification or instruction.

1.6 Contract Agreement

The Parties shall enter into a Contract Agreement within 28 days after the Contractor receives the Letter of Acceptance, unless the Particular Conditions establish otherwise. The Contract Agreement shall be based upon the form annexed to the Particular Conditions. The costs of stamp duties and similar charges (if any) imposed by law in connection with entry into the Contract Agreement shall be borne by the Employer.

1.7 Assignment

Neither Party shall assign the whole or any part of the Contract or any benefit or interest in or under the Contract. However, either Party:

(a) may assign the whole or any part with the prior agreement of the other Party, at the sole discretion of such other Party, and

(b) may, as security in favour of a bank or financial institution, assign its right to any moneys due, or to become due, under the Contract.

1.8 Care and Supply of Documents

The Specification and Drawings shall be in the custody and care of the Employer. Unless otherwise stated in the Contract, two copies of the Contract and of each subsequent Drawing shall be supplied to the Contractor, who may make or request further copies at the cost of the Contractor.

Each of the Contractor's Documents shall be in the custody and care of the Contractor, unless and until taken over by the Employer. Unless otherwise stated in the Contract, the Contractor shall supply to the Engineer six copies of each of the Contractor's Documents.

The Contractor shall keep, on the Site, a copy of the Contract, publications named in the Specification, the Contractor's Documents (if any), the Drawings and Variations and other communications given under the Contract. The Employer's Personnel shall have the right of access to all these documents at all reasonable times.

If a Party becomes aware of an error or defect in a document which was prepared for use in executing the Works, the Party shall promptly give notice to the other Party of such error or defect.

1.9 Delayed Drawings or Instructions

The Contractor shall give notice to the Engineer whenever the Works are likely to be delayed or disrupted if any necessary drawing or instruction is not issued to the Contractor within a particular time, which shall be reasonable. The notice shall include details of the necessary drawing or instruction, details of why and by when it should be issued, and the nature and amount of the delay or disruption likely to be suffered if it is late.

If the Contractor suffers delay and/or incurs Cost as a result of a failure of the Engineer to issue the notified drawing or instruction within a time which is reasonable and is specified in the notice with supporting details, the Contractor shall give a further notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost plus profit, which shall be included in the Contract Price.

After receiving this further notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

However, if and to the extent that the Engineer's failure was caused by any error or delay by the Contractor, including an error in, or delay in the submission of, any of the Contractor's Documents, the Contractor shall not be entitled to such extension of time, Cost or profit.

1.10 Employer's Use of

As between the Parties, the Contractor shall retain the copyright and

Contractor's Documents

other intellectual property rights in the Contractor's Documents and other design documents made by (or on behalf of) the Contractor.

The Contractor shall be deemed (by signing the Contract) to give to the Employer a non-terminable transferable non-exclusive royalty-free licence to copy, use and communicate the Contractor's Documents, including making and using modifications of them. This licence shall:

(a) apply throughout the actual or intended working life (whichever is longer) of the relevant parts of the Works,

(b) entitle any person in proper possession of the relevant part of the Works to copy, use and communicate the Contractor's Documents for the purposes of completing, operating, maintaining, altering, adjusting, repairing and demolishing the Works, and

(c) in the case of Contractor's Documents which are in the form of computer programs and other software, permit their use on any computer on the Site and other places as envisaged by the Contract, including replacements of any computers supplied by the Contractor.

The Contractor's Documents and other design documents made by (or on behalf of) the Contractor shall not, without the Contractor's consent, be used, copied or communicated to a third party by (or on behalf of) the Employer for purposes other than those permitted under this Sub-Clause.

1.11 Contractor's Use of Employer's Documents

As between the Parties, the Employer shall retain the copyright and other intellectual property rights in the Specification, the Drawings and other documents made by (or on behalf of) the Employer. The Contractor may, at his cost, copy, use, and obtain communication of these documents for the purposes of the Contract. They shall not, without the Employer's consent, be copied, used or communicated to a third party by the Contractor, except as necessary for the purposes of the Contract.

1.12 Confidential Details

The Contractor's and the Employer's Personnel shall disclose all such confidential and other information as may be reasonably required in order to verify the Contractor's compliance with the Contract and allow its proper implementation.

Each of them shall treat the details of the Contract as private and confidential, except to the extent necessary to carry out their respective obligations under the Contract or to comply with applicable Laws. Each of them shall not publish or disclose any particulars of the Works prepared by the other Party without the previous agreement of the other Party. However, the Contractor shall be permitted to disclose any publicly available information, or information otherwise required to establish his qualifications to compete for other projects.

1.13 Compliance with

The Contractor shall, in performing the Contract, comply with

Laws

applicable Laws. Unless otherwise stated in the Particular Conditions:

(a) the Employer shall have obtained (or shall obtain) the planning, zoning, building permit or similar permission for the Permanent Works, and any other permissions described in the Specification as having been (or to be) obtained by the Employer; and the Employer shall indemnify and hold the Contractor harmless against and from the consequences of any failure to do so; and

(b) the Contractor shall give all notices, pay all taxes, duties and fees, and obtain all permits, licences and approvals, as required by the Laws in relation to the execution and completion of the Works and the remedying of any defects; and the Contractor shall indemnify and hold the Employer harmless against and from the consequences of any failure to do so, unless the Contractor is impeded to accomplish these actions and shows evidence of its diligence.

1.14 Joint and Several Liability

If the Contractor constitutes (under applicable Laws) a joint venture or other unincorporated grouping of two or more persons:

(a) these persons shall be deemed to be jointly and severally liable to the Employer for the performance of the Contract;

(b) these persons shall notify the Employer of their leader who shall have authority to bind the Contractor and each of these persons; and

(c) the Contractor shall not alter its composition or legal status without the prior consent of the Employer.

1.15 Inspections and Audit by the Bank

The Contractor shall permit the Bank and/or persons appointed by the Bank to inspect the Site and/or the accounts and records of the Contractor and its subcontractors relating to the performance of the Contract, and to have such accounts and records audited by auditors appointed by the Bank if required by the Bank. The Contractor's attention is drawn to Sub-Clause 15.6 [Corrupt or Fraudulent Practices] which provides, inter alia, that acts intended to materially impede the exercise of the Bank's inspection and audit rights provided for under Sub-Clause 1.15 constitute a prohibited practice subject to contract termination (as well as to a determination of ineligibility under the Procurement Guidelines).

2. The Employer

2.1 Right of Access to the Site

The Employer shall give the Contractor right of access to, and possession of, all parts of the Site within the time (or times) stated in the Contract Data. The right and possession may not be exclusive to the Contractor. If, under the Contract, the Employer is required to give (to the Contractor) possession of any foundation, structure, plant or means of access, the Employer shall do so in the time and manner stated in the Specification. However, the Employer may withhold any such right or possession until the Performance Security has been received.

If no such time is stated in the Contract Data, the Employer shall give the Contractor right of access to, and possession of, the Site within such times as required to enable the Contractor to proceed without disruption in accordance with the programme submitted under Sub-Clause 8.3 [Programme].

If the Contractor suffers delay and/or incurs Cost as a result of a failure by the Employer to give any such right or possession within such time, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost plus profit, which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

However, if and to the extent that the Employer's failure was caused by any error or delay by the Contractor, including an error in, or delay in the submission of, any of the Contractor's Documents, the Contractor shall not be entitled to such extension of time, Cost or profit.

2.2 Permits, Licences or Approvals

The Employer shall provide, at the request of the Contractor, such reasonable assistance as to allow the Contractor to obtain properly:

(a) copies of the Laws of the Country which are relevant to the Contract but are not readily available, and

(b) any permits, licences or approvals required by the Laws of the Country:

(i) which the Contractor is required to obtain under Sub-Clause 1.13 [Compliance with Laws],

(ii) for the delivery of Goods, including clearance through customs, and

(iii) for the export of Contractor's Equipment when it is removed from the Site.

2.3 Employer's Personnel

The Employer shall be responsible for ensuring that the Employer's Personnel and the Employer's other contractors on the Site:

(a) co-operate with the Contractor's efforts under Sub-Clause 4.6 [Co-operation], and

(b) take actions similar to those which the Contractor is required to take under sub-paragraphs (a), (b) and (c) of Sub-Clause 4.8 [Safety Procedures] and under Sub-Clause 4.18 [Protection of the Environment].

2.4 Employer's

The Employer shall submit, before the Commencement Date and

Financial Arrangements

thereafter within 28 days after receiving any request from the Contractor, reasonable evidence that financial arrangements have been made and are being maintained which will enable the Employer to pay the Contract Price punctually (as estimated at that time) in accordance with Clause 14 [Contract Price and Payment]. Before the Employer makes any material change to his financial arrangements, the Employer shall give notice to the Contractor with detailed particulars.

In addition, if the Bank has notified to the Borrower that the Bank has suspended disbursements under its loan, which finances in whole or in part the execution of the Works, the Employer shall give notice of such suspension to the Contractor with detailed particulars, including the date of such notification, with a copy to the Engineer, within 7 days of the Borrower having received the suspension notification from the Bank. If alternative funds will be available in appropriate currencies to the Employer to continue making payments to the Contractor beyond a date 60 days after the date of Bank notification of the suspension, the Employer shall provide reasonable evidence in such notice of the extent to which such funds will be available.

2.5 Employer's Claims

If the Employer considers himself to be entitled to any payment under any Clause of these Conditions or otherwise in connection with the Contract, and/or to any extension of the Defects Notification Period, the Employer or the Engineer shall give notice and particulars to the Contractor. However, notice is not required for payments due under Sub-Clause 4.19 [Electricity, Water and Gas], under Sub-Clause 4.20 [Employer's Equipment and Free-Issue Material], or for other services requested by the Contractor.

The notice shall be given as soon as practicable and no longer than 28 days after the Employer became aware, or should have become aware, of the event or circumstances giving rise to the claim. A notice relating to any extension of the Defects Notification Period shall be given before the expiry of such period.

The particulars shall specify the Clause or other basis of the claim, and shall include substantiation of the amount and/or extension to which the Employer considers himself to be entitled in connection with the Contract. The Engineer shall then proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine (i) the amount (if any) which the Employer is entitled to be paid by the Contractor, and/or (ii) the extension (if any) of the Defects Notification Period in accordance with Sub-Clause 11.3 [Extension of Defects Notification Period].

This amount may be included as a deduction in the Contract Price and Payment Certificates. The Employer shall only be entitled to set off against or make any deduction from an amount certified in a Payment Certificate, or to otherwise claim against the Contractor, in accordance with this Sub-Clause.

3. The Engineer

3.1 Engineer's Duties and Authority

The Employer shall appoint the Engineer who shall carry out the duties assigned to him in the Contract. The Engineer's staff shall include suitably qualified engineers and other professionals who are competent to carry out these duties.

The Engineer shall have no authority to amend the Contract.

The Engineer may exercise the authority attributable to the Engineer as specified in or necessarily to be implied from the Contract. If the Engineer is required to obtain the approval of the Employer before exercising a specified authority, the requirements shall be as stated in the Particular Conditions. The Employer shall promptly inform the Contractor of any change to the authority attributed to the Engineer.

However, whenever the Engineer exercises a specified authority for which the Employer's approval is required, then (for the purposes of the Contract) the Employer shall be deemed to have given approval.

Except as otherwise stated in these Conditions:

(a) whenever carrying out duties or exercising authority, specified in or implied by the Contract, the Engineer shall be deemed to act for the Employer;

(b) the Engineer has no authority to relieve either Party of any duties, obligations or responsibilities under the Contract; and

(c) any approval, check, certificate, consent, examination, inspection, instruction, notice, proposal, request, test, or similar act by the Engineer (including absence of disapproval) shall not relieve the Contractor from any responsibility he has under the Contract, including responsibility for errors, omissions, discrepancies and non-compliances.

(d) Any act by the Engineer in response to a Contractor's request except otherwise expressly specified shall be notified in writing to the Contractor within 28 days of receipt.

The following provisions shall apply:

The Engineer shall obtain the specific approval of the Employer before taking action under the-following Sub-Clauses of these Conditions:

(a) Sub-Clause 4.12 [Unforeseeable Physical Conditions]: Agreeing or determining an extension of time and/or additional cost.

(b) Sub-Clause 13.1 [Right to Vary]: Instructing a Variation, except;

(i) in an emergency situation as determined by the Engineer, or

(ii) if such a Variation would increase the Accepted Contract Amount by less than the percentage specified in the Contract Data.

(c) Sub-Clause 13.3 [Variation Procedure]: Approving a proposal for Variation submitted by the Contractor in accordance with Sub Clause 13.1 [Right to Vary] or 13.2 [Value Engineering].

(d) Sub-Clause 13.4 [Payment in Applicable Currencies]: Specifying the amount payable in each of the applicable currencies

Notwithstanding the obligation, as set out above, to obtain approval, if, in the opinion of the Engineer, an emergency occurs affecting the safety of life or of the Works or of adjoining property, he may, without relieving the Contractor of any of his duties and responsibility under the Contract, instruct the Contractor to execute all such work or to do all such things as may, in the opinion of the Engineer, be necessary to abate or reduce the risk. The Contractor shall forthwith comply, despite the absence of approval of the Employer, with any such instruction of the Engineer. The Engineer shall determine an addition to the Contract Price, in respect of such instruction, in accordance with Clause 13 [Variations and Adjustments] and shall notify the Contractor accordingly, with a copy to the Employer.

3.2 Delegation by the Engineer

The Engineer may from time to time assign duties and delegate authority to assistants, and may also revoke such assignment or delegation. These assistants may include a resident engineer, and/or independent inspectors appointed to inspect and/or test items of Plant and/or Materials. The assignment, delegation or revocation shall be in writing and shall not take effect until copies have been received by both Parties.

However, unless otherwise agreed by both Parties, the Engineer shall not delegate the authority to determine any matter in accordance with Sub-Clause 3.5 [Determinations].

Assistants shall be suitably qualified persons, who are competent to carry out these duties and exercise this authority, and who are fluent in the language for communications defined in Sub-Clause 1.4 [Law and Language].

Each assistant, to whom duties have been assigned or authority has been delegated, shall only be authorised to issue instructions to the Contractor to the extent defined by the delegation. Any approval, check, certificate, consent, examination, inspection, instruction, notice, proposal, request, test, or similar act by an assistant, in accordance with the delegation, shall have the same effect as though the act had been an act of the Engineer. However:

(a) any failure to disapprove any work, Plant or Materials shall not constitute approval, and shall therefore not prejudice the right of the Engineer to reject the work, Plant or Materials;

(b) if the Contractor questions any determination or instruction of an assistant, the Contractor may refer the matter to the Engineer, who shall promptly confirm, reverse or vary the determination or instruction.

3.3 Instructions of the Engineer

The Engineer may issue to the Contractor (at any time) instructions and additional or modified Drawings which may be necessary for the execution of the Works and the remedying of any defects, all in accordance with the Contract. The Contractor shall only take instructions from the Engineer, or from an assistant to whom the appropriate authority has been delegated under this Clause. If an instruction constitutes a Variation, Clause 13 [Variations and Adjustments] shall apply.

The Contractor shall comply with the instructions given by the Engineer or delegated assistant, on any matter related to the Contract. Whenever practicable, their instructions shall be given in writing. If the Engineer or a delegated assistant:

(a) gives an oral instruction,

(b) receives a written confirmation of the instruction, from (or on behalf of) the Contractor, within two working days after giving the instruction, and

(c) does not reply by issuing a written rejection and/or instruction within two working days after receiving the confirmation,

then the confirmation shall constitute the written instruction of the Engineer or delegated assistant (as the case may be).

3.4 Replacement of the Engineer

If the Employer intends to replace the Engineer, the Employer shall, not less than 21 days before the intended date of replacement, give notice to the Contractor of the name, address and relevant experience of the intended replacement Engineer. If the Contractor considers the intended replacement Engineer to be unsuitable, he has the right to raise objection against him by notice to the Employer, with supporting particulars, and the Employer shall give full and fair consideration to this objection.

3.5 Determinations

Whenever these Conditions provide that the Engineer shall proceed in accordance with this Sub-Clause 3.5 to agree or determine any matter, the Engineer shall consult with each Party in an endeavour to reach agreement. If agreement is not achieved, the Engineer shall make a fair determination in accordance with the Contract, taking due regard of all relevant circumstances.

The Engineer shall give notice to both Parties of each agreement or determination, with supporting particulars within 28 days from the receipt of the corresponding claim or request except when otherwise specified. Each Party shall give effect to each agreement or determination unless and until revised under Clause 20 [Claims, Disputes and Arbitration].

4. The Contractor

4.1 Contractor's General Obligations

The Contractor shall design (to the extent specified in the Contract), execute and complete the Works in accordance with the Contract and with the Engineer's instructions, and shall remedy any defects in the Works.

The Contractor shall provide the Plant and Contractor's Documents specified in the Contract, and all Contractor's Personnel, Goods, consumables and other things and services, whether of a temporary or permanent nature, required in and for this design, execution, completion and remedying of defects.

All equipment, material, and services to be incorporated in or required for the Works shall have their origin in any eligible source country as defined by the Bank.

The Contractor shall be responsible for the adequacy, stability and safety of all Site operations and of all methods of construction. Except to the extent specified in the Contract, the Contractor (i) shall be responsible for all Contractor's Documents, Temporary Works, and such design of each item of Plant and Materials as is required for the item to be in accordance with the Contract, and (ii) shall not otherwise be responsible for the design or specification of the Permanent Works.

The Contractor shall, whenever required by the Engineer, submit details of the arrangements and methods which the Contractor proposes to adopt for the execution of the Works. No significant alteration to these arrangements and methods shall be made without this having previously been notified to the Engineer.

If the Contract specifies that the Contractor shall design any part of the Permanent Works, then unless otherwise stated in the Particular Conditions:

(a) the Contractor shall submit to the Engineer the Contractor's Documents for this part in accordance with the procedures specified in the Contract;

(b) these Contractor's Documents shall be in accordance with the Specification and Drawings, shall be written in the language for communications defined in Sub-Clause 1.4 [Law and Language], and shall include additional information required by the Engineer to add to the Drawings for co-ordination of each Party's designs;

(c) the Contractor shall be responsible for this part and it shall, when the Works are completed, be fit for such purposes for which the part is intended as are specified in the Contract; and

(d) prior to the commencement of the Tests on Completion, the Contractor shall submit to the Engineer the "as-built" documents and, if applicable, operation and maintenance manuals in accordance with the Specification and in sufficient detail for the Employer to operate, maintain, dismantle, reassemble, adjust and

repair this part of the Works. Such part shall not be considered to be completed for the purposes of taking-over under Sub-Clause 10.1 [Taking Over of the Works and Sections] until these documents and manuals have been submitted to the Engineer.

4.2 Performance Security

The Contractor shall obtain (at his cost) a Performance Security for proper performance, in the amount and currencies stated in the Contract Data. If an amount is not stated in the Contract Data, this Sub-Clause shall not apply.

The Contractor shall deliver the Performance Security to the Employer within 28 days after receiving the Letter of Acceptance, and shall send a copy to the Engineer. The Performance Security shall be issued by an entity and from within a country (or other jurisdiction) approved by the Employer, and shall be in the form annexed to the Particular Conditions or in another form approved by the Employer.

The Contractor shall ensure that the Performance Security is valid and enforceable until the Contractor has executed and completed the Works and remedied any defects. If the terms of the Performance Security specify its expiry date, and the Contractor has not become entitled to receive the Performance Certificate by the date 28 days prior to the expiry date, the Contractor shall extend the validity of the Performance Security until the Works have been completed and any defects have been remedied.

The Employer shall not make a claim under the Performance Security, except for amounts to which the Employer is entitled under the Contract.

The Employer shall indemnify and hold the Contractor harmless against and from all damages, losses and expenses (including legal fees and expenses) resulting from a claim under the Performance Security to the extent to which the Employer was not entitled to make the claim.

The Employer shall return the Performance Security to the Contractor within 21 days after receiving a copy of the Performance Certificate.

Without limitation to the provisions of the rest of this Sub-Clause, whenever the Engineer determines an addition or a reduction to the Contract Price as a result of a change in cost and/or legislation or as a result of a Variation amounting to more than 25 percent of the portion of the Contract Price payable in a specific currency, the Contractor shall at the Engineer's request promptly increase, or may decrease, as the case may be, the value of the Performance Security in that currency by an equal percentage.

4.3 Contractor's Representative

The Contractor shall appoint the Contractor's Representative and shall give him all authority necessary to act on the Contractor's behalf under the Contract.

Unless the Contractor's Representative is named in the Contract, the Contractor shall, prior to the Commencement Date, submit to the

Engineer for consent the name and particulars of the person the Contractor proposes to appoint as Contractor's Representative. If consent is withheld or subsequently revoked in terms of Sub-Clause 6.9 [Contractor's Personnel], or if the appointed person fails to act as Contractor's Representative, the Contractor shall similarly submit the name and particulars of another suitable person for such appointment.

The Contractor shall not, without the prior consent of the Engineer, revoke the appointment of the Contractor's Representative or appoint a replacement.

The whole time of the Contractor's Representative shall be given to directing the Contractor's performance of the Contract. If the Contractor's Representative is to be temporarily absent from the Site during the execution of the Works, a suitable replacement person shall be appointed, subject to the Engineer's prior consent, and the Engineer shall be notified accordingly.

The Contractor's Representative shall, on behalf of the Contractor, receive instructions under Sub-Clause 3.3 [Instructions of the Engineer].

The Contractor's Representative may delegate any powers, functions and authority to any competent person, and may at any time revoke the delegation. Any delegation or revocation shall not take effect until the Engineer has received prior notice signed by the Contractor's Representative, naming the person and specifying the powers, functions and authority being delegated or revoked.

The Contractor's Representative shall be fluent in the language for communications defined in Sub-Clause 1.4 [Law and Language]. If the Contractor's Representative's delegates are not fluent in the said language, the Contractor shall make competent interpreters available during all working hours in a number deemed sufficient by the Engineer.

4.4 Subcontractors

The Contractor shall not subcontract the whole of the Works.

The Contractor shall be responsible for the acts or defaults of any Subcontractor, his agents or employees, as if they were the acts or defaults of the Contractor. Unless otherwise stated in the Particular Conditions:

(a) the Contractor shall not be required to obtain consent to suppliers solely of Materials, or to a subcontract for which the Subcontractor is named in the Contract;

(b) the prior consent of the Engineer shall be obtained to other proposed Subcontractors;

(c) the Contractor shall give the Engineer not less than 28 days' notice of the intended date of the commencement of each Subcontractor's work, and of the commencement of such work

on the Site; and

(d) each subcontract shall include provisions which would entitle the Employer to require the subcontract to be assigned to the Employer under Sub-Clause 4.5 [Assignment of Benefit of Subcontract] (if or when applicable) or in the event of termination under Sub-Clause 15.2 [Termination by Employer].

The Contractor shall ensure that the requirements imposed on the Contractor by Sub-Clause 1.12 [Confidential Details] apply equally to each Subcontractor.

Where practicable, the Contractor shall give fair and reasonable opportunity for contractors from the Country to be appointed as Subcontractors.

4.5 Assignment of Benefit of Subcontract

If a Subcontractor's obligations extend beyond the expiry date of the relevant Defects Notification Period and the Engineer, prior to this date, instructs the Contractor to assign the benefit of such obligations to the Employer, then the Contractor shall do so. Unless otherwise stated in the assignment, the Contractor shall have no liability to the Employer for the work carried out by the Subcontractor after the assignment takes effect.

4.6 Co-operation

The Contractor shall, as specified in the Contract or as instructed by the Engineer, allow appropriate opportunities for carrying out work to:

(a) the Employer's Personnel,

(b) any other contractors employed by the Employer, and

(c) the personnel of any legally constituted public authorities,

who may be employed in the execution on or near the Site of any work not included in the Contract.

Any such instruction shall constitute a Variation if and to the extent that it causes the Contractor to suffer delays and/or to incur Unforeseeable Cost. Services for these personnel and other contractors may include the use of Contractor's Equipment, Temporary Works or access arrangements which are the responsibility of the Contractor.

If, under the Contract, the Employer is required to give to the Contractor possession of any foundation, structure, plant or means of access in accordance with Contractor's Documents, the Contractor shall submit such documents to the Engineer in the time and manner stated in the Specification.

4.7 Setting Out

The Contractor shall set out the Works in relation to original points, lines and levels of reference specified in the Contract or notified by the Engineer. The Contractor shall be responsible for the correct positioning of all parts of the Works, and shall rectify any error in the positions, levels, dimensions or alignment of the Works.

The Employer shall be responsible for any errors in these specified or notified items of reference, but the Contractor shall use reasonable

efforts to verify their accuracy before they are used.

If the Contractor suffers delay and/or incurs Cost from executing work which was necessitated by an error in these items of reference, and an experienced contractor could not reasonably have discovered such error and avoided this delay and/or Cost, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost plus profit, which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine (i) whether and (if so) to what extent the error could not reasonably have been discovered, and (ii) the matters described in sub-paragraphs (a) and (b) above related to this extent.

4.8 Safety Procedures

The Contractor shall:

(a) comply with all applicable safety regulations,

(b) take care for the safety of all persons entitled to be on the Site,

(c) use reasonable efforts to keep the Site and Works clear of unnecessary obstruction so as to avoid danger to these persons,

(d) provide fencing, lighting, guarding and watching of the Works until completion and taking over under Clause 10 [Employer's Taking Over], and

(e) provide any Temporary Works (including roadways, footways, guards and fences) which may be necessary, because of the execution of the Works, for the use and protection of the public and of owners and occupiers of adjacent land.

4.9 Quality Assurance

The Contractor shall institute a quality assurance system to demonstrate compliance with the requirements of the Contract. The system shall be in accordance with the details stated in the Contract. The Engineer shall be entitled to audit any aspect of the system.

Details of all procedures and compliance documents shall be submitted to the Engineer for information before each design and execution stage is commenced. When any document of a technical nature is issued to the Engineer, evidence of the prior approval by the Contractor himself shall be apparent on the document itself.

Compliance with the quality assurance system shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

4.10 Site Data

The Employer shall have made available to the Contractor for his

information, prior to the Base Date, all relevant data in the Employer's possession on sub-surface and hydrological conditions at the Site, including environmental aspects. The Employer shall similarly make available to the Contractor all such data which come into the Employer's possession after the Base Date. The Contractor shall be responsible for interpreting all such data.

To the extent which was practicable (taking account of cost and time), the Contractor shall be deemed to have obtained all necessary information as to risks, contingencies and other circumstances which may influence or affect the Tender or Works. To the same extent, the Contractor shall be deemed to have inspected and examined the Site, its surroundings, the above data and other available information, and to have been satisfied before submitting the Tender as to all relevant matters, including (without limitation):

(a) the form and nature of the Site, including sub-surface conditions,

(b) the hydrological and climatic conditions,

(c) the extent and nature of the work and Goods necessary for the execution and completion of the Works and the remedying of any defects,

(d) the Laws, procedures and labour practices of the Country, and

(e) the Contractor's requirements for access, accommodation, facilities, personnel, power, transport, water and other services.

4.11 Sufficiency of the Accepted Contract Amount

The Contractor shall be deemed to:

(a) have satisfied himself as to the correctness and sufficiency of the Accepted Contract Amount, and

(b) have based the Accepted Contract Amount on the data, interpretations, necessary information, inspections, examinations and satisfaction as to all relevant matters referred to in Sub-Clause 4.10 [Site Data].

Unless otherwise stated in the Contract, the Accepted Contract Amount covers all the Contractor's obligations under the Contract (including those under Provisional Sums, if any) and all things necessary for the proper execution and completion of the Works and the remedying of any defects.

4.12 Unforeseeable Physical Conditions

In this Sub-Clause, "physical conditions" means natural physical conditions and man-made and other physical obstructions and pollutants, which the Contractor encounters at the Site when executing the Works, including sub-surface and hydrological conditions but excluding climatic conditions.

If the Contractor encounters adverse physical conditions which he considers to have been Unforeseeable, the Contractor shall give notice to the Engineer as soon as practicable.

This notice shall describe the physical conditions, so that they can be inspected by the Engineer, and shall set out the reasons why the Contractor considers them to be Unforeseeable. The Contractor shall continue executing the Works, using such proper and reasonable measures as are appropriate for the physical conditions, and shall comply with any instructions which the Engineer may give. If an instruction constitutes a Variation, Clause 13 [Variations and Adjustments] shall apply.

If and to the extent that the Contractor encounters physical conditions which are Unforeseeable, gives such a notice, and suffers delay and/or incurs Cost due to these conditions, the Contractor shall be entitled subject to notice under Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost, which shall be included in the Contract Price.

Upon receiving such notice and inspecting and/or investigating these physical conditions, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine (i) whether and (if so) to what extent these physical conditions were Unforeseeable, and (ii) the matters described in sub-paragraphs (a) and (b) above related to this extent.

However, before additional Cost is finally agreed or determined under sub-paragraph (ii), the Engineer may also review whether other physical conditions in similar parts of the Works (if any) were more favourable than could reasonably have been foreseen when the Contractor submitted the Tender. If and to the extent that these more favourable conditions were encountered, the Engineer may proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine the reductions in Cost which were due to these conditions, which may be included (as deductions) in the Contract Price and Payment Certificates. However, the net effect of all adjustments under sub-paragraph (b) and all these reductions, for all the physical conditions encountered in similar parts of the Works, shall not result in a net reduction in the Contract Price.

The Engineer shall take account of any evidence of the physical conditions foreseen by the Contractor when submitting the Tender, which shall be made available by the Contractor, but shall not be bound by the Contractor's interpretation of any such evidence.

4.13 Rights of Way and Facilities

Unless otherwise specified in the Contract the Employer shall provide access to and possession of the Site including special and/or temporary rights-of-way which are necessary for the Works. The Contractor shall obtain, at his risk and cost, any additional rights of way or facilities outside the Site which he may require for the purposes of the Works.

4.14 Avoidance of Interference

The Contractor shall not interfere unnecessarily or improperly with:

(a) the convenience of the public, or

(b) the access to and use and occupation of all roads and footpaths, irrespective of whether they are public or in the possession of the Employer or of others.

The Contractor shall indemnify and hold the Employer harmless against and from all damages, losses and expenses (including legal fees and expenses) resulting from any such unnecessary or improper interference.

4.15 Access Route

The Contractor shall be deemed to have been satisfied as to the suitability and availability of access routes to the Site at Base Date. The Contractor shall use reasonable efforts to prevent any road or bridge from being damaged by the Contractor's traffic or by the Contractor's Personnel. These efforts shall include the proper use of appropriate vehicles and routes.

Except as otherwise stated in these Conditions:

(a) the Contractor shall (as between the Parties) be responsible for any maintenance which may be required for his use of access routes;

(b) the Contractor shall provide all necessary signs or directions along access routes, and shall obtain any permission which may be required from the relevant authorities for his use of routes, signs and directions;

(c) the Employer shall not be responsible for any claims which may arise from the use or otherwise of any access route;

(d) the Employer does not guarantee the suitability or availability of particular access routes; and

(e) Costs due to non-suitability or non-availability, for the use required by the Contractor, of access routes shall be borne by the Contractor.

4.16 Transport of Goods

Unless otherwise stated in the Particular Conditions:

(a) the Contractor shall give the Engineer not less than 21 days' notice of the date on which any Plant or a major item of other Goods will be delivered to the Site;

(b) the Contractor shall be responsible for packing, loading, transporting, receiving, unloading, storing and protecting all Goods and other things required for the Works; and

(c) the Contractor shall indemnify and hold the Employer harmless against and from all damages, losses and expenses (including legal fees and expenses) resulting from the transport of Goods,

and shall negotiate and pay all claims arising from their transport.

4.17 Contractor's Equipment

The Contractor shall be responsible for all Contractor's Equipment. When brought on to the Site, Contractor's Equipment shall be deemed to be exclusively intended for the execution of the Works. The Contractor shall not remove from the Site any major items of Contractor's Equipment without the consent of the Engineer. However, consent shall not be required for vehicles transporting Goods or Contractor's Personnel off Site.

4.18 Protection of the Environment

The Contractor shall take all reasonable steps to protect the environment (both on and off the Site) and to limit damage and nuisance to people and property resulting from pollution, noise and other results of his operations.

The Contractor shall ensure that emissions, surface discharges and effluent from the Contractor's activities shall not exceed the values stated in the Specification or prescribed by applicable Laws.

4.19 Electricity, Water and Gas

The Contractor shall, except as stated below, be responsible for the provision of all power, water and other services he may require for his construction activities and to the extent defined in the Specifications, for the tests.

The Contractor shall be entitled to use for the purposes of the Works such supplies of electricity, water, gas and other services as may be available on the Site and of which details and prices are given in the Specification. The Contractor shall, at his risk and cost, provide any apparatus necessary for his use of these services and for measuring the quantities consumed.

The quantities consumed and the amounts due (at these prices) for such services shall be agreed or determined by the Engineer in accordance with Sub-Clause 2.5 [Employer's Claims] and Sub-Clause 3.5 [Determinations]. The Contractor shall pay these amounts to the Employer.

4.20 Employer's Equipment and Free-Issue Materials

The Employer shall make the Employer's Equipment (if any) available for the use of the Contractor in the execution of the Works in accordance with the details, arrangements and prices stated in the Specification. Unless otherwise stated in the Specification:

(a) the Employer shall be responsible for the Employer's Equipment, except that

(b) the Contractor shall be responsible for each item of Employer's Equipment whilst any of the Contractor's Personnel is operating it, driving it, directing it or in possession or control of it.

The appropriate quantities and the amounts due (at such stated prices) for the use of Employer's Equipment shall be agreed or determined by

the Engineer in accordance with Sub-Clause 2.5 [Employer's Claims] and Sub-Clause 3.5 [Determinations]. The Contractor shall pay these amounts to the Employer.

The Employer shall supply, free of charge, the "free-issue materials" (if any) in accordance with the details stated in the Specification. The Employer shall, at his risk and cost, provide these materials at the time and place specified in the Contract. The Contractor shall then visually inspect them, and shall promptly give notice to the Engineer of any shortage, defect or default in these materials. Unless otherwise agreed by both Parties, the Employer shall immediately rectify the notified shortage, defect or default.

After this visual inspection, the free-issue materials shall come under the care, custody and control of the Contractor. The Contractor's obligations of inspection, care, custody and control shall not relieve the Employer of liability for any shortage, defect or default not apparent from a visual inspection.

4.21 Progress Reports

Unless otherwise stated in the Particular Conditions, monthly progress reports shall be prepared by the Contractor and submitted to the Engineer in six copies. The first report shall cover the period up to the end of the first calendar month following the Commencement Date. Reports shall be submitted monthly thereafter, each within 7 days after the last day of the period to which it relates.

Reporting shall continue until the Contractor has completed all work which is known to be outstanding at the completion date stated in the Taking-Over Certificate for the Works.

Each report shall include:

(a) charts and detailed descriptions of progress, including each stage of design (if any), Contractor's Documents, procurement, manufacture, delivery to Site, construction, erection and testing; and including these stages for work by each nominated Subcontractor (as defined in Clause 5 [Nominated Subcontractors]),

(b) photographs showing the status of manufacture and of progress on the Site;

(c) for the manufacture of each main item of Plant and Materials, the name of the manufacturer, manufacture location, percentage progress, and the actual or expected dates of:

(i) commencement of manufacture,

(ii) Contractor's inspections,

(iii) tests, and

(iv) shipment and arrival at the Site;

(d) the details described in Sub-Clause 6.10 [Records of Contractor's Personnel and Equipment];

(e) copies of quality assurance documents, test results and certificates of Materials;

(f) list of notices given under Sub-Clause 2.5 [Employer's Claims] and notices given under Sub-Clause 20.1 [Contractor's Claims];

(g) safety statistics, including details of any hazardous incidents and activities relating to environmental aspects and public relations; and

(h) comparisons of actual and planned progress, with details of any events or circumstances which may jeopardise the completion in accordance with the Contract, and the measures being (or to be) adopted to overcome delays.

4.22 Security of the Site

Unless otherwise stated in the Particular Conditions:

(a) the Contractor shall be responsible for keeping unauthorised persons off the Site, and

(b) authorised persons shall be limited to the Contractor's Personnel and the Employer's Personnel; and to any other personnel notified to the Contractor, by the Employer or the Engineer, as authorised personnel of the Employer's other contractors on the Site.

4.23 Contractor's Operations on Site

The Contractor shall confine his operations to the Site, and to any additional areas which may be obtained by the Contractor and agreed by the Engineer as additional working areas. The Contractor shall take all necessary precautions to keep Contractor's Equipment and Contractor's Personnel within the Site and these additional areas, and to keep them off adjacent land.

During the execution of the Works, the Contractor shall keep the Site free from all unnecessary obstruction, and shall store or dispose of any Contractor's Equipment or surplus materials. The Contractor shall clear away and remove from the Site any wreckage, rubbish and Temporary Works which are no longer required.

Upon the issue of a Taking-Over Certificate, the Contractor shall clear away and remove, from that part of the Site and Works to which the Taking-Over Certificate refers, all Contractor's Equipment, surplus material, wreckage, rubbish and Temporary Works. The Contractor shall leave that part of the Site and the Works in a clean and safe condition. However, the Contractor may retain on Site, during the Defects Notification Period, such Goods as are required for the Contractor to fulfil obligations under the Contract.

4.24 Fossils

All fossils, coins, articles of value or antiquity, and structures and other remains or items of geological or archaeological interest found on the

Site shall be placed under the care and authority of the Employer. The Contractor shall take reasonable precautions to prevent Contractor's Personnel or other persons from removing or damaging any of these findings.

The Contractor shall, upon discovery of any such finding, promptly give notice to the Engineer, who shall issue instructions for dealing with it. If the Contractor suffers delay and/or incurs Cost from complying with the instructions, the Contractor shall give a further notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost, which shall be included in the Contract Price.

After receiving this further notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

5. Nominated Subcontractors

5.1 Definition of "nominated Subcontractor"

In the Contract, "nominated Subcontractor" means a Subcontractor:

(a) who is stated in the Contract as being a nominated Subcontractor, or

(b) whom the Engineer, under Clause 13 [Variations and Adjustments], instructs the Contractor to employ as a Subcontractor subject to Sub-Clause 5.2 [Objection to Notification].

5.2 Objection to Nomination

The Contractor shall not be under any obligation to employ a nominated Subcontractor against whom the Contractor raises reasonable objection by notice to the Engineer as soon as practicable, with supporting particulars. An objection shall be deemed reasonable if it arises from (among other things) any of the following matters, unless the Employer agrees in writing to indemnify the Contractor against and from the consequences of the matter:

(a) there are reasons to believe that the Subcontractor does not have sufficient competence, resources or financial strength;

(b) the nominated Subcontractor does not accept to indemnify the Contractor against and from any negligence or misuse of Goods by the nominated Subcontractor, his agents and employees; or

(c) the nominated Subcontractor does not accept to enter into a subcontract which specifies that, for the subcontracted work (including design, if any), the nominated Subcontractor shall:

(i) undertake to the Contractor such obligations and liabilities as will enable the Contractor to discharge his obligations

and liabilities under the Contract;

(ii) indemnify the Contractor against and from all obligations and liabilities arising under or in connection with the Contract and from the consequences of any failure by the Subcontractor to perform these obligations or to fulfil these liabilities; and

(iii) be paid only if and when the Contractor has received from the Employer payments for sums due under the Subcontract referred to under Sub-Clause 5.3 [Payment to nominated Subcontractors].

5.3 Payments to nominated Subcontractors

The Contractor shall pay to the nominated Subcontractor the amounts shown on the nominated Subcontractor's invoices approved by the Contractor which the Engineer certifies to be due in accordance with the subcontract. These amounts plus other charges shall be included in the Contract Price in accordance with sub-paragraph (b) of Sub-Clause 13.5 [Provisional Sums], except as stated in Sub-Clause 5.4 [Evidence of Payments].

5.4 Evidence of Payments

Before issuing a Payment Certificate which includes an amount payable to a nominated Subcontractor, the Engineer may request the Contractor to supply reasonable evidence that the nominated Subcontractor has received all amounts due in accordance with previous Payment Certificates, less applicable deductions for retention or otherwise. Unless the Contractor:

(a) submits this reasonable evidence to the Engineer, or

(b)

(i) satisfies the Engineer in writing that the Contractor is reasonably entitled to withhold or refuse to pay these amounts, and

(ii) submits to the Engineer reasonable evidence that the nominated Subcontractor has been notified of the Contractor's entitlement,

then the Employer may (at his sole discretion) pay, direct to the nominated Subcontractor, part or all of such amounts previously certified (less applicable deductions) as are due to the nominated Subcontractor and for which the Contractor has failed to submit the evidence described in sub-paragraphs (a) or (b) above. The Contractor shall then repay, to the Employer, the amount which the nominated Subcontractor was directly paid by the Employer.

6. Staff and Labour

6.1 Engagement of Staff and Labour

Except as otherwise stated in the Specification, the Contractor shall make arrangements for the engagement of all staff and labour, local or otherwise, and for their payment, feeding, transport, and, when appropriate, housing.

The Contractor is encouraged, to the extent practicable and reasonable, to employ staff and labour with appropriate qualifications and experience from sources within the Country.

6.2 Rates of Wages and Conditions of Labour

The Contractor shall pay rates of wages, and observe conditions of labour, which are not lower than those established for the trade or industry where the work is carried out. If no established rates or conditions are applicable, the Contractor shall pay rates of wages and observe conditions which are not lower than the general level of wages and conditions observed locally by employers whose trade or industry is similar to that of the Contractor.

The Contractor shall inform the Contractor's Personnel about their liability to pay personal income taxes in the Country in respect of such of their salaries, wages, allowances and any benefits as are subject to tax under the Laws of the Country for the time being in force, and the Contractor shall perform such duties in regard to such deductions thereof as may be imposed on him by such Laws.

6.3 Persons in the Service of Employer

The Contractor shall not recruit, or attempt to recruit, staff and labour from amongst the Employer's Personnel.

6.4 Labour Laws

The Contractor shall comply with all the relevant labour Laws applicable to the Contractor's Personnel, including Laws relating to their employment, health, safety, welfare, immigration and emigration, and shall allow them all their legal rights.

The Contractor shall require his employees to obey all applicable Laws, including those concerning safety at work.

6.5 Working Hours

No work shall be carried out on the Site on locally recognised days of rest, or outside the normal working hours stated in the Contract Data, unless:

(a) otherwise stated in the Contract,

(b) the Engineer gives consent, or

(c) the work is unavoidable, or necessary for the protection of life or property or for the safety of the Works, in which case the Contractor shall immediately advise the Engineer.

6.6 Facilities for Staff and Labour

Except as otherwise stated in the Specification, the Contractor shall provide and maintain all necessary accommodation and welfare facilities for the Contractor's Personnel. The Contractor shall also provide facilities for the Employer's Personnel as stated in the Specification.

The Contractor shall not permit any of the Contractor's Personnel to maintain any temporary or permanent living quarters within the structures forming part of the Permanent Works.

6.7 Health and Safety

The Contractor shall at all times take all reasonable precautions to maintain the health and safety of the Contractor's Personnel. In

collaboration with local health authorities, the Contractor shall ensure that medical staff, first aid facilities, sick bay and ambulance service are available at all times at the Site and at any accommodation for Contractor's and Employer's Personnel, and that suitable arrangements are made for all necessary welfare and hygiene requirements and for the prevention of epidemics.

The Contractor shall appoint an accident prevention officer at the Site, responsible for maintaining safety and protection against accidents. This person shall be qualified for this responsibility, and shall have the authority to issue instructions and take protective measures to prevent accidents. Throughout the execution of the Works, the Contractor shall provide whatever is required by this person to exercise this responsibility and authority.

The Contractor shall send, to the Engineer, details of any accident as soon as practicable after its occurrence. The Contractor shall maintain records and make reports concerning health, safety and welfare of persons, and damage to property, as the Engineer may reasonably require.

HIV-AIDS Prevention. The Contractor shall conduct an HIV-AIDS awareness programme via an approved service provider, and shall undertake such other measures as are specified in this Contract to reduce the risk of the transfer of the HIV virus between and among the Contractor's Personnel and the local community, to promote early diagnosis and to assist affected individuals.

The Contractor shall throughout the contract (including the Defects Notification Period): (i) conduct Information, Education and Consultation Communication (IEC) campaigns, at least every other month, addressed to all the Site staff and labour (including all the Contractor's employees, all Sub-Contractors and Consultants' employees, and all truck drivers and crew making deliveries to Site for construction activities) and to the immediate local communities, concerning the risks, dangers and impact, and appropriate avoidance behavior with respect to of Sexually Transmitted Diseases (STD)—or Sexually Transmitted Infections (STI) in general and HIV/AIDS in particular; (ii) provide male or female condoms for all Site staff and labour as appropriate; and (iii) provide for STI and HIV/AIDS screening, diagnosis, counseling and referral to a dedicated national STI and HIV/AIDS program, (unless otherwise agreed) of all Site staff and labour.

The Contractor shall include in the program to be submitted for the execution of the Works under Sub-Clause 8.3 [Programme] an alleviation program for Site staff and labour and their families in respect of Sexually Transmitted Infections (STI) and Sexually Transmitted Diseases (STD) including HIV/AIDS. The STI, STD and HIV/AIDS alleviation program shall indicate when, how and at what cost the Contractor plans to satisfy the requirements of this Sub-Clause and the related specification. For each component, the program shall detail the resources to be provided or utilized and any related sub-contracting proposed. The program shall also include provision of a

detailed cost estimate with supporting documentation. Payment to the Contractor for preparation and implementation this program shall not exceed the Provisional Sum dedicated for this purpose.

6.8 Contractor's Superintendence

Throughout the execution of the Works, and as long thereafter as is necessary to fulfil the Contractor's obligations, the Contractor shall provide all necessary superintendence to plan, arrange, direct, manage, inspect and test the work.

Superintendence shall be given by a sufficient number of persons having adequate knowledge of the language for communications (defined in Sub-Clause 1.4 [Law and Language]) and of the operations to be carried out (including the methods and techniques required, the hazards likely to be encountered and methods of preventing accidents), for the satisfactory and safe execution of the Works.

6.9 Contractor's Personnel

The Contractor's Personnel shall be appropriately qualified, skilled and experienced in their respective trades or occupations. The Engineer may require the Contractor to remove (or cause to be removed) any person employed on the Site or Works, including the Contractor's Representative if applicable, who:

(a) persists in any misconduct or lack of care,

(b) carries out duties incompetently or negligently,

(c) fails to conform with any provisions of the Contract, or

(d) persists in any conduct which is prejudicial to safety, health, or the protection of the environment.

If appropriate, the Contractor shall then appoint (or cause to be appointed) a suitable replacement person.

6.10 Records of Contractor's Personnel and Equipment

The Contractor shall submit, to the Engineer, details showing the number of each class of Contractor's Personnel and of each type of Contractor's Equipment on the Site. Details shall be submitted each calendar month, in a form approved by the Engineer, until the Contractor has completed all work which is known to be outstanding at the completion date stated in the Taking-Over Certificate for the Works.

6.11 Disorderly Conduct

The Contractor shall at all times take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or amongst the Contractor's Personnel, and to preserve peace and protection of persons and property on and near the Site.

6.12 Foreign Personnel

The Contractor may bring in to the Country any foreign personnel who are necessary for the execution of the Works to the extent allowed by the applicable Laws. The Contractor shall ensure that these personnel are provided with the required residence visas and work permits. The Employer will, if requested by the Contractor, use his best endeavours in a timely and expeditious manner to assist the Contractor in obtaining any local, state, national, or government permission required

for bringing in the Contractor's personnel.

The Contractor shall be responsible for the return of these personnel to the place where they were recruited or to their domicile. In the event of the death in the Country of any of these personnel or members of their families, the Contractor shall similarly be responsible for making the appropriate arrangements for their return or burial.

6.13 Supply of Foodstuffs

The Contractor shall arrange for the provision of a sufficient supply of suitable food as may be stated in the Specification at reasonable prices for the Contractor's Personnel for the purposes of or in connection with the Contract.

6.14 Supply of Water

The Contractor shall, having regard to local conditions, provide on the Site an adequate supply of drinking and other water for the use of the Contractor's Personnel.

6.15 Measures against Insect and Pest Nuisance

The Contractor shall at all times take the necessary precautions to protect the Contractor's Personnel employed on the Site from insect and pest nuisance, and to reduce their danger to health. The Contractor shall comply with all the regulations of the local health authorities, including use of appropriate insecticide.

6.16 Alcoholic Liquor or Drugs

The Contractor shall not, otherwise than in accordance with the Laws of the Country, import, sell, give barter or otherwise dispose of any alcoholic liquor or drugs, or permit or allow importation, sale, gift barter or disposal thereto by Contractor's Personnel.

6.17 Arms and Ammunition

The Contractor shall not give, barter, or otherwise dispose of, to any person, any arms or ammunition of any kind, or allow Contractor's Personnel to do so.

6.18 Festivals and Religious Customs

The Contractor shall respect the Country's recognized festivals, days of rest and religious or other customs.

6.19 Funeral Arrangements

The Contractor shall be responsible, to the extent required by local regulations, for making any funeral arrangements for any of his local employees who may die while engaged upon the Works.

6.20 Prohibition of Forced or Compulsory Labour

The contractor shall not employ "forced or compulsory labour" in any form. "Forced or compulsory labour" consists of all work or service, not voluntarily performed, that is extracted from an individual under threat of force or penalty.

6.21 Prohibition of Harmful Child Labour

The Contractor shall not employ any child to perform any work that is economically exploitative, or is likely to be hazardous to, or to interfere with, the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development.

6.22 Employment Records of Workers

The Contractor shall keep complete and accurate records of the employment of labour at the Site. The records shall include the names, ages, genders, hours worked and wages paid to all workers. These records shall be summarized on a monthly basis and submitted to the Engineer, and these records shall be available for inspection by Auditors during normal working hours. These records shall be included in the details to be submitted by the Contractor under Sub-Clause 6.10 [Records of Contractor's Personnel and Equipment].

7. Plant, Materials and Workmanship

7.1 Manner of Execution

The Contractor shall carry out the manufacture of Plant, the production and manufacture of Materials, and all other execution of the Works:

(a) in the manner (if any) specified in the Contract,

(b) in a proper workmanlike and careful manner, in accordance with recognised good practice, and

(c) with properly equipped facilities and non-hazardous Materials, except as otherwise specified in the Contract.

7.2 Samples

The Contractor shall submit the following samples of Materials, and relevant information, to the Engineer for consent prior to using the Materials in or for the Works:

(a) manufacturer's standard samples of Materials and samples specified in the Contract, all at the Contractor's cost, and

(b) additional samples instructed by the Engineer as a Variation.

Each sample shall be labelled as to origin and intended use in the Works.

7.3 Inspection

The Employer's Personnel shall at all reasonable times:

(a) have full access to all parts of the Site and to all places from which natural Materials are being obtained, and

(b) during production, manufacture and construction (at the Site and elsewhere), be entitled to examine, inspect, measure and test the materials and workmanship, and to check the progress of manufacture of Plant and production and manufacture of Materials.

The Contractor shall give the Employer's Personnel full opportunity to carry out these activities, including providing access, facilities, permissions and safety equipment. No such activity shall relieve the Contractor from any obligation or responsibility.

The Contractor shall give notice to the Engineer whenever any work is ready and before it is covered up, put out of sight, or packaged for storage or transport. The Engineer shall then either carry out the examination, inspection, measurement or testing without unreasonable delay, or promptly give notice to the Contractor that the Engineer does not require to do so. If the Contractor fails to give the notice, he shall, if and when required by the Engineer, uncover the work and thereafter

reinstate and make good, all at the Contractor's cost.

7.4 Testing

This Sub-Clause shall apply to all tests specified in the Contract, other than the Tests after Completion (if any).

Except as otherwise specified in the Contract, the Contractor shall provide all apparatus, assistance, documents and other information, electricity, equipment, fuel, consumables, instruments, labour, materials, and suitably qualified and experienced staff, as are necessary to carry out the specified tests efficiently. The Contractor shall agree, with the Engineer, the time and place for the specified testing of any Plant, Materials and other parts of the Works.

The Engineer may, under Clause 13 [Variations and Adjustments], vary the location or details of specified tests, or instruct the Contractor to carry out additional tests. If these varied or additional tests show that the tested Plant, Materials or workmanship is not in accordance with the Contract, the cost of carrying out this Variation shall be borne by the Contractor, notwithstanding other provisions of the Contract.

The Engineer shall give the Contractor not less than 24 hours' notice of the Engineer's intention to attend the tests. If the Engineer does not attend at the time and place agreed, the Contractor may proceed with the tests, unless otherwise instructed by the Engineer, and the tests shall then be deemed to have been made in the Engineer's presence.

If the Contractor suffers delay and/or incurs Cost from complying with these instructions or as a result of a delay for which the Employer is responsible, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost plus profit, which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

The Contractor shall promptly forward to the Engineer duly certified reports of the tests. When the specified tests have been passed, the Engineer shall endorse the Contractor's test certificate, or issue a certificate to him, to that effect. If the Engineer has not attended the tests, he shall be deemed to have accepted the readings as accurate.

7.5 Rejection

If, as a result of an examination, inspection, measurement or testing, any Plant, Materials or workmanship is found to be defective or otherwise not in accordance with the Contract, the Engineer may reject the Plant, Materials or workmanship by giving notice to the Contractor, with reasons. The Contractor shall then promptly make good the defect and ensure that the rejected item complies with the Contract.

If the Engineer requires this Plant, Materials or workmanship to be retested, the tests shall be repeated under the same terms and conditions. If the rejection and retesting cause the Employer to incur additional costs, the Contractor shall subject to Sub-Clause 2.5 [Employer's Claims] pay these costs to the Employer.

7.6 Remedial Work

Notwithstanding any previous test or certification, the Engineer may instruct the Contractor to:

(a) remove from the Site and replace any Plant or Materials which is not in accordance with the Contract,

(b) remove and re-execute any other work which is not in accordance with the Contract, and

(c) execute any work which is urgently required for the safety of the Works, whether because of an accident, unforeseeable event or otherwise.

The Contractor shall comply with the instruction within a reasonable time, which shall be the time (if any) specified in the instruction, or immediately if urgency is specified under sub-paragraph (c).

If the Contractor fails to comply with the instruction, the Employer shall be entitled to employ and pay other persons to carry out the work. Except to the extent that the Contractor would have been entitled to payment for the work, the Contractor shall subject to Sub-Clause 2.5 [Employer's Claims] pay to the Employer all costs arising from this failure.

7.7 Ownership of Plant and Materials

Except otherwise specified in the Contract, each item of Plant and Materials shall, to the extent consistent with the Laws of the Country, become the property of the Employer at whichever is the earlier of the following times, free from liens and other encumbrances:

(a) when it is incorporated in the Works;

(b) when the Contractor is paid the corresponding value of the Plant and Materials under Sub-Clause 8.10 [Payment for Plant and Materials in Event of Suspension].

7.8 Royalties

Unless otherwise stated in the Specification, the Contractor shall pay all royalties, rents and other payments for:

(a) natural Materials obtained from outside the Site, and

(b) the disposal of material from demolitions and excavations and of other surplus material (whether natural or man-made), except to the extent that disposal areas within the Site are specified in the Contract.

8. Commencement, Delays and Suspension

8.1 Commencement of Works

Except otherwise specified in the Particular Conditions, the Commencement Date shall be the date at which the following

precedent conditions have all been fulfilled and the Engineer's instruction recording the agreement of both Parties on such fulfilment and instructing to commence the Works is received by the Contractor:

(a) signature of the Contract Agreement by both Parties, and if required, approval of the Contract by relevant authorities in the Country;

(b) delivery to the Contractor of reasonable evidence of the Employer's Financial arrangements (under Sub-Clause 2.4 [Employer's Financial Arrangements])

(c) except if otherwise specified in the Contract Data, possession of the Site given to the Contractor together with such permission(s) under (a) of Sub-Clause 1.13 [Compliance with Laws] as required for the commencement of the Works; and

(d) receipt by the Contractor of the Advance Payment under Sub-Clause 14.2 [Advance Payment] provided that the corresponding bank guarantee has been delivered by the Contractor.

(e) If the said Engineer's instruction is not received by the Contractor within 180 days from his receipt of the Letter of Acceptance, the Contractor shall be entitled to terminate the Contract under Sub-Clause 16.2 [Termination by Contractor].

The Contractor shall commence the execution of the Works as soon as is reasonably practicable after the Commencement Date, and shall then proceed with the Works with due expedition and without delay.

8.2 Time for Completion

The Contractor shall complete the whole of the Works, and each Section (if any), within the Time for Completion for the Works or Section (as the case may be), including:

(a) achieving the passing of the Tests on Completion, and

(b) completing all work which is stated in the Contract as being required for the Works or Section to be considered to be completed for the purposes of taking-over under Sub-Clause 10.1 [Taking Over of the Works and Sections].

8.3 Programme

The Contractor shall submit a detailed time programme to the Engineer within 28 days after receiving the notice under Sub-Clause 8.1 [Commencement of Works]. The Contractor shall also submit a revised programme whenever the previous programme is inconsistent with actual progress or with the Contractor's obligations. Each programme shall include:

(a) the order in which the Contractor intends to carry out the Works, including the anticipated timing of each stage of design (if any), Contractor's Documents, procurement, manufacture of Plant, delivery to Site, construction, erection and testing,

(b) each of these stages for work by each nominated Subcontractor

(as defined in Clause 5 [Nominated Subcontractors]),

(c) the sequence and timing of inspections and tests specified in the Contract, and

(d) a supporting report which includes:

(i) a general description of the methods which the Contractor intends to adopt, and of the major stages, in the execution of the Works, and

(ii) details showing the Contractor's reasonable estimate of the number of each class of Contractor's Personnel and of each type of Contractor's Equipment, required on the Site for each major stage.

Unless the Engineer, within 21 days after receiving a programme, gives notice to the Contractor stating the extent to which it does not comply with the Contract, the Contractor shall proceed in accordance with the programme, subject to his other obligations under the Contract. The Employer's Personnel shall be entitled to rely upon the programme when planning their activities.

The Contractor shall promptly give notice to the Engineer of specific probable future events or circumstances which may adversely affect the work, increase the Contract Price, or delay the execution of the Works. The Engineer may require the Contractor to submit an estimate of the anticipated effect of the future event or circumstances, and/or a proposal under Sub-Clause 13.3 [Variation Procedure].

If, at any time, the Engineer gives notice to the Contractor that a programme fails (to the extent stated) to comply with the Contract or to be consistent with actual progress and the Contractor's stated intentions, the Contractor shall submit a revised programme to the Engineer in accordance with this Sub-Clause.

8.4 Extension of Time for Completion

The Contractor shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to an extension of the Time for Completion if and to the extent that completion for the purposes of Sub-Clause 10.1 [Taking-Over of the Works and Sections] is or will be delayed by any of the following causes:

(a) a Variation (unless an adjustment to the Time for Completion has been agreed under Sub-Clause 13.3 [Variation Procedure]) or other substantial change in the quantity of an item of work included in the Contract,

(b) a cause of delay giving an entitlement to extension of time under a Sub-Clause of these Conditions,

(c) exceptionally adverse climatic conditions,

(d) Unforeseeable shortages in the availability of personnel or Goods caused by epidemic or governmental actions, or

(e) any delay, impediment or prevention caused by or attributable to

the Employer, the Employer's Personnel, or the Employer's other contractors.

If the Contractor considers himself to be entitled to an extension of the Time for Completion, the Contractor shall give notice to the Engineer in accordance with Sub-Clause 20.1 [Contractor's Claims]. When determining each extension of time under Sub-Clause 20.1, the Engineer shall review previous determinations and may increase, but shall not decrease, the total extension of time.

8.5 Delays Caused by Authorities

If the following conditions apply, namely:

(a) the Contractor has diligently followed the procedures laid down by the relevant legally constituted public authorities in the Country,

(b) these authorities delay or disrupt the Contractor's work, and

(c) the delay or disruption was Unforeseeable,

then this delay or disruption will be considered as a cause of delay under sub-paragraph (b) of Sub-Clause 8.4 [Extension of Time for Completion].

8.6 Rate of Progress

If, at any time:

(a) actual progress is too slow to complete within the Time for Completion, and/or

(b) progress has fallen (or will fall) behind the current programme under Sub-Clause 8.3 [Programme],

other than as a result of a cause listed in Sub-Clause 8.4 [Extension of Time for Completion], then the Engineer may instruct the Contractor to submit, under Sub-Clause 8.3 [Programme], a revised programme and supporting report describing the revised methods which the Contractor proposes to adopt in order to expedite progress and complete within the Time for Completion.

Unless the Engineer notifies otherwise, the Contractor shall adopt these revised methods, which may require increases in the working hours and/or in the numbers of Contractor's Personnel and/or Goods, at the risk and cost of the Contractor. If these revised methods cause the Employer to incur additional costs, the Contractor shall subject to notice under Sub-Clause 2.5 [Employer's Claims] pay these costs to the Employer, in addition to delay damages (if any) under Sub-Clause 8.7 [Delay Damages] below.

Additional costs of revised methods, including acceleration measures, instructed by the Engineer to reduce delays resulting from causes listed under Sub-Clause 8.4 [Extension of Time for Completion] shall be paid by the Employer, without generating, however, any other additional payment benefit to the Contractor.

8.7 Delay Damages

If the Contractor fails to comply with Sub-Clause 8.2 [Time for Completion], the Contractor shall be subject to notice under Sub-Clause

2.5 [Employer's Claims] pay delay damages to the Employer for this default. These delay damages shall be the sum stated in the Contract Data, which shall be paid for every day which shall elapse between the relevant Time for Completion and the date stated in the Taking-Over Certificate. However, the total amount due under this Sub-Clause shall not exceed the maximum amount of delay damages (if any) stated in the Contract Data.

These delay damages shall be the only damages due from the Contractor for such default, other than in the event of termination under Sub-Clause 15.2 [Termination by Employer] prior to completion of the Works. These damages shall not relieve the Contractor from his obligation to complete the Works, or from any other duties, obligations or responsibilities which he may have under the Contract.

8.8 Suspension of Work

The Engineer may at any time instruct the Contractor to suspend progress of part or all of the Works. During such suspension, the Contractor shall protect, store and secure such part or the Works against any deterioration, loss or damage.

The Engineer may also notify the cause for the suspension. If and to the extent that the cause is notified and is the responsibility of the Contractor, the following Sub-Clauses 8.9 [Consequences of Suspension], 8.10 [Payment for Plant and Materials in Event of Suspension] and 8.11 [Prolonged Suspension] shall not apply.

8.9 Consequences of Suspension

If the Contractor suffers delay and/or incurs Cost from complying with the Engineer's instructions under Sub-Clause 8.8 [Suspension of Work] and/or from resuming the work, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost, which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

The Contractor shall not be entitled to an extension of time for, or to payment of the Cost incurred in, making good the consequences of the Contractor's faulty design, workmanship or materials, or of the Contractor's failure to protect, store or secure in accordance with Sub-Clause 8.8 [Suspension of Work].

8.10 Payment for Plant and Materials in Event of Suspension

The Contractor shall be entitled to payment of the value (as at the date of suspension) of Plant and/or Materials which have not been delivered to Site, if:

(a) the work on Plant or delivery of Plant and/or Materials has been suspended for more than 28 days, and

(b) the Contractor has marked the Plant and/or Materials as the Employer's property in accordance with the Engineer's instructions.

8.11 Prolonged Suspension

If the suspension under Sub-Clause 8.8 [Suspension of Work] has continued for more than 84 days, the Contractor may request the Engineer's permission to proceed. If the Engineer does not give permission within 28 days after being requested to do so, the Contractor may, by giving notice to the Engineer, treat the suspension as an omission under Clause 13 [Variations and Adjustments] of the affected part of the Works. If the suspension affects the whole of the Works, the Contractor may give notice of termination under Sub-Clause 16.2 [Termination by Contractor].

8.12 Resumption of Work

After the permission or instruction to proceed is given, the Contractor and the Engineer shall jointly examine the Works and the Plant and Materials affected by the suspension. The Contractor shall make good any deterioration or defect in or loss of the Works or Plant or Materials, which has occurred during the suspension after receiving from the Engineer an instruction to this effect under Clause 13 [Variations and Adjustments].

9. Tests on Completion

9.1 Contractor's Obligations

The Contractor shall carry out the Tests on Completion in accordance with this Clause and Sub-Clause 7.4 [Testing], after providing the documents in accordance with sub-paragraph (d) of Sub-Clause 4.1 [Contractor's General Obligations].

The Contractor shall give to the Engineer not less than 21 days' notice of the date after which the Contractor will be ready to carry out each of the Tests on Completion. Unless otherwise agreed, Tests on Completion shall be carried out within 14 days after this date, on such day or days as the Engineer shall instruct.

In considering the results of the Tests on Completion, the Engineer shall make allowances for the effect of any use of the Works by the Employer on the performance or other characteristics of the Works. As soon as the Works, or a Section, have passed any Tests on Completion, the Contractor shall submit a certified report of the results of these Tests to the Engineer.

9.2 Delayed Tests

If the Tests on Completion are being unduly delayed by the Employer, Sub-Clause 7.4 [Testing] (fifth paragraph) and/or Sub-Clause 10.3 [Interference with Tests on Completion] shall be applicable.

If the Tests on Completion are being unduly delayed by the Contractor, the Engineer may by notice require the Contractor to carry out the Tests within 21 days after receiving the notice. The Contractor shall carry out the Tests on such day or days within that period as the Contractor may fix and of which he shall give notice to the Engineer.

If the Contractor fails to carry out the Tests on Completion within the period of 21 days, the Employer's Personnel may proceed with the

Tests at the risk and cost of the Contractor. The Tests on Completion shall then be deemed to have been carried out in the presence of the Contractor and the results of the Tests shall be accepted as accurate.

9.3 Retesting

If the Works, or a Section, fail to pass the Tests on Completion, Sub-Clause 7.5 [Rejection] shall apply, and the Engineer or the Contractor may require the failed Tests, and Tests on Completion on any related work, to be repeated under the same terms and conditions.

9.4 Failure to Pass Tests on Completion

If the Works, or a Section, fail to pass the Tests on Completion repeated under Sub-Clause 9.3 [Retesting], the Engineer shall be entitled to:

(a) order further repetition of Tests on Completion under Sub-Clause 9.3;

(b) if the failure deprives the Employer of substantially the whole benefit of the Works or Section, reject the Works or Section (as the case may be), in which event the Employer shall have the same remedies as are provided in sub-paragraph (c) of Sub-Clause 11.4 [Failure to Remedy Defects]; or

(c) issue a Taking-Over Certificate, if the Employer so requests.

In the event of sub-paragraph (c), the Contractor shall proceed in accordance with all other obligations under the Contract, and the Contract Price shall be reduced by such amount as shall be appropriate to cover the reduced value to the Employer as a result of this failure. Unless the relevant reduction for this failure is stated (or its method of calculation is defined) in the Contract, the Employer may require the reduction to be (i) agreed by both Parties (in full satisfaction of this failure only) and paid before this Taking-Over Certificate is issued, or (ii) determined and paid under Sub-Clause 2.5 [Employer's Claims] and Sub-Clause 3.5 [Determinations].

10. Employer's Taking Over

10.1 Taking Over of the Works and Sections

Except as stated in Sub-Clause 9.4 [Failure to Pass Tests on Completion], the Works shall be taken over by the Employer when (i) the Works have been completed in accordance with the Contract, including the matters described in Sub-Clause 8.2 [Time for Completion] and except as allowed in sub-paragraph (a) below, and (ii) a Taking-Over Certificate for the Works has been issued, or is deemed to have been issued in accordance with this Sub-Clause.

The Contractor may apply by notice to the Engineer for a Taking-Over Certificate not earlier than 14 days before the Works will, in the Contractor's opinion, be complete and ready for taking over. If the Works are divided into Sections, the Contractor may similarly apply for a Taking-Over Certificate for each Section.

The Engineer shall, within 28 days after receiving the Contractor's application:

(a) issue the Taking-Over Certificate to the Contractor, stating the date on which the Works or Section were completed in

accordance with the Contract, except for any minor outstanding work and defects which will not substantially affect the use of the Works or Section for their intended purpose (either until or whilst this work is completed and these defects are remedied); or

(b) reject the application, giving reasons and specifying the work required to be done by the Contractor to enable the Taking-Over Certificate to be issued. The Contractor shall then complete this work before issuing a further notice under this Sub-Clause.

If the Engineer fails either to issue the Taking-Over Certificate or to reject the Contractor's application within the period of 28 days, and if the Works or Section (as the case may be) are substantially in accordance with the Contract, the Taking-Over Certificate shall be deemed to have been issued on the last day of that period.

10.2 Taking Over of Parts of the Works

The Engineer may, at the sole discretion of the Employer, issue a Taking-Over Certificate for any part of the Permanent Works.

The Employer shall not use any part of the Works (other than as a temporary measure which is either specified in the Contract or agreed by both Parties) unless and until the Engineer has issued a Taking-Over Certificate for this part. However, if the Employer does use any part of the Works before the Taking-Over Certificate is issued:

(a) the part which is used shall be deemed to have been taken over as from the date on which it is used,

(b) the Contractor shall cease to be liable for the care of such part as from this date, when responsibility shall pass to the Employer, and

(c) if requested by the Contractor, the Engineer shall issue a Taking-Over Certificate for this part.

After the Engineer has issued a Taking-Over Certificate for a part of the Works, the Contractor shall be given the earliest opportunity to take such steps as may be necessary to carry out any outstanding Tests on Completion. The Contractor shall carry out these Tests on Completion as soon as practicable before the expiry date of the relevant Defects Notification Period.

If the Contractor incurs Cost as a result of the Employer taking over and/or using a part of the Works, other than such use as is specified in the Contract or agreed by the Contractor, the Contractor shall (i) give notice to the Engineer and (ii) be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to payment of any such Cost plus profit, which shall be included in the Contract Price. After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine this Cost and profit.

If a Taking-Over Certificate has been issued for a part of the Works (other than a Section), the delay damages thereafter for completion of the remainder of the Works shall be reduced. Similarly, the delay damages for the remainder of the Section (if any) in which this part is

included shall also be reduced. For any period of delay after the date stated in this Taking-Over Certificate, the proportional reduction in these delay damages shall be calculated as the proportion which the value of the part so certified bears to the value of the Works or Section (as the case may be) as a whole. The Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these proportions. The provisions of this paragraph shall only apply to the daily rate of delay damages under Sub-Clause 8.7 [Delay Damages], and shall not affect the maximum amount of these damages.

10.3 Interference with Tests on Completion

If the Contractor is prevented, for more than 14 days, from carrying out the Tests on Completion by a cause for which the Employer is responsible, the Employer shall be deemed to have taken over the Works or Section (as the case may be) on the date when the Tests on Completion would otherwise have been completed.

The Engineer shall then issue a Taking-Over Certificate accordingly, and the Contractor shall carry out the Tests on Completion as soon as practicable, before the expiry date of the Defects Notification Period. The Engineer shall require the Tests on Completion to be carried out by giving 14 days' notice and in accordance with the relevant provisions of the Contract.

If the Contractor suffers delay and/or incurs Cost as a result of this delay in carrying out the Tests on Completion, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost plus profit, which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

10.4 Surfaces Requiring Reinstatement

Except as otherwise stated in a Taking-Over Certificate, a certificate for a Section or part of the Works shall not be deemed to certify completion of any ground or other surfaces requiring reinstatement.

11. Defects Liability

11.1 Completion of Outstanding Work and Remedying Defects

In order that the Works and Contractor's Documents, and each Section, shall be in the condition required by the Contract (fair wear and tear excepted) by the expiry date of the relevant Defects Notification Period or as soon as practicable thereafter, the Contractor shall:

(a) complete any work which is outstanding on the date stated in a Taking-Over Certificate, within such reasonable time as is

instructed by the Engineer, and

(b) execute all work required to remedy defects or damage, as may be notified by (or on behalf of) the Employer on or before the expiry date of the Defects Notification Period for the Works or Section (as the case may be).

If a defect appears or damage occurs, the Contractor shall be notified accordingly, by (or on behalf of) the Employer.

11.2 Cost of Remedying Defects

All work referred to in sub-paragraph (b) of Sub-Clause 11.1 [Completion of Outstanding Work and Remedying Defects] shall be executed at the risk and cost of the Contractor, if and to the extent that the work is attributable to:

(a) any design for which the Contractor is responsible,

(b) Plant, Materials or workmanship not being in accordance with the Contract, or

(c) failure by the Contractor to comply with any other obligation.

If and to the extent that such work is attributable to any other cause, the Contractor shall be notified promptly by (or on behalf of) the Employer and Sub-Clause 13.3 [Variation Procedure] shall apply.

11.3 Extension of Defects Notification Period

The Employer shall be entitled subject to Sub-Clause 2.5 [Employer's Claims] to an extension of the Defects Notification Period for the Works or a Section if and to the extent that the Works, Section or a major item of Plant (as the case may be, and after taking over) cannot be used for the purposes for which they are intended by reason of a defect or by reason of a damage attributable to the Contractor. However, a Defects Notification Period shall not be extended by more than two years.

If delivery and/or erection of Plant and/or Materials was suspended under Sub-Clause 8.8 [Suspension of Work] or Sub-Clause 16.1 [Contractor's Entitlement to Suspend Work], the Contractor's obligations under this Clause shall not apply to any defects or damage occurring more than two years after the Defects Notification Period for the Plant and/or Materials would otherwise have expired.

11.4 Failure to Remedy Defects

If the Contractor fails to remedy any defect or damage within a reasonable time, a date may be fixed by (or on behalf of) the Employer, on or by which the defect or damage is to be remedied. The Contractor shall be given reasonable notice of this date.

If the Contractor fails to remedy the defect or damage by this notified date and this remedial work was to be executed at the cost of the Contractor under Sub-Clause 11.2 [Cost of Remedying Defects], the Employer may (at his option):

(a) carry out the work himself or by others, in a reasonable manner and at the Contractor's cost, but the Contractor shall have no responsibility for this work; and the Contractor shall subject to

Sub-Clause 2.5 [Employer's Claims] pay to the Employer the costs reasonably incurred by the Employer in remedying the defect or damage;

(b) require the Engineer to agree or determine a reasonable reduction in the Contract Price in accordance with Sub-Clause 3.5 [Determinations]; or

(c) if the defect or damage deprives the Employer of substantially the whole benefit of the Works or any major part of the Works, terminate the Contract as a whole, or in respect of such major part which cannot be put to the intended use. Without prejudice to any other rights, under the Contract or otherwise, the Employer shall then be entitled to recover all sums paid for the Works or for such part (as the case may be), plus financing costs and the cost of dismantling the same, clearing the Site and returning Plant and Materials to the Contractor.

11.5 Removal of Defective Work

If the defect or damage cannot be remedied expeditiously on the Site and the Employer gives consent, the Contractor may remove from the Site for the purposes of repair such items of Plant as are defective or damaged. This consent may require the Contractor to increase the amount of the Performance Security by the full replacement cost of these items, or to provide other appropriate security.

11.6 Further Tests

If the work of remedying of any defect or damage may affect the performance of the Works, the Engineer may require the repetition of any of the tests described in the Contract. The requirement shall be made by notice within 28 days after the defect or damage is remedied.

These tests shall be carried out in accordance with the terms applicable to the previous tests, except that they shall be carried out at the risk and cost of the Party liable, under Sub-Clause 11.2 [Cost of Remedying Defects], for the cost of the remedial work.

11.7 Right of Access

Until the Performance Certificate has been issued, the Contractor shall have such right of access to the Works as is reasonably required in order to comply with this Clause, except as may be inconsistent with the Employer's reasonable security restrictions.

11.8 Contractor to Search

The Contractor shall, if required by the Engineer, search for the cause of any defect, under the direction of the Engineer. Unless the defect is to be remedied at the cost of the Contractor under Sub-Clause 11.2 [Cost of Remedying Defects], the Cost of the search plus profit shall be agreed or determined by the Engineer in accordance with Sub-Clause 3.5 [Determinations] and shall be included in the Contract Price.

11.9 Performance Certificate

Performance of the Contractor's obligations shall not be considered to have been completed until the Engineer has issued the Performance Certificate to the Contractor, stating the date on which the Contractor completed his obligations under the Contract.

The Engineer shall issue the Performance Certificate within 28 days after the latest of the expiry dates of the Defects Notification Periods, or as soon thereafter as the Contractor has supplied all the Contractor's

Documents and completed and tested all the Works, including remedying any defects. A copy of the Performance Certificate shall be issued to the Employer.

Only the Performance Certificate shall be deemed to constitute acceptance of the Works.

11.10 Unfulfilled Obligations

After the Performance Certificate has been issued, each Party shall remain liable for the fulfilment of any obligation which remains unperformed at that time. For the purposes of determining the nature and extent of unperformed obligations, the Contract shall be deemed to remain in force.

11.11 Clearance of Site

Upon receiving the Performance Certificate, the Contractor shall remove any remaining Contractor's Equipment, surplus material, wreckage, rubbish and Temporary Works from the Site.

If all these items have not been removed within 28 days after receipt by the Contractor of the Performance Certificate, the Employer may sell or otherwise dispose of any remaining items. The Employer shall be entitled to be paid the costs incurred in connection with, or attributable to, such sale or disposal and restoring the Site.

Any balance of the moneys from the sale shall be paid to the Contractor. If these moneys are less than the Employer's costs, the Contractor shall pay the outstanding balance to the Employer.

12. Measurement and Evaluation

12.1 Works to be Measured

The Works shall be measured, and valued for payment, in accordance with this Clause. The Contractor shall show in each application under Sub-Clauses 14.3 [Application for Interim Payment Certificates], 14.10 [Statement at Completion], and 14.11 [Application for Final Payment Certificate] the quantities and other particulars detailing the amounts which he considers to be entitled under the Contract.

Whenever the Engineer requires any part of the Works to be measured, reasonable notice shall be given to the Contractor's Representative, who shall:

(a) promptly either attend or send another qualified representative to assist the Engineer in making the measurement, and

(b) supply any particulars requested by the Engineer.

If the Contractor fails to attend or send a representative, the measurement made by (or on behalf of) the Engineer shall be accepted as accurate.

Except as otherwise stated in the Contract, wherever any Permanent Works are to be measured from records, these shall be prepared by the Engineer. The Contractor shall, as and when requested, attend to examine and agree the records with the Engineer, and shall sign the same when agreed. If the Contractor does not attend, the records shall be accepted as accurate.

If the Contractor examines and disagrees the records, and/or does not sign them as agreed, then the Contractor shall give notice to the Engineer of the respects in which the records are asserted to be inaccurate. After receiving this notice, the Engineer shall review the records and either confirm or vary them and certify the payment of the undisputed part. If the Contractor does not so give notice to the Engineer within 14 days after being requested to examine the records, they shall be accepted as accurate.

12.2 Method of Measurement

Except as otherwise stated in the Contract and notwithstanding local practice:

(a) measurement shall be made of the net actual quantity of each item of the Permanent Works, and

(b) the method of measurement shall be in accordance with the Bill of Quantities or other applicable Schedules.

12.3 Evaluation

Except as otherwise stated in the Contract, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine the Contract Price by evaluating each item of work, applying the measurement agreed or determined in accordance with the above Sub-Clauses 12.1 [Works to be Measured] and 12.2 [Method of Measurement] and the appropriate rate or price for the item.

For each item of work, the appropriate rate or price for the item shall be the rate or price specified for such item in the Contract or, if there is no such item, specified for similar work.

Any item of work included in the Bill of Quantities for which no rate or price was specified shall be considered as included in other rates and prices in the Bill of Quantities and will not be paid for separately.

However, a new rate or price shall be appropriate for an item of work if:

(a)

(i) the measured quantity of the item is changed by more than 25% from the quantity of this item in the Bill of Quantities or other Schedule,

(ii) this change in quantity multiplied by such specified rate for this item exceeds 0.25% of the Accepted Contract Amount,

(iii) this change in quantity directly changes the Cost per unit quantity of this item by more than 1%, and

(iv) this item is not specified in the Contract as a "fixed rate item";

or

(b)

(i) the work is instructed under Clause 13 [Variations and

Adjustments],

(ii) no rate or price is specified in the Contract for this item, and

(iii) no specified rate or price is appropriate because the item of work is not of similar character, or is not executed under similar conditions, as any item in the Contract.

Each new rate or price shall be derived from any relevant rates or prices in the Contract, with reasonable adjustments to take account of the matters described in sub-paragraph (a) and/or (b), as applicable. If no rates or prices are relevant for the derivation of a new rate or price, it shall be derived from the reasonable Cost of executing the work, together with profit, taking account of any other relevant matters.

Until such time as an appropriate rate or price is agreed or determined, the Engineer shall determine a provisional rate or price for the purposes of Interim Payment Certificates as soon as the concerned Works commences.

12.4 Omissions

Whenever the omission of any work forms part (or all) of a Variation, the value of which has not been agreed, if:

(a) the Contractor will incur (or has incurred) cost which, if the work had not been omitted, would have been deemed to be covered by a sum forming part of the Accepted Contract Amount;

(b) the omission of the work will result (or has resulted) in this sum not forming part of the Contract Price; and

(c) this cost is not deemed to be included in the evaluation of any substituted work;

then the Contractor shall give notice to the Engineer accordingly, with supporting particulars. Upon receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine this cost, which shall be included in the Contract Price.

13. Variations and Adjustments

13.1 Right to Vary

Variations may be initiated by the Engineer at any time prior to issuing the Taking-Over Certificate for the Works, either by an instruction or by a request for the Contractor to submit a proposal.

The Contractor shall execute and be bound by each Variation, unless the Contractor promptly gives notice to the Engineer stating (with supporting particulars) that (i) the Contractor cannot readily obtain the Goods required for the Variation, or (ii) such Variation triggers a substantial change in the sequence or progress of the Works. Upon receiving this notice, the Engineer shall cancel, confirm or vary the instruction.

Each Variation may include:

(a) changes to the quantities of any item of work included in the Contract (however, such changes do not necessarily constitute a

Variation),

(b) changes to the quality and other characteristics of any item of work,

(c) changes to the levels, positions and/or dimensions of any part of the Works,

(d) omission of any work unless it is to be carried out by others,

(e) any additional work, Plant, Materials or services necessary for the Permanent Works, including any associated Tests on Completion, boreholes and other testing and exploratory work, or

(f) changes to the sequence or timing of the execution of the Works.

The Contractor shall not make any alteration and/or modification of the Permanent Works, unless and until the Engineer instructs or approves a Variation.

13.2 Value Engineering

The Contractor may, at any time, submit to the Engineer a written proposal which (in the Contractor's opinion) will, if adopted, (i) accelerate completion, (ii) reduce the cost to the Employer of executing, maintaining or operating the Works, (iii) improve the efficiency or value to the Employer of the completed Works, or (iv) otherwise be of benefit to the Employer.

The proposal shall be prepared at the cost of the Contractor and shall include the items listed in Sub-Clause 13.3 [Variation Procedure].

If a proposal, which is approved by the Engineer, includes a change in the design of part of the Permanent Works, then unless otherwise agreed by both Parties:

(a) the Contractor shall design this part,

(b) sub-paragraphs (a) to (d) of Sub-Clause 4.1 [Contractor's General Obligations] shall apply, and

(c) if this change results in a reduction in the contract value of this part, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine a fee, which shall be included in the Contract Price. This fee shall be half (50%) of the difference between the following amounts:

    (i) such reduction in contract value, resulting from the change, excluding adjustments under Sub-Clause 13.7 [Adjustments for Changes in Legislation] and Sub-Clause 13.8 [Adjustments for Changes in Cost],and

    (ii) the reduction (if any) in the value to the Employer of the varied works, taking account of any reductions in quality, anticipated life or operational efficiencies.

However, if amount (i) is less than amount (ii), there shall not be a fee.

13.3 Variation

If the Engineer requests a proposal, prior to instructing a Variation, the

Procedure

Contractor shall respond in writing as soon as practicable, either by giving reasons why he cannot comply (if this is the case) or by submitting:

(a) a description of the proposed work to be performed and a programme for its execution,

(b) the Contractor's proposal for any necessary modifications to the programme according to Sub-Clause 8.3 [Programme] and to the Time for Completion, and

(c) the Contractor's proposal for evaluation of the Variation.

The Engineer shall, as soon as practicable after receiving such proposal (under Sub-Clause 13.2 [Value Engineering] or otherwise), respond with approval, disapproval or comments. The Contractor shall not delay any work whilst awaiting a response.

Each instruction to execute a Variation, with any requirements for the recording of Costs, shall be issued by the Engineer to the Contractor, who shall acknowledge receipt.

Each Variation shall be evaluated in accordance with Clause 12 [Measurement and Evaluation], unless the Engineer instructs or approves otherwise in accordance with this Clause.

13.4 Payment in Applicable Currencies

If the Contract provides for payment of the Contract Price in more than one currency, then whenever an adjustment is agreed, approved or determined as stated above, the amount payable in each of the applicable currencies shall be specified. For this purpose, reference shall be made to the actual or expected currency proportions of the Cost of the varied work, and to the proportions of various currencies specified for payment of the Contract Price.

13.5 Provisional Sums

Each Provisional Sum shall only be used, in whole or in part, in accordance with the Engineer's instructions, and the Contract Price shall be adjusted accordingly. The total sum paid to the Contractor shall include only such amounts, for the work, supplies or services to which the Provisional Sum relates, as the Engineer shall have instructed. For each Provisional Sum, the Engineer may instruct:

(a) work to be executed (including Plant, Materials or services to be supplied) by the Contractor and valued under Sub-Clause 13.3 [Variation Procedure]; and/or

(b) Plant, Materials or services to be purchased by the Contractor, from a nominated Subcontractor (as defined in Clause 5 [Nominated Subcontractors]) or otherwise; and for which there shall be included in the Contract Price:

(i) the actual amounts paid (or due to be paid) by the Contractor, and

(ii) a sum for overhead charges and profit, calculated as a percentage of these actual amounts by applying the relevant

percentage rate (if any) stated in the appropriate Schedule. If there is no such rate, the percentage rate stated in the Contract Data shall be applied.

The Contractor shall, when required by the Engineer, produce quotations, invoices, vouchers and accounts or receipts in substantiation.

13.6 Daywork

For work of a minor or incidental nature, the Engineer may instruct that a Variation shall be executed on a daywork basis. The work shall then be valued in accordance with the Daywork Schedule included in the Contract, and the following procedure shall apply. If a Daywork Schedule is not included in the Contract, this Sub-Clause shall not apply.

Before ordering Goods for the work, the Contractor shall submit quotations to the Engineer. When applying for payment, the Contractor shall submit invoices, vouchers and accounts or receipts for any Goods.

Except for any items for which the Daywork Schedule specifies that payment is not due, the Contractor shall deliver each day to the Engineer accurate statements in duplicate which shall include the following details of the resources used in executing the previous day's work:

(a) the names, occupations and time of Contractor's Personnel,

(b) the identification, type and time of Contractor's Equipment and Temporary Works, and

(c) the quantities and types of Plant and Materials used.

One copy of each statement will, if correct, or when agreed, be signed by the Engineer and returned to the Contractor. The Contractor shall then submit priced statements of these resources to the Engineer, prior to their inclusion in the next Statement under Sub-Clause 14.3 [Application for Interim Payment Certificates].

13.7 Adjustments for Changes in Legislation

The Contract Price shall be adjusted to take account of any increase or decrease in Cost resulting from a change in the Laws of the Country (including the introduction of new Laws and the repeal or modification of existing Laws) or in the judicial or official governmental interpretation of such Laws, made after the Base Date, which affect the Contractor in the performance of obligations under the Contract.

If the Contractor suffers (or will suffer) delay and/or incurs (or will incur) additional Cost as a result of these changes in the Laws or in such interpretations, made after the Base Date, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for

Completion], and

(b) payment of any such Cost, which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

Notwithstanding the foregoing, the Contractor shall not be entitled to an extension of time if the relevant delay has already been taken into account in the determination of a previous extension of time and such Cost shall not be separately paid if the same shall already have been taken into account in the indexing of any inputs to the table of adjustment data in accordance with the provisions of Sub-Clause 13.8 [Adjustments for Changes in Cost].

13.8 Adjustments for Changes in Cost

In this Sub-Clause, "table of adjustment data" means the completed table of adjustment data for local and foreign currencies included in the Schedules. If there is no such table of adjustment data, this Sub-Clause shall not apply.

If this Sub-Clause applies, the amounts payable to the Contractor shall be adjusted for rises or falls in the cost of labour, Goods and other inputs to the Works, by the addition or deduction of the amounts determined by the formulae prescribed in this Sub-Clause. To the extent that full compensation for any rise or fall in Costs is not covered by the provisions of this or other Clauses, the Accepted Contract Amount shall be deemed to have included amounts to cover the contingency of other rises and falls in costs.

The adjustment to be applied to the amount otherwise payable to the Contractor, as valued in accordance with the appropriate Schedule and certified in Payment Certificates, shall be determined from formulae for each of the currencies in which the Contract Price is payable. No adjustment is to be applied to work valued on the basis of Cost or current prices. The formulae shall be of the following general type:

$Pn = a + b\ Ln/Lo + c\ En/Eo + d\ Mn/Mo + ...$ where:

"Pn" is the adjustment multiplier to be applied to the estimated contract value in the relevant currency of the work carried out in period "n", this period being a month unless otherwise stated in the Contract Data ;

"a" is a fixed coefficient, stated in the relevant table of adjustment data, representing the non-adjustable portion in contractual payments;

"b", "c", "d", … are coefficients representing the estimated proportion of each cost element related to the execution of the Works, as stated in the relevant table of adjustment data; such tabulated cost elements may be indicative of resources such as labour, equipment and materials;

"Ln", "En", "Mn", … are the current cost indices or reference prices for period "n", expressed in the relevant currency of payment, each of which is applicable to the relevant tabulated cost element on the date 49 days prior to the last day of the period (to which the particular Payment Certificate relates); and

"Lo", "Eo", "Mo", … are the base cost indices or reference prices, expressed in the relevant currency of payment, each of which is applicable to the relevant tabulated cost element on the Base Date.

The cost indices or reference prices stated in the table of adjustment data shall be used. If their source is in doubt, it shall be determined by the Engineer. For this purpose, reference shall be made to the values of the indices at stated dates (quoted in the fourth and fifth columns respectively of the table) for the purposes of clarification of the source; although these dates (and thus these values) may not correspond to the base cost indices.

In cases where the "currency of index" (stated in the table) is not the relevant currency of payment, each index shall be converted into the relevant currency of payment at the selling rate, established by the central bank of the Country, of this relevant currency on the above date for which the index is required to be applicable.

Until such time as each current cost index is available, the Engineer shall determine a provisional index for the issue of Interim Payment Certificates. When a current cost index is available, the adjustment shall be recalculated accordingly.

If the Contractor fails to complete the Works within the Time for Completion, adjustment of prices thereafter shall be made using either (i) each index or price applicable on the date 49 days prior to the expiry of the Time for Completion of the Works, or (ii) the current index or price: whichever is more favourable to the Employer.

The weightings (coefficients) for each of the factors of cost stated in the table(s) of adjustment data shall only be adjusted if they have been rendered unreasonable, unbalanced or inapplicable, as a result of Variations.

14. Contract Price and Payment

14.1 The Contract Price

Unless otherwise stated in the Particular Conditions:

(a) the Contract Price shall be agreed or determined under Sub-Clause 12.3 [Evaluation] and be subject to adjustments in accordance with the Contract;

(b) the Contractor shall pay all taxes, duties and fees required to be paid by him under the Contract, and the Contract Price shall not be adjusted for any of these costs except as stated in Sub-Clause 13.7 [Adjustments for Changes in Legislation];

(c) any quantities which may be set out in the Bill of Quantities or other Schedule are estimated quantities and are not to be taken as

the actual and correct quantities:

(i) of the Works which the Contractor is required to execute, or

(ii) for the purposes of Clause 12 [Measurement and Evaluation]; and

(d) the Contractor shall submit to the Engineer, within 28 days after the Commencement Date, a proposed breakdown of each lump sum price in the Schedules. The Engineer may take account of the breakdown when preparing Payment Certificates, but shall not be bound by it.

(e) Notwithstanding the provisions of subparagraph (b), Contractor's Equipment, including essential spare parts therefor, imported by the Contractor for the sole purpose of executing the Contract shall be exempt from the payment of import duties and taxes upon importation.

14.2 Advance Payment The Employer shall make an advance payment, as an interest-free loan for mobilisation and cash flow support, when the Contractor submits a guarantee in accordance with this Sub-Clause. The total advance payment, the number and timing of instalments (if more than one), and the applicable currencies and proportions, shall be as stated in the Contract Data.

Unless and until the Employer receives this guarantee, or if the total advance payment is not stated in the Contract Data, this Sub-Clause shall not apply.

The Engineer shall deliver to the Employer and to the Contractor an Interim Payment Certificate for the advance payment or its first instalment after receiving a Statement (under Sub-Clause 14.3 [Application for Interim Payment Certificates]) and after the Employer receives (i) the Performance Security in accordance with Sub-Clause 4.2 [Performance Security] and (ii) a guarantee in amounts and currencies equal to the advance payment. This guarantee shall be issued by an entity and from within a country (or other jurisdiction) approved by the Employer, and shall be in the form annexed to the Particular Conditions or in another form approved by the Employer.

The Contractor shall ensure that the guarantee is valid and enforceable until the advance payment has been repaid, but its amount shall be progressively reduced by the amount repaid by the Contractor as indicated in the Payment Certificates. If the terms of the guarantee specify its expiry date, and the advance payment has not been repaid by the date 28 days prior to the expiry date, the Contractor shall extend the validity of the guarantee until the advance payment has been repaid.

Unless stated otherwise in the Contract Data, the advance payment shall be repaid through percentage deductions from the interim payments determined by the Engineer in accordance with Sub-Clause 14.6 [Issue of Interim Payment Certificates], as follows:.

(a) deductions shall commence in the next interim Payment Certificate following that in which the total of all certified interim payments (excluding the advance payment and deductions and repayments of retention) exceeds 30 percent (30%) of the Accepted Contract Amount less Provisional Sums; and

(b) deductions shall be made at the amortisation rate stated in the Contract Data of the amount of each Interim Payment Certificate (excluding the advance payment and deductions for its repayments as well as deductions for retention money) in the currencies and proportions of the advance payment until such time as the advance payment has been repaid; provided that the advance payment shall be completely repaid prior to the time when 90 per cent (90%) of the Accepted Contract Amount less Provisional Sums has been certified for payment.

If the advance payment has not been repaid prior to the issue of the Taking-Over Certificate for the Works or prior to termination under Clause 15 [Termination by Employer], Clause 16 [Suspension and Termination by Contractor] or Clause 19 [Force Majeure] (as the case may be), the whole of the balance then outstanding shall immediately become due and in case of termination under Clause 15 [Termination by Employer] and Sub-Clause 19.6 [Optional Termination, Payment and Release], payable by the Contractor to the Employer.

14.3 Application for Interim Payment Certificates

The Contractor shall submit a Statement in six copies to the Engineer after the end of each month, in a form approved by the Engineer, showing in detail the amounts to which the Contractor considers himself to be entitled, together with supporting documents which shall include the report on the progress during this month in accordance with Sub-Clause 4.21 [Progress Reports].

The Statement shall include the following items, as applicable, which shall be expressed in the various currencies in which the Contract Price is payable, in the sequence listed:

(a) the estimated contract value of the Works executed and the Contractor's Documents produced up to the end of the month (including Variations but excluding items described in sub-paragraphs (b) to (g) below);

(b) any amounts to be added and deducted for changes in legislation and changes in cost, in accordance with Sub-Clause 13.7 [Adjustments for Changes in Legislation] and Sub-Clause 13.8 [Adjustments for Changes in Cost];

(c) any amount to be deducted for retention, calculated by applying the percentage of retention stated in the Contract Data to the total of the above amounts, until the amount so retained by the Employer reaches the limit of Retention Money (if any) stated in the Contract Data;

(d) any amounts to be added for the advance payment and (if more than one instalment) and to be deducted for its repayments in

accordance with Sub-Clause 14.2 [Advance Payment];

(e) any amounts to be added and deducted for Plant and Materials in accordance with Sub-Clause 14.5 [Plant and Materials intended for the Works];

(f) any other additions or deductions which may have become due under the Contract or otherwise, including those under Clause 20 [Claims, Disputes and Arbitration]; and

(g) the deduction of amounts certified in all previous Payment Certificates.

14.4 Schedule of Payments

If the Contract includes a schedule of payments specifying the instalments in which the Contract Price will be paid, then unless otherwise stated in this schedule:

(a) the instalments quoted in this schedule of payments shall be the estimated contract values for the purposes of sub-paragraph (a) of Sub-Clause 14.3 [Application for Interim Payment Certificates];

(b) Sub-Clause 14.5 [Plant and Materials intended for the Works] shall not apply; and

(c) if these instalments are not defined by reference to the actual progress achieved in executing the Works, and if actual progress is found to be less or more than that on which this schedule of payments was based, then the Engineer may proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine revised instalments, which shall take account of the extent to which progress is less or more than that on which the instalments were previously based.

If the Contract does not include a schedule of payments, the Contractor shall submit non-binding estimates of the payments which he expects to become due during each quarterly period. The first estimate shall be submitted within 42 days after the Commencement Date. Revised estimates shall be submitted at quarterly intervals, until the Taking-Over Certificate has been issued for the Works.

14.5 Plant and Materials intended for the Works

If this Sub-Clause applies, Interim Payment Certificates shall include, under sub-paragraph (e) of Sub-Clause 14.3, (i) an amount for Plant and Materials which have been sent to the Site for incorporation in the Permanent Works, and (ii) a reduction when the contract value of such Plant and Materials is included as part of the Permanent Works under sub-paragraph (a) of Sub-Clause 14.3 [Application for Interim Payment Certificates].

If the lists referred to in sub-paragraphs (b)(i) or (c)(i) below are not included in the Schedules, this Sub-Clause shall not apply.

The Engineer shall determine and certify each addition if the following conditions are satisfied:

(a) the Contractor has:

(i) kept satisfactory records (including the orders, receipts, Costs and use of Plant and Materials) which are available for inspection, and

(ii) submitted a statement of the Cost of acquiring and delivering the Plant and Materials to the Site, supported by satisfactory evidence;

and either:

(b) the relevant Plant and Materials:

(i) are those listed in the Schedules for payment when shipped,

(ii) have been shipped to the Country, en route to the Site, in accordance with the Contract; and

(iii) are described in a clean shipped bill of lading or other evidence of shipment, which has been submitted to the Engineer together with evidence of payment of freight and insurance, any other documents reasonably required, and a bank guarantee in a form and issued by an entity approved by the Employer in amounts and currencies equal to the amount due under this Sub-Clause: this guarantee may be in a similar form to the form referred to in Sub-Clause 14.2 [Advance Payment] and shall be valid until the Plant and Materials are properly stored on Site and protected against loss, damage or deterioration;

or

(c) the relevant Plant and Materials:

(i) are those listed in the Schedules for payment when delivered to the Site, and

(ii) have been delivered to and are properly stored on the Site, are protected against loss, damage or deterioration, and appear to be in accordance with the Contract.

The additional amount to be certified shall be the equivalent of eighty percent of the Engineer's determination of the cost of the Plant and Materials (including delivery to Site), taking account of the documents mentioned in this Sub-Clause and of the contract value of the Plant and Materials.

The currencies for this additional amount shall be the same as those in which payment will become due when the contract value is included under sub-paragraph (a) of Sub-Clause 14.3 [Application for Interim Payment Certificates]. At that time, the Payment Certificate shall include the applicable reduction which shall be equivalent to, and in the same currencies and proportions as, this additional amount for the relevant Plant and Materials.

14.6 Issue of Interim Payment Certificates

No amount will be certified or paid until the Employer has received and approved the Performance Security. Thereafter, the Engineer shall, within 28 days after receiving a Statement and supporting documents, deliver to the Employer and to the Contractor an Interim Payment Certificate which shall state the amount which the Engineer fairly determines to be due, with all supporting particulars for any reduction or withholding made by the Engineer on the Statement if any.

However, prior to issuing the Taking-Over Certificate for the Works, the Engineer shall not be bound to issue an Interim Payment Certificate in an amount which would (after retention and other deductions) be less than the minimum amount of Interim Payment Certificates (if any) stated in the Contract Data. In this event, the Engineer shall give notice to the Contractor accordingly.

An Interim Payment Certificate shall not be withheld for any other reason, although:

(a) if any thing supplied or work done by the Contractor is not in accordance with the Contract, the cost of rectification or replacement may be withheld until rectification or replacement has been completed; and/or

(b) if the Contractor was or is failing to perform any work or obligation in accordance with the Contract, and had been so notified by the Engineer, the value of this work or obligation may be withheld until the work or obligation has been performed.

The Engineer may in any Payment Certificate make any correction or modification that should properly be made to any previous Payment Certificate. A Payment Certificate shall not be deemed to indicate the Engineer's acceptance, approval, consent or satisfaction.

14.7 Payment

The Employer shall pay to the Contractor:

(a) the first instalment of the advance payment within 42 days after issuing the Letter of Acceptance or within 21 days after receiving the documents in accordance with Sub-Clause 4.2 [Performance Security] and Sub-Clause 14.2 [Advance Payment], whichever is later;

(b) the amount certified in each Interim Payment Certificate within 56 days after the Engineer receives the Statement and supporting documents or, at a time when the Bank's loan or credit (from which part of the payments to the Contractor is being made) is suspended, the amount shown on any statement submitted by the Contractor, within 14 days after such statement is submitted, any discrepancy being rectified in the next payment to the Contractor; and

(c) the amount certified in the Final Payment Certificate within 56 days after the Employer receives this Payment Certificate or, at a time when the Bank's loan or credit (from which part of the

payments to the Contractor is being made) is suspended, the undisputed amount shown in the Final Statement, within 56 days after the date of notification of the suspension in accordance with Sub-Clause 16.2.

Payment of the amount due in each currency shall be made into the bank account, nominated by the Contractor, in the payment country (for this currency) specified in the Contract.

14.8 Delayed Payment

If the Contractor does not receive payment in accordance with Sub-Clause 14.7 [Payment], the Contractor shall be entitled to receive financing charges compounded monthly on the amount unpaid during the period of delay. This period shall be deemed to commence on the date for payment specified in Sub-Clause 14.7 [Payment], irrespective (in the case of its sub-paragraph (b)) of the date on which any Interim Payment Certificate is issued.

Unless otherwise stated in the Particular Conditions, these financing charges shall be calculated at the annual rate of three percentage points above the discount rate of the central bank in the country of the currency of payment, or if not available, the interbank offered rate, and shall be paid in such currency.

The Contractor shall be entitled to this payment without formal notice or certification, and without prejudice to any other right or remedy.

14.9 Payment of Retention Money

When the Taking-Over Certificate has been issued for the Works, the first half of the Retention Money shall be certified by the Engineer for payment to the Contractor. If a Taking-Over Certificate is issued for a Section or part of the Works, a proportion of the Retention Money shall be certified and paid. This proportion shall be half (50%) of the proportion calculated by dividing the estimated contract value of the Section or part, by the estimated final Contract Price.

Promptly after the latest of the expiry dates of the Defects Notification Periods, the outstanding balance of the Retention Money shall be certified by the Engineer for payment to the Contractor. If a Taking-Over Certificate was issued for a Section, a proportion of the second half of the Retention Money shall be certified and paid promptly after the expiry date of the Defects Notification Period for the Section. This proportion shall be half (50%) of the proportion calculated by dividing the estimated contract value of the Section by the estimated final Contract Price.

However, if any work remains to be executed under Clause 11 [Defects Liability], the Engineer shall be entitled to withhold certification of the estimated cost of this work until it has been executed.

When calculating these proportions, no account shall be taken of any adjustments under Sub-Clause 13.7 [Adjustments for Changes in Legislation] and Sub-Clause 13.8 [Adjustments for Changes in Cost].

Unless otherwise stated in the Particular Conditions, when the Taking-Over Certificate has been issued for the Works and the first half of the Retention Money has been certified for payment by the Engineer, the

Contractor shall be entitled to substitute a guarantee, in the form annexed to the Particular Conditions or in another form approved by the Employer and provided by an entity approved by the Employer, for the second half of the Retention Money. The Contractor shall ensure that the guarantee is in the amounts and currencies of the second half of the Retention Money and is valid and enforceable until the Contractor has executed and completed the Works and remedied any defects, as specified for the Performance Security in Sub-Clause 4.2. On receipt by the Employer of the required guarantee, the Engineer shall certify and the Employer shall pay the second half of the Retention Money. The release of the second half of the Retention Money against a guarantee shall then be in lieu of the release under the second paragraph of this Sub-Clause. The Employer shall return the guarantee to the Contractor within 21 days after receiving a copy of the Performance Certificate.

If the Performance Security required under Sub-Clause 4.2 is in the form of a demand guarantee, and the amount guaranteed under it when the Taking-Over Certificate is issued is more than half of the Retention Money, then the Retention Money guarantee will not be required. If the amount guaranteed under the Performance Security when the Taking-Over Certificate is issued is less than half of the Retention Money, the Retention Money guarantee will only be required for the difference between half of the Retention Money and the amount guaranteed under the Performance Security.

14.10 Statement at Completion

Within 84 days after receiving the Taking-Over Certificate for the Works, the Contractor shall submit to the Engineer six copies of a Statement at completion with supporting documents, in accordance with Sub-Clause 14.3 [Application for Interim Payment Certificates], showing:

(a) the value of all work done in accordance with the Contract up to the date stated in the Taking-Over Certificate for the Works,

(b) any further sums which the Contractor considers to be due, and

(c) an estimate of any other amounts which the Contractor considers will become due to him under the Contract. Estimated amounts shall be shown separately in this Statement at completion.

The Engineer shall then certify in accordance with Sub-Clause 14.6 [Issue of Interim Payment Certificates].

14.11 Application for Final Payment Certificate

Within 56 days after receiving the Performance Certificate, the Contractor shall submit, to the Engineer, six copies of a draft final statement with supporting documents showing in detail in a form approved by the Engineer:

(a) the value of all work done in accordance with the Contract, and

(b) any further sums which the Contractor considers to be due to him

under the Contract or otherwise.

If the Engineer disagrees with or cannot verify any part of the draft final statement, the Contractor shall submit such further information as the Engineer may reasonably require within 28 days from receipt of the said draft and shall make such changes in the draft as may be agreed between them. The Contractor shall then prepare and submit to the Engineer the final statement as agreed. This agreed statement is referred to in these Conditions as the "Final Statement".

However if, following discussions between the Engineer and the Contractor and any changes to the draft final statement which are agreed, it becomes evident that a dispute exists, the Engineer shall deliver to the Employer (with a copy to the Contractor) an Interim Payment Certificate for the agreed parts of the draft final statement. Thereafter, if the dispute is finally resolved under Sub-Clause 20.4 [Obtaining Dispute Board's Decision] or Sub-Clause 20.5 [Amicable Settlement], the Contractor shall then prepare and submit to the Employer (with a copy to the Engineer) a Final Statement.

14.12 Discharge

When submitting the Final Statement, the Contractor shall submit a discharge which confirms that the total of the Final Statement represents full and final settlement of all moneys due to the Contractor under or in connection with the Contract. This discharge may state that it becomes effective when the Contractor has received the Performance Security and the outstanding balance of this total, in which event the discharge shall be effective on such date.

14.13 Issue of Final Payment Certificate

Within 28 days after receiving the Final Statement and discharge in accordance with Sub-Clause 14.11 [Application for Final Payment Certificate] and Sub-Clause 14.12 [Discharge], the Engineer shall deliver to the Employer and to the Contractor, the Final Payment Certificate which shall state:

(a) the amount which he fairly determines is finally due, and

(b) after giving credit to the Employer for all amounts previously paid by the Employer and for all sums to which the Employer is entitled, the balance (if any) due from the Employer to the Contractor or from the Contractor to the Employer, as the case may be.

If the Contractor has not applied for a Final Payment Certificate in accordance with Sub-Clause 14.11 [Application for Final Payment Certificate] and Sub-Clause 14.12 [Discharge], the Engineer shall request the Contractor to do so. If the Contractor fails to submit an application within a period of 28 days, the Engineer shall issue the Final Payment Certificate for such amount as he fairly determines to be due.

14.14 Cessation of Employer's Liability

The Employer shall not be liable to the Contractor for any matter or thing under or in connection with the Contract or execution of the Works, except to the extent that the Contractor shall have included an

amount expressly for it:

(a) in the Final Statement and also

(b) (except for matters or things arising after the issue of the Taking-Over Certificate for the Works) in the Statement at completion described in Sub-Clause 14.10 [Statement at Completion].

However, this Sub-Clause shall not limit the Employer's liability under his indemnification obligations, or the Employer's liability in any case of fraud, deliberate default or reckless misconduct by the Employer.

14.15 Currencies of Payment

The Contract Price shall be paid in the currency or currencies named in the Schedule of Payment Currencies. If more than one currency is so named, payments shall be made as follows:

(a) if the Accepted Contract Amount was expressed in Local Currency only:

(i) the proportions or amounts of the Local and Foreign Currencies, and the fixed rates of exchange to be used for calculating the payments, shall be as stated in the Schedule of Payment Currencies, except as otherwise agreed by both Parties;

(ii) payments and deductions under Sub-Clause 13.5 [Provisional Sums] and Sub-Clause 13.7 [Adjustments for Changes in Legislation] shall be made in the applicable currencies and proportions; and

(iii) other payments and deductions under sub-paragraphs (a) to (d) of Sub-Clause 14.3 [Application for Interim Payment Certificates] shall be made in the currencies and proportions specified in sub-paragraph (a)(i) above;

(b) payment of the damages specified in the Contract Data, shall be made in the currencies and proportions specified in the Schedule of Payment Currencies;

(c) other payments to the Employer by the Contractor shall be made in the currency in which the sum was expended by the Employer, or in such currency as may be agreed by both Parties;

(d) if any amount payable by the Contractor to the Employer in a particular currency exceeds the sum payable by the Employer to the Contractor in that currency, the Employer may recover the balance of this amount from the sums otherwise payable to the Contractor in other currencies; and

(e) if no rates of exchange are stated in the Schedule of Payment Currencies, they shall be those prevailing on the Base Date and determined by the central bank of the Country.

15. Termination by Employer

15.1 Notice to Correct

If the Contractor fails to carry out any obligation under the Contract, the Engineer may by notice require the Contractor to make good the failure and to remedy it within a specified reasonable time.

15.2 Termination by Employer

The Employer shall be entitled to terminate the Contract if the Contractor:

(a) fails to comply with Sub-Clause 4.2 [Performance Security] or with a notice under Sub-Clause 15.1 [Notice to Correct],

(b) abandons the Works or otherwise plainly demonstrates the intention not to continue performance of his obligations under the Contract,

(c) without reasonable excuse fails:

(i) to proceed with the Works in accordance with Clause 8 [Commencement, Delays and Suspension], or

(ii) to comply with a notice issued under Sub-Clause 7.5 [Rejection] or Sub-Clause 7.6 [Remedial Work], within 28 days after receiving it,

(d) subcontracts the whole of the Works or assigns the Contract without the required agreement,

(e) becomes bankrupt or insolvent, goes into liquidation, has a receiving or administration order made against him, compounds with his creditors, or carries on business under a receiver, trustee or manager for the benefit of his creditors, or if any act is done or event occurs which (under applicable Laws) has a similar effect to any of these acts or events, or

(f) gives or offers to give (directly or indirectly) to any person any bribe, gift, gratuity, commission or other thing of value, as an inducement or reward:

(i) for doing or forbearing to do any action in relation to the Contract, or

(ii) for showing or forbearing to show favour or disfavour to any person in relation to the Contract,

or if any of the Contractor's Personnel, agents or Subcontractors gives or offers to give (directly or indirectly) to any person any such inducement or reward as is described in this sub-paragraph (f). However, lawful inducements and rewards to Contractor's Personnel shall not entitle termination.

In any of these events or circumstances, the Employer may, upon giving 14 days' notice to the Contractor, terminate the Contract and expel the Contractor from the Site. However, in the case of sub-paragraph (e) or (f), the Employer may by notice terminate the Contract immediately.

The Employer's election to terminate the Contract shall not prejudice

any other rights of the Employer, under the Contract or otherwise.

The Contractor shall then leave the Site and deliver any required Goods, all Contractor's Documents, and other design documents made by or for him, to the Engineer. However, the Contractor shall use his best efforts to comply immediately with any reasonable instructions included in the notice (i) for the assignment of any subcontract, and (ii) for the protection of life or property or for the safety of the Works.

After termination, the Employer may complete the Works and/or arrange for any other entities to do so. The Employer and these entities may then use any Goods, Contractor's Documents and other design documents made by or on behalf of the Contractor.

The Employer shall then give notice that the Contractor's Equipment and Temporary Works will be released to the Contractor at or near the Site. The Contractor shall promptly arrange their removal, at the risk and cost of the Contractor. However, if by this time the Contractor has failed to make a payment due to the Employer, these items may be sold by the Employer in order to recover this payment. Any balance of the proceeds shall then be paid to the Contractor.

15.3 Valuation at Date of Termination

As soon as practicable after a notice of termination under Sub-Clause 15.2 [Termination by Employer] has taken effect, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine the value of the Works, Goods and Contractor's Documents, and any other sums due to the Contractor for work executed in accordance with the Contract.

15.4 Payment after Termination

After a notice of termination under Sub-Clause 15.2 [Termination by Employer] has taken effect, the Employer may:

(a) proceed in accordance with Sub-Clause 2.5 [Employer's Claims],

(b) withhold further payments to the Contractor until the costs of execution, completion and remedying of any defects, damages for delay in completion (if any), and all other costs incurred by the Employer, have been established, and/or

(c) recover from the Contractor any losses and damages incurred by the Employer and any extra costs of completing the Works, after allowing for any sum due to the Contractor under Sub-Clause 15.3 [Valuation at Date of Termination]. After recovering any such losses, damages and extra costs, the Employer shall pay any balance to the Contractor.

15.5 Employer's Entitlement to Termination for Convenience

The Employer shall be entitled to terminate the Contract, at any time for the Employer's convenience, by giving notice of such termination to the Contractor. The termination shall take effect 28 days after the later of the dates on which the Contractor receives this notice or the Employer returns the Performance Security. The Employer shall not terminate the Contract under this Sub-Clause in order to execute the Works himself or to arrange for the Works to be executed by another

contractor or to avoid a termination of the Contract by the Contractor under Sub-Clause 16.2 [Termination by Contractor].

After this termination, the Contractor shall proceed in accordance with Sub-Clause 16.3 [Cessation of Work and Removal of Contractor's equipment] and shall be paid in accordance with Sub-Clause 16.4 [Payment on Termination].

15.6 Corrupt or Fraudulent Practices

If the Employer determines that the Contractor and/or its subcontractors has engaged in corrupt, fraudulent, collusive coercive, or obstructive practices, in competing for or in executing the Contract, then the Employer may, after giving 14 days notice to the Contractor, terminate the Contractor's employment under the Contract and expel him from the Site, and the provisions of Clause 15 shall apply as if such expulsion had been made under Sub-Clause 15.2 [Termination by Employer].

Should any employee of the Contractor be determined to have engaged in corrupt, fraudulent, collusive, coercive, or obstructive practice during the execution of the Works, then that employee shall be removed in accordance with Sub-Clause 6.9 [Contractor's Personnel].

For the purposes of this Sub-Clause:

(i) "corrupt practice"[1] is the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence improperly the actions of another party;

(ii) "fraudulent practice"[2] is any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation;

(iii) "collusive practice"[3] is an arrangement between two or more parties designed to achieve an improper purpose, including to influence improperly the actions of another party;

(iv) "coercive practice"[4] is impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party;

(v) "obstructive practice" is

(aa) deliberately destroying, falsifying, altering or concealing of evidence material to the investigation or making false statements to

[1] "another party" refers to a public official acting in relation to the procurement process or contract execution]. In this context, "public official" includes World Bank staff and employees of other organizations taking or reviewing procurement decisions.

[2] a "party" refers to a public official; the terms "benefit" and "obligation" relate to the procurement process or contract execution; and the "act or omission" is intended to influence the procurement process or contract execution.

[3] "parties" refers to participants in the procurement process (including public officials) attempting to establish bid prices at artificial, non competitive levels.

[4] a "party" refers to a participant in the procurement process or contract execution.

investigators in order to materially impede a Bank investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; and/or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation, or

(bb) acts intended to materially impede the exercise of the Bank's inspection and audit rights provided for under Sub-Clause 1.15 [Inspections and Audits by the Bank].

16. Suspension and Termination by Contractor

16.1 Contractor's Entitlement to Suspend Work

If the Engineer fails to certify in accordance with Sub-Clause 14.6 [Issue of Interim Payment Certificates] or the Employer fails to comply with Sub-Clause 2.4 [Employer's Financial Arrangements] or Sub-Clause 14.7 [Payment], the Contractor may, after giving not less than 21 days' notice to the Employer, suspend work (or reduce the rate of work) unless and until the Contractor has received the Payment Certificate, reasonable evidence or payment, as the case may be and as described in the notice.

Notwithstanding the above, if the Bank has suspended disbursements under the loan or credit from which payments to the Contractor are being made, in whole or in part, for the execution of the Works, and no alternative funds are available as provided for in Sub-Clause 2.4 [Employer's Financial Arrangements], the Contractor may by notice suspend work or reduce the rate of work at any time, but not less than 7 days after the Borrower having received the suspension notification from the Bank.

The Contractor's action shall not prejudice his entitlements to financing charges under Sub-Clause 14.8 [Delayed Payment] and to termination under Sub-Clause 16.2 [Termination by Contractor].

If the Contractor subsequently receives such Payment Certificate, evidence or payment (as described in the relevant Sub-Clause and in the above notice) before giving a notice of termination, the Contractor shall resume normal working as soon as is reasonably practicable.

If the Contractor suffers delay and/or incurs Cost as a result of suspending work (or reducing the rate of work) in accordance with this Sub-Clause, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost plus profit, which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance

with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

16.2 Termination by Contractor

The Contractor shall be entitled to terminate the Contract if:

(a) the Contractor does not receive the reasonable evidence within 42 days after giving notice under Sub-Clause 16.1 [Contractor's Entitlement to Suspend Work] in respect of a failure to comply with Sub-Clause 2.4 [Employer's Financial Arrangements],

(b) the Engineer fails, within 56 days after receiving a Statement and supporting documents, to issue the relevant Payment Certificate,

(c) the Contractor does not receive the amount due under an Interim Payment Certificate within 42 days after the expiry of the time stated in Sub-Clause 14.7 [Payment] within which payment is to be made (except for deductions in accordance with Sub-Clause 2.5 [Employer's Claims]),

(d) the Employer substantially fails to perform his obligations under the Contract in such manner as to materially and adversely affect the economic balance of the Contract and/or the ability of the Contractor to perform the Contract,

(e) the Employer fails to comply with Sub-Clause 1.6 [Contract Agreement] or Sub-Clause 1.7 [Assignment],

(f) a prolonged suspension affects the whole of the Works as described in Sub-Clause 8.11 [Prolonged Suspension], or

(g) the Employer becomes bankrupt or insolvent, goes into liquidation, has a receiving or administration order made against him, compounds with his creditors, or carries on business under a receiver, trustee or manager for the benefit of his creditors, or if any act is done or event occurs which (under applicable Laws) has a similar effect to any of these acts or events.

(h) In the event the Bank suspends the loan or credit from which part of the payments to the Contractor are being made, if the Contractor has not received the sums due to him upon expiration of the 14 days referred to in Sub-Clause 14.7 [Payment] for payments under Interim Payment certificates, the Contractor may, without prejudice to the Contractor's entitlement to financing charges under Sub-Clause 14.8 [Delayed Payment], take one of the following actions, namely (i) suspend work or reduce the rate of work, or (ii) terminate his employment under the Contract by giving notice to the Employer, with a copy to the Engineer, such termination to take effect 14 days after the giving of the notice.

(i) the Contractor does not receive the Engineer's instruction recording the agreement of both Parties on the fulfilment of the conditions for the Commencement of Works under Sub-Clause

8.1 [Commencement of Works].

In any of these events or circumstances, the Contractor may, upon giving 14 days' notice to the Employer, terminate the Contract. However, in the case of sub-paragraph (f) or (g), the Contractor may by notice terminate the Contract immediately.

The Contractor's election to terminate the Contract shall not prejudice any other rights of the Contractor, under the Contract or otherwise.

16.3 Cessation of Work and Removal of Contractor's Equipment

After a notice of termination under Sub-Clause 15.5 [Employer's Entitlement to Termination for Convenience], Sub-Clause 16.2 [Termination by Contractor] or Sub-Clause 19.6 [Optional Termination, Payment and Release] has taken effect, the Contractor shall promptly:

(a) cease all further work, except for such work as may have been instructed by the Engineer for the protection of life or property or for the safety of the Works,

(b) hand over Contractor's Documents, Plant, Materials and other work, for which the Contractor has received payment, and

(c) remove all other Goods from the Site, except as necessary for safety, and leave the Site.

16.4 Payment on Termination

After a notice of termination under Sub-Clause 16.2 [Termination by Contractor] has taken effect, the Employer shall promptly:

(a) return the Performance Security to the Contractor,

(b) pay the Contractor in accordance with Sub-Clause 19.6 [Optional Termination, Payment and Release], and

(c) pay to the Contractor the amount of any loss or damage sustained by the Contractor as a result of this termination.

17. Risk and Responsibility

17.1 Indemnities

The Contractor shall indemnify and hold harmless the Employer, the Employer's Personnel, and their respective agents, against and from all claims, damages, losses and expenses (including legal fees and expenses) in respect of:

(a) bodily injury, sickness, disease or death, of any person whatsoever arising out of or in the course of or by reason of the Contractor's design (if any), the execution and completion of the Works and the remedying of any defects, unless attributable to any negligence, wilful act or breach of the Contract by the Employer, the Employer's Personnel, or any of their respective agents, and

(b) damage to or loss of any property, real or personal (other than the Works), to the extent that such damage or loss arises out of or in the course of or by reason of the Contractor's design (if any), the execution and completion of the Works and the remedying of any defects, unless and to the extent that any such damage or loss is attributable to any negligence, wilful act or breach of the Contract by the Employer, the Employer's Personnel, their respective agents, or anyone directly or indirectly employed by any of them.

The Employer shall indemnify and hold harmless the Contractor, the Contractor's Personnel, and their respective agents, against and from all claims, damages, losses and expenses (including legal fees and expenses) in respect of (1) bodily injury, sickness, disease or death, which is attributable to any negligence, wilful act or breach of the Contract by the Employer, the Employer's Personnel, or any of their respective agents, and (2) the matters for which liability may be excluded from insurance cover, as described in sub-paragraphs (d)(i), (ii) and (iii) of Sub-Clause 18.3 [Insurance Against Injury to Persons and Damage to Property].

17.2 Contractor's Care of the Works

The Contractor shall take full responsibility for the care of the Works and Goods from the Commencement Date until the Taking-Over Certificate is issued (or is deemed to be issued under Sub-Clause 10.1 [Taking Over of the Works and Sections]) for the Works, when responsibility for the care of the Works shall pass to the Employer. If a Taking-Over Certificate is issued (or is so deemed to be issued) for any Section or part of the Works, responsibility for the care of the Section or part shall then pass to the Employer.

After responsibility has accordingly passed to the Employer, the Contractor shall take responsibility for the care of any work which is outstanding on the date stated in a Taking-Over Certificate, until this outstanding work has been completed.

If any loss or damage happens to the Works, Goods or Contractor's Documents during the period when the Contractor is responsible for their care, from any cause not listed in Sub-Clause 17.3 [Employer's Risks], the Contractor shall rectify the loss or damage at the Contractor's risk and cost, so that the Works, Goods and Contractor's Documents conform with the Contract.

The Contractor shall be liable for any loss or damage caused by any actions performed by the Contractor after a Taking-Over Certificate has been issued. The Contractor shall also be liable for any loss or damage which occurs after a Taking-Over Certificate has been issued and which arose from a previous event for which the Contractor was liable.

17.3 Employer's Risks

The risks referred to in Sub-Clause 17.4 [Consequences of Employer's Risks] below, insofar as they directly affect the execution of the Works in the Country, are:

(a) war, hostilities (whether war be declared or not), invasion, act of

foreign enemies,

(b) rebellion, terrorism, sabotage by persons other than the Contractor's Personnel, revolution, insurrection, military or usurped power, or civil war, within the Country,

(c) riot, commotion or disorder within the Country by persons other than the Contractor's Personnel,

(d) munitions of war, explosive materials, ionising radiation or contamination by radio-activity, within the Country, except as may be attributable to the Contractor's use of such munitions, explosives, radiation or radio-activity,

(e) pressure waves caused by aircraft or other aerial devices travelling at sonic or supersonic speeds,

(f) use or occupation by the Employer of any part of the Permanent Works, except as may be specified in the Contract,

(g) design of any part of the Works by the Employer's Personnel or by others for whom the Employer is responsible, and

(h) any operation of the forces of nature which is Unforeseeable or against which an experienced contractor could not reasonably have been expected to have taken adequate preventative precautions.

17.4 Consequences of Employer's Risks

If and to the extent that any of the risks listed in Sub-Clause 17.3 above results in loss or damage to the Works, Goods or Contractor's Documents, the Contractor shall promptly give notice to the Engineer and shall rectify this loss or damage to the extent required by the Engineer.

If the Contractor suffers delay and/or incurs Cost from rectifying this loss or damage, the Contractor shall give a further notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost, which shall be included in the Contract Price. In the case of sub-paragraphs (f) and (g) of Sub-Clause 17.3 [Employer's Risks], Cost plus profit shall be payable.

After receiving this further notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

17.5 Intellectual and Industrial

In this Sub-Clause, "infringement" means an infringement (or alleged infringement) of any patent, registered design, copyright, trade mark,

Property Rights trade name, trade secret or other intellectual or industrial property right relating to the Works; and "claim" means a claim (or proceedings pursuing a claim) alleging an infringement.

Whenever a Party does not give notice to the other Party of any claim within 28 days of receiving the claim, the first Party shall be deemed to have waived any right to indemnity under this Sub-Clause.

The Employer shall indemnify and hold the Contractor harmless against and from any claim alleging an infringement which is or was:

(a) an unavoidable result of the Contractor's compliance with the Contract, or

(b) a result of any Works being used by the Employer:

(i) for a purpose other than that indicated by, or reasonably to be inferred from, the Contract, or

(ii) in conjunction with any thing not supplied by the Contractor, unless such use was disclosed to the Contractor prior to the Base Date or is stated in the Contract.

The Contractor shall indemnify and hold the Employer harmless against and from any other claim which arises out of or in relation to (i) the manufacture, use, sale or import of any Goods, or (ii) any design for which the Contractor is responsible.

If a Party is entitled to be indemnified under this Sub-Clause, the indemnifying Party may (at its cost) conduct negotiations for the settlement of the claim, and any litigation or arbitration which may arise from it. The other Party shall, at the request and cost of the indemnifying Party, assist in contesting the claim. This other Party (and its Personnel) shall not make any admission which might be prejudicial to the indemnifying Party, unless the indemnifying Party failed to take over the conduct of any negotiations, litigation or arbitration upon being requested to do so by such other Party.

17.6 Limitation of Liability Neither Party shall be liable to the other Party for loss of use of any Works, loss of profit, loss of any contract or for any indirect or consequential loss or damage which may be suffered by the other Party in connection with the Contract, other than as specifically provided in Sub-Clause 8.7 [Delay Damages]; Sub-Clause 11.2 [Cost of Remedying Defects]; Sub-Clause 15.4 [Payment after Termination]; Sub-Clause 16.4 [Payment on Termination]; Sub-Clause 17.1 [Indemnities]; Sub-Clause 17.4 (b) [Consequences of Employer's Risks] and Sub-Clause 17.5 [Intellectual and Industrial Property Rights].

The total liability of the Contractor to the Employer, under or in connection with the Contract other than under Sub-Clause 4.19 [Electricity, Water and Gas], Sub-Clause 4.20 [Employer's Equipment and Free-Issue Material], Sub-Clause 17.1 [Indemnities] and Sub-Clause 17.5 [Intellectual and Industrial Property Rights], shall not

exceed the sum resulting from the application of a multiplier (less or greater than one) to the Accepted Contract Amount, as stated in the Contract Data, or (if such multiplier or other sum is not so stated), the Accepted Contract Amount.

This Sub-Clause shall not limit liability in any case of fraud, deliberate default or reckless misconduct by the defaulting Party.

17.7 Use of Employer's Accomoda-tion/Facilities

The Contractor shall take full responsibility for the care of the Employer provided accommodation and facilities, if any, as detailed in the Specification, from the respective dates of hand-over to the Contractor until cessation of occupation (where hand-over or cessation of occupation may take place after the date stated in the Taking-Over Certificate for the Works).

If any loss or damage happens to any of the above items while the Contractor is responsible for their care arising from any cause whatsoever other than those for which the Employer is liable, the Contractor shall, at his own cost, rectify the loss or damage to the satisfaction of the Engineer.

18. Insurance

18.1 General Requirements for Insurances

In this Clause, "insuring Party" means, for each type of insurance, the Party responsible for effecting and maintaining the insurance specified in the relevant Sub-Clause.

Wherever the Contractor is the insuring Party, each insurance shall be effected with insurers and in terms acceptable to the Employer. These terms shall be consistent with any terms agreed by both Parties before the date of the Letter of Acceptance. This agreement of terms shall take precedence over the provisions of this Clause.

Wherever the Employer is the insuring Party, each insurance shall be effected with insurers and in terms acceptable to the Contractor. These terms shall be consistent with any terms agreed by both Parties before the date of the Letter of Acceptance. This agreement of terms shall take precedence over the provisions of this Clause.

If a policy is required to indemnify joint insured, the cover shall apply separately to each insured as though a separate policy had been issued for each of the joint insured. If a policy indemnifies additional joint insured, namely in addition to the insured specified in this Clause, (i) the Contractor shall act under the policy on behalf of these additional joint insured except that the Employer shall act for Employer's Personnel, (ii) additional joint insured shall not be entitled to receive payments directly from the insurer or to have any other direct dealings with the insurer, and (iii) the insuring Party shall require all additional joint insured to comply with the conditions stipulated in the policy.

Each policy insuring against loss or damage shall provide for payments to be made in the currencies required to rectify the loss or damage. Payments received from insurers shall be used for the rectification of the loss or damage.

The relevant insuring Party shall, within the respective periods stated in the Contract Data (calculated from the Commencement Date), submit to the other Party:

(a) evidence that the insurances described in this Clause have been effected, and

(b) copies of the policies for the insurances described in Sub-Clause 18.2 [Insurance for Works and Contractor's Equipment] and Sub-Clause 18.3 [Insurance against Injury to Persons and Damage to Property].

When each premium is paid, the insuring Party shall submit evidence of payment to the other Party. Whenever evidence or policies are submitted, the insuring Party shall also give notice to the Engineer.

Each Party shall comply with the conditions stipulated in each of the insurance policies. The insuring Party shall keep the insurers informed of any relevant changes to the execution of the Works and ensure that insurance is maintained in accordance with this Clause.

Neither Party shall make any material alteration to the terms of any insurance without the prior approval of the other Party. If an insurer makes (or attempts to make) any alteration, the Party first notified by the insurer shall promptly give notice to the other Party.

If the insuring Party fails to effect and keep in force any of the insurances it is required to effect and maintain under the Contract, or fails to provide satisfactory evidence and copies of policies in accordance with this Sub-Clause, the other Party may (at its option and without prejudice to any other right or remedy) effect insurance for the relevant coverage and pay the premiums due. The insuring Party shall pay the amount of these premiums to the other Party, and the Contract Price shall be adjusted accordingly.

Nothing in this Clause limits the obligations, liabilities or responsibilities of the Contractor or the Employer, under the other terms of the Contract or otherwise. Any amounts not insured or not recovered from the insurers shall be borne by the Contractor and/or the Employer in accordance with these obligations, liabilities or responsibilities. However, if the insuring Party fails to effect and keep in force an insurance which is available and which it is required to effect and maintain under the Contract, and the other Party neither approves the omission nor effects insurance for the coverage relevant to this default, any moneys which should have been recoverable under this insurance shall be paid by the insuring Party.

Payments by one Party to the other Party shall be subject to Sub-Clause 2.5 [Employer's Claims] or Sub-Clause 20.1 [Contractor's Claims], as applicable.

The Contractor shall be entitled to place all insurance relating to the Contract (including, but not limited to the insurance referred to Clause 18) with insurers from any eligible source country.

18.2 Insurance for Works and Contractor's Equipment

The insuring Party shall insure the Works, Plant, Materials and Contractor's Documents for not less than the full reinstatement cost including the costs of demolition, removal of debris and professional fees and profit. This insurance shall be effective from the date by which the evidence is to be submitted under sub-paragraph (a) of Sub-Clause 18.1 [General Requirements for Insurances], until the date of issue of the Taking-Over Certificate for the Works.

The insuring Party shall maintain this insurance to provide cover until the date of issue of the Performance Certificate, for loss or damage for which the Contractor is liable arising from a cause occurring prior to the issue of the Taking-Over Certificate, and for loss or damage caused by the Contractor in the course of any other operations (including those under Clause 11 [Defects Liability]).

The insuring Party shall insure the Contractor's Equipment for not less than the full replacement value, including delivery to Site. For each item of Contractor's Equipment, the insurance shall be effective while it is being transported to the Site and until it is no longer required as Contractor's Equipment.

Unless otherwise stated in the Particular Conditions, insurances under this Sub-Clause:

(a) shall be effected and maintained by the Contractor as insuring Party,

(b) shall be in the joint names of the Parties, who shall be jointly entitled to receive payments from the insurers, payments being held or allocated to the Party actually bearing the costs of rectifying the loss or damage,

(c) shall cover all loss and damage from any cause not listed in Sub-Clause 17.3 [Employer's Risks],

(d) shall also cover, to the extent specifically required in the bidding documents of the Contract, loss or damage to a part of the Works which is attributable to the use or occupation by the Employer of another part of the Works, and loss or damage from the risks listed in sub-paragraphs (c), (g) and (h) of Sub-Clause 17.3 [Employer's Risks], excluding (in each case) risks which are not insurable at commercially reasonable terms, with deductibles per occurrence of not more than the amount stated in the Contract Data (if an amount is not so stated, this sub-paragraph (d) shall not apply), and

(e) may however exclude loss of, damage to, and reinstatement of:

(i) a part of the Works which is in a defective condition due to a defect in its design, materials or workmanship (but cover shall include any other parts which are lost or damaged as a direct result of this defective condition and not as described

in sub-paragraph (ii) below),

(ii) a part of the Works which is lost or damaged in order to reinstate any other part of the Works if this other part is in a defective condition due to a defect in its design, materials or workmanship,

(iii) a part of the Works which has been taken over by the Employer, except to the extent that the Contractor is liable for the loss or damage, and

(iv) Goods while they are not in the Country, subject to Sub-Clause 14.5 [Plant and Materials intended for the Works].

If, more than one year after the Base Date, the cover described in sub-paragraph (d) above ceases to be available at commercially reasonable terms, the Contractor shall (as insuring Party) give notice to the Employer, with supporting particulars. The Employer shall then (i) be entitled subject to Sub-Clause 2.5 [Employer's Claims] to payment of an amount equivalent to such commercially reasonable terms as the Contractor should have expected to have paid for such cover, and (ii) be deemed, unless he obtains the cover at commercially reasonable terms, to have approved the omission under Sub-Clause 18.1 [General Requirements for Insurances].

18.3 Insurance against Injury to Persons and Damage to Property

The insuring Party shall insure against each Party's liability for any loss, damage, death or bodily injury which may occur to any physical property (except things insured under Sub-Clause 18.2 [Insurance for Works and Contractor's Equipment]) or to any person (except persons insured under Sub-Clause 18.4 [Insurance for Contractor's Personnel]), which may arise out of the Contractor's performance of the Contract and occurring before the issue of the Performance Certificate.

This insurance shall be for a limit per occurrence of not less than the amount stated in the Contract Data, with no limit on the number of occurrences. If an amount is not stated in the Contract Data, this Sub-Clause shall not apply.

Unless otherwise stated in the Particular Conditions, the insurances specified in this Sub-Clause:

(a) shall be effected and maintained by the Contractor as insuring Party,

(b) shall be in the joint names of the Parties,

(c) shall be extended to cover liability for all loss and damage to the Employer's property (except things insured under Sub-Clause 18.2) arising out of the Contractor's performance of the Contract, and

(d) may however exclude liability to the extent that it arises from:

(i) the Employer's right to have the Permanent Works executed on, over, under, in or through any land, and to occupy this land for the Permanent Works,

(ii) damage which is an unavoidable result of the Contractor's obligations to execute the Works and remedy any defects, and

(iii) a cause listed in Sub-Clause 17.3 [Employer's Risks], except to the extent that cover is available at commercially reasonable terms.

18.4 Insurance for Contractor's Personnel

The Contractor shall effect and maintain insurance against liability for claims, damages, losses and expenses (including legal fees and expenses) arising from injury, sickness, disease or death of any person employed by the Contractor or any other of the Contractor's Personnel.

The insurance shall cover the Employer and the Engineer against liability for claims, damages, losses and expenses (including legal fees and expenses) arising from injury, sickness, disease or death of any person employed by the Contractor or any other of the Contractor's Personnel, except that this insurance may exclude losses and claims to the extent that they arise from any act or neglect of the Employer or of the Employer's Personnel.

The insurance shall be maintained in full force and effect during the whole time that these personnel are assisting in the execution of the Works. For a Subcontractor's employees, the insurance may be effected by the Subcontractor, but the Contractor shall be responsible for compliance with this Clause.

19. Force Majeure

19.1 Definition of Force Majeure

In this Clause, "Force Majeure" means an exceptional event or circumstance:

(a) which is beyond a Party's control,

(b) which such Party could not reasonably have provided against before entering into the Contract,

(c) which, having arisen, such Party could not reasonably have avoided or overcome, and

(d) which is not substantially attributable to the other Party.

Force Majeure may include, but is not limited to, exceptional events or circumstances of the kind listed below, so long as conditions (a) to (d) above are satisfied:

(i) war, hostilities (whether war be declared or not), invasion,

act of foreign enemies,

(ii) rebellion, terrorism, sabotage by persons other than the Contractor's Personnel, revolution, insurrection, military or usurped power, or civil war,

(iii) riot, commotion, disorder, strike or lockout by persons other than the Contractor's Personnel,

(iv) munitions of war, explosive materials, ionising radiation or contamination by radio-activity, except as may be attributable to the Contractor's use of such munitions, explosives, radiation or radio-activity, and

(v) natural catastrophes such as earthquake, hurricane, typhoon or volcanic activity.

19.2 Notice of Force Majeure

If a Party is or will be prevented from performing its substantial obligations under the Contract by Force Majeure, then it shall give notice to the other Party of the event or circumstances constituting the Force Majeure and shall specify the obligations, the performance of which is or will be prevented. The notice shall be given within 14 days after the Party became aware, or should have become aware, of the relevant event or circumstance constituting Force Majeure.

The Party shall, having given notice, be excused performance of its obligations for so long as such Force Majeure prevents it from performing them.

Notwithstanding any other provision of this Clause, Force Majeure shall not apply to obligations of either Party to make payments to the other Party under the Contract.

19.3 Duty to Minimise Delay

Each Party shall at all times use all reasonable endeavours to minimise any delay in the performance of the Contract as a result of Force Majeure.

A Party shall give notice to the other Party when it ceases to be affected by the Force Majeure.

19.4 Consequences of Force Majeure

If the Contractor is prevented from performing its substantial obligations under the Contract by Force Majeure of which notice has been given under Sub-Clause 19.2 [Notice of Force Majeure], and suffers delay and/or incurs Cost by reason of such Force Majeure, the Contractor shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) if the event or circumstance is of the kind described in sub-paragraphs (i) to (iv) of Sub-Clause 19.1 [Definition of Force Majeure] and, in the case of sub-paragraphs (ii) to (iv), occurs in

the Country, payment of any such Cost, including the costs of rectifying or replacing the Works and/or Goods damaged or destructed by Force Majeure, to the extent they are not indemnified through the insurance policy referred to in Sub-Clause 18.2 [Insurance for Works and Contractor's Equipment].

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

19.5 Force Majeure Affecting Subcontractor

If any Subcontractor is entitled under any contract or agreement relating to the Works to relief from force majeure on terms additional to or broader than those specified in this Clause, such additional or broader force majeure events or circumstances shall not excuse the Contractor's non-performance or entitle him to relief under this Clause.

19.6 Optional Termination, Payment and Release

If the execution of substantially all the Works in progress is prevented for a continuous period of 84 days by reason of Force Majeure of which notice has been given under Sub-Clause 19.2 [Notice of Force Majeure], or for multiple periods which total more than 140 days due to the same notified Force Majeure, then either Party may give to the other Party a notice of termination of the Contract. In this event, the termination shall take effect 7 days after the notice is given, and the Contractor shall proceed in accordance with Sub-Clause 16.3 [Cessation of Work and Removal of Contractor's Equipment].

Upon such termination, the Engineer shall determine the value of the work done and issue a Payment Certificate which shall include:

(a) the amounts payable for any work carried out for which a price is stated in the Contract;

(b) the Cost of Plant and Materials ordered for the Works which have been delivered to the Contractor, or of which the Contractor is liable to accept delivery: this Plant and Materials shall become the property of (and be at the risk of) the Employer when paid for by the Employer, and the Contractor shall place the same at the Employer's disposal;

(c) other Costs or liabilities which in the circumstances were reasonably and necessarily incurred by the Contractor in the expectation of completing the Works;

(d) the Cost of removal of Temporary Works and Contractor's Equipment from the Site and the return of these items to the Contractor's works in his country (or to any other destination at no greater cost); and

(e) the Cost of repatriation of the Contractor's staff and labour employed wholly in connection with the Works at the date of

termination.

19.7 Release from Performance

Notwithstanding any other provision of this Clause, if any event or circumstance outside the control of the Parties (including, but not limited to, Force Majeure) arises which makes it impossible or unlawful for either or both Parties to fulfil its or their contractual obligations or which, under the law governing the Contract, entitles the Parties to be released from further performance of the Contract, then upon notice by either Party to the other Party of such event or circumstance:

(a) the Parties shall be discharged from further performance, without prejudice to the rights of either Party in respect of any previous breach of the Contract, and

(b) the sum payable by the Employer to the Contractor shall be the same as would have been payable under Sub-Clause 19.6 [Optional Termination, Payment and Release] if the Contract had been terminated under Sub-Clause 19.6.

20. Claims, Disputes and Arbitration

20.1 Contractor's Claims

If the Contractor considers himself to be entitled to any extension of the Time for Completion and/or any additional payment, under any Clause of these Conditions or otherwise in connection with the Contract, the Contractor shall give notice to the Engineer, describing the event or circumstance giving rise to the claim. The notice shall be given as soon as practicable, and not later than 28 days after the Contractor became aware, or should have become aware, of the event or circumstance.

If the Contractor fails to give notice of a claim within such period of 28 days, the Time for Completion shall not be extended, the Contractor shall not be entitled to additional payment, and the Employer shall be discharged from all liability in connection with the claim. Otherwise, the following provisions of this Sub-Clause shall apply.

The Contractor shall also submit any other notices which are required by the Contract, and supporting particulars for the claim, all as relevant to such event or circumstance.

The Contractor shall keep such contemporary records as may be necessary to substantiate any claim, either on the Site or at another location acceptable to the Engineer. Without admitting the Employer's liability, the Engineer may, after receiving any notice under this Sub-Clause, monitor the record-keeping and/or instruct the Contractor to keep further contemporary records. The Contractor shall permit the Engineer to inspect all these records, and shall (if instructed) submit copies to the Engineer.

Within 42 days after the Contractor became aware (or should have become aware) of the event or circumstance giving rise to the claim, or within such other period as may be proposed by the Contractor and approved by the Engineer, the Contractor shall send to the Engineer a fully detailed claim which includes full supporting particulars of the

basis of the claim and of the extension of time and/or additional payment claimed. If the event or circumstance giving rise to the claim has a continuing effect:

(a) this fully detailed claim shall be considered as interim;

(b) the Contractor shall send further interim claims at monthly intervals, giving the accumulated delay and/or amount claimed, and such further particulars as the Engineer may reasonably require; and

(c) the Contractor shall send a final claim within 28 days after the end of the effects resulting from the event or circumstance, or within such other period as may be proposed by the Contractor and approved by the Engineer.

Within 42 days after receiving a claim or any further particulars supporting a previous claim, or within such other period as may be proposed by the Engineer and approved by the Contractor, the Engineer shall respond with approval, or with disapproval and detailed comments. He may also request any necessary further particulars, but shall nevertheless give his response on the principles of the claim within the above defined time period.

Within the above defined period of 42 days, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine (i) the extension (if any) of the Time for Completion (before or after its expiry) in accordance with Sub-Clause 8.4 [Extension of Time for Completion], and/or (ii) the additional payment (if any) to which the Contractor is entitled under the Contract.

Each Payment Certificate shall include such additional payment for any claim as have been reasonably substantiated as due under the relevant provision of the Contract. Unless and until the particulars supplied are sufficient to substantiate the whole of the claim, the Contractor shall only be entitled to payment for such part of the claim as he has been able to substantiate.

If the Engineer does not respond within the timeframe defined in this Clause, either Party may consider that the claim is rejected by the Engineer and any of the Parties may refer it to the Dispute Board in accordance with Sub-Clause 20.4 [Obtaining Dispute Board's Decision].

The requirements of this Sub-Clause are in addition to those of any other Sub-Clause which may apply to a claim. If the Contractor fails to comply with this or another Sub-Clause in relation to any claim, any extension of time and/or additional payment shall take account of the extent (if any) to which the failure has prevented or prejudiced proper investigation of the claim, unless the claim is excluded under the second paragraph of this Sub-Clause.

20.2 Appointment of the Dispute

Disputes shall be referred to a DB for decision in accordance with Sub-Clause 20.4 [Obtaining Dispute Board's Decision]. The Parties shall

Board

appoint a DB by the date stated in the Contract Data.

The DB shall comprise, as stated in the Contract Data, either one or three suitably qualified persons ("the members"), each of whom shall be fluent in the language for communication defined in the Contract and shall be a professional experienced in the type of construction involved in the Works and with the interpretation of contractual documents. If the number is not so stated and the Parties do not agree otherwise, the DB shall comprise three persons.

If the Parties have not jointly appointed the DB 21 days before the date stated in the Contract Data and the DB is to comprise three persons, each Party shall nominate one member for the approval of the other Party. The first two members shall recommend and the Parties shall agree upon the third member, who shall act as chairman.

However, if a list of potential members has been agreed by the Parties and is included in the Contract, the members shall be selected from those on the list, other than anyone who is unable or unwilling to accept appointment to the DB.

The agreement between the Parties and either the sole member or each of the three members shall incorporate by reference the General Conditions of Dispute Board Agreement contained in the Appendix to these General Conditions, with such amendments as are agreed between them.

The terms of the remuneration of either the sole member or each of the three members, including the remuneration of any expert whom the DB consults, shall be mutually agreed upon by the Parties when agreeing the terms of appointment. Each Party shall be responsible for paying one-half of this remuneration.

If at any time the Parties so agree, they may jointly refer a matter to the DB for it to give its opinion. Neither Party shall consult the DB on any matter without the agreement of the other Party.

If a member declines to act or is unable to act as a result of death, disability, resignation or termination of appointment, a replacement shall be appointed in the same manner as the replaced person was required to have been nominated or agreed upon, as described in this Sub-Clause.

The appointment of any member may be terminated by mutual agreement of both Parties, but not by the Employer or the Contractor acting alone. Unless otherwise agreed by both Parties, the appointment of the DB (including each member) shall expire when the discharge referred to in Sub-Clause 14.12 [Discharge] shall have become effective.

20.3 Failure to Agree on the

If any of the following conditions apply, namely:

Composition of the Dispute Board

(a) the Parties fail to agree upon the appointment of the sole member of the DB by the date stated in the first paragraph of Sub-Clause 20.2, [Appointment of the Dispute Board],

(b) either Party fails to nominate a member (for approval by the other Party), or fails to approve a member nominated by the other Party, of a DB of three persons by such date,

(c) the Parties fail to agree upon the appointment of the third member (to act as chairman) of the DB by such date, or

(d) the Parties fail to agree upon the appointment of a replacement person within 42 days after the date on which the sole member or one of the three members declines to act or is unable to act as a result of death, disability, resignation or termination of appointment,

then the appointing entity or official named in the Contract Data shall, upon the request of either or both of the Parties and after due consultation with both Parties, appoint this member of the DB. This appointment shall be final and conclusive. Each Party shall be responsible for paying one-half of the remuneration of the appointing entity or official.

20.4 Obtaining Dispute Board's Decision

If a dispute (of any kind whatsoever) arises between the Parties in connection with, or arising out of, the Contract or the execution of the Works, including any dispute as to any certificate, determination, instruction, opinion or valuation of the Engineer, either Party may refer the dispute in writing to the DB for its decision, with copies to the other Party and the Engineer. Such reference shall state that it is given under this Sub-Clause.

For a DB of three persons, the DB shall be deemed to have received such reference on the date when it is received by the chairman of the DB.

Both Parties shall promptly make available to the DB all such additional information, further access to the Site, and appropriate facilities, as the DB may require for the purposes of making a decision on such dispute. The DB shall be deemed to be not acting as arbitrator(s).

Within 84 days after receiving such reference, or within such other period as may be proposed by the DB and approved by both Parties, the DB shall give its decision, which shall be reasoned and shall state that it is given under this Sub-Clause. The decision shall be binding on both Parties, who shall promptly give effect to it unless and until it shall be revised in an amicable settlement or an arbitral award as described below. Unless the Contract has already been abandoned, repudiated or terminated, the Contractor shall continue to proceed with the Works in accordance with the Contract.

If either Party is dissatisfied with the DB's decision, then either Party may, within 28 days after receiving the decision, give notice to the other Party of its dissatisfaction and intention to commence arbitration. If the DB fails to give its decision within the period of 84 days (or as

otherwise approved) after receiving such reference, then either Party may, within 28 days after this period has expired, give notice to the other Party of its dissatisfaction and intention to commence arbitration.

In either event, this notice of dissatisfaction shall state that it is given under this Sub-Clause, and shall set out the matter in dispute and the reason(s) for dissatisfaction. Except as stated in Sub-Clause 20.7 [Failure to Comply with Dispute Board's Decision] and Sub-Clause 20.8 [Expiry of Dispute Board's Appointment], neither Party shall be entitled to commence arbitration of a dispute unless a notice of dissatisfaction has been given in accordance with this Sub-Clause.

If the DB has given its decision as to a matter in dispute to both Parties, and no notice of dissatisfaction has been given by either Party within 28 days after it received the DB's decision, then the decision shall become final and binding upon both Parties.

20.5 Amicable Settlement

Where notice of dissatisfaction has been given under Sub-Clause 20.4 above, both Parties shall attempt to settle the dispute amicably before the commencement of arbitration. However, unless both Parties agree otherwise, arbitration may be commenced on or after the fifty-sixth day after the day on which a notice of dissatisfaction and intention to commence arbitration was given, even if no attempt at amicable settlement has been made.

20.6 Arbitration

Unless indicated otherwise in the Particular Conditions, any dispute not settled amicably and in respect of which the DB's decision (if any) has not become final and binding shall be finally settled by arbitration. Unless otherwise agreed by both Parties:

(a) For contracts with foreign contractors, international arbitration with proceedings administered by the institution appointed in the Contract Data, conducted in accordance with the rules of arbitration of the appointed institution, if any, or in accordance with UNCITRAL arbitration rules, at the choice of the appointed institution,

(b) the place of arbitration shall be the city where the headquarters of the appointed arbitration institution is located,

(c) the arbitration shall be conducted in the language for communications defined in Sub-Clause 1.4 [Law and Language], and

(d) For contracts with domestic contractors, arbitration with proceedings conducted in accordance with the laws of the Employer's country.

The arbitrators shall have full power to open up, review and revise any certificate, determination, instruction, opinion or valuation of the Engineer, and any decision of the DB, relevant to the dispute. Nothing shall disqualify representatives of the Parties and the Engineer from being called as a witness and giving evidence before the arbitrators on any matter whatsoever relevant to the dispute.

Neither Party shall be limited in the proceedings before the arbitrators to the evidence or arguments previously put before the DB to obtain its decision, or to the reasons for dissatisfaction given in its notice of dissatisfaction. Any decision of the DB shall be admissible in evidence in the arbitration.

Arbitration may be commenced prior to or after completion of the Works. The obligations of the Parties, the Engineer and the DB shall not be altered by reason of any arbitration being conducted during the progress of the Works.

20.7 Failure to Comply with Dispute Board's Decision

In the event that a Party fails to comply with a final and binding DB decision, then the other Party may, without prejudice to any other rights it may have, refer the failure itself to arbitration under Sub-Clause 20.6 [Arbitration]. Sub-Clause 20.4 [Obtaining Dispute Board's Decision] and Sub-Clause 20.5 [Amicable Settlement] shall not apply to this reference.

20.8 Expiry of Dispute Board's Appointment

If a dispute arises between the Parties in connection with, or arising out of, the Contract or the execution of the Works and there is no DB in place, whether by reason of the expiry of the DB's appointment or otherwise:

(a) Sub-Clause 20.4 [Obtaining Dispute Board's Decision] and Sub-Clause 20.5 [Amicable Settlement] shall not apply, and

(b) the dispute may be referred directly to arbitration under Sub-Clause 20.6 [Arbitration].

APPENDIX

General Conditions of Dispute Board Agreement

1. Definitions

Each "Dispute Board Agreement" is a tripartite agreement by and between:

(a) the "Employer";

(b) the "Contractor"; and

(c) the "Member" who is defined in the Dispute Board Agreement as being:

(i) the sole member of the "DB" and, where this is the case, all references to the "Other Members" do not apply, or

(ii) one of the three persons who are jointly called the "DB" (or "Dispute Board") and, where this is the case, the other two persons are called the "Other Members."

The Employer and the Contractor have entered (or intend to enter) into a contract, which is called the "Contract" and is defined in the Dispute Board Agreement, which incorporates this Appendix. In the Dispute Board Agreement, words and expressions which are not otherwise defined shall have the meanings assigned to them in the Contract.

2. General Provisions

Unless otherwise stated in the Dispute Board Agreement, it shall take effect on the latest of the following dates:

(a) the Commencement Date defined in the Contract,

(b) when the Employer, the Contractor and the Member have each signed the Dispute Board Agreement, or

(c) when the Employer, the Contractor and each of the Other Members (if any) have respectively each signed a dispute board agreement.

This employment of the Member is a personal appointment. At any time, the Member may give not less than 70 days' notice of resignation to the Employer and to the Contractor, and the Dispute Agreement shall terminate upon the expiry of this period.

3. Warranties

The Member warrants and agrees that he/she is and shall be impartial and independent of the Employer, the Contractor and the Engineer. The Member shall promptly disclose, to each of them and to the Other Members (if any), any fact or circumstance which might appear inconsistent with his/her warranty and agreement of impartiality and independence.

When appointing the Member, the Employer and the Contractor relied upon the Member's representations that he/she is:

(a) experienced in the work which the Contractor is to carry out under the Contract,

(b) experienced in the interpretation of contract documentation, and

(c) fluent in the language for communications defined in the Contract.

4. General Obligations of the Member

The Member shall:

(a) have no interest financial or otherwise in the Employer, the Contractor or Engineer, nor any financial interest in the Contract except for payment under the Dispute Board Agreement;

(b) not previously have been employed as a consultant or otherwise by the Employer, the Contractor or the Engineer, except in such circumstances as were disclosed in writing to the Employer and the Contractor before they signed the Dispute Board Agreement;

(c) have disclosed in writing to the Employer, the Contractor and the Other Members (if any), before entering into the Dispute Board Agreement and to his/her best knowledge and recollection, any professional or personal relationships with any director, officer or employee of the Employer, the Contractor or the Engineer, and any previous involvement in the overall project of which the Contract forms part;

(d) not, for the duration of the Dispute Board Agreement, be employed as a consultant or otherwise by the Employer, the Contractor or the Engineer, except as may be agreed in writing by the Employer, the Contractor and the Other Members (if any);

(e) comply with the annexed procedural rules and with Sub-Clause 20.4 of the Conditions of Contract;

(f) not give advice to the Employer, the Contractor, the Employer's Personnel or the Contractor's Personnel concerning the conduct of the Contract, other than in accordance with the annexed procedural rules;

(g) not while a Member enter into discussions or make any agreement with the Employer, the Contractor or the Engineer regarding employment by any of them, whether as a consultant or otherwise, after ceasing to act under the Dispute Board Agreement;

(h) ensure his/her availability for all site visits and hearings as are necessary;

(i) become conversant with the Contract and with the progress of the Works (and of any other parts of the project of which the Contract forms part) by studying all documents received which shall be maintained in a current working file;

(j) treat the details of the Contract and all the DB's activities and hearings as private and confidential, and not publish or disclose them without the prior written consent of the Employer, the Contractor and the Other Members (if any); and

(k) be available to give advice and opinions, on any matter relevant to the Contract when requested by both the Employer and the Contractor, subject to the agreement of the Other Members (if any).

5. General Obligations of the Employer and the Contractor

The Employer, the Contractor, the Employer's Personnel and the Contractor's Personnel shall not request advice from or consultation with the Member regarding the Contract, otherwise than in the normal course of the DB's activities under the Contract and the Dispute Board Agreement. The Employer and the Contractor shall be responsible for compliance with this provision, by the Employer's Personnel and the Contractor's Personnel respectively.

The Employer and the Contractor undertake to each other and to the Member that the Member shall not, except as otherwise agreed in writing by the Employer, the Contractor, the Member and the Other Members (if any):

(a) be appointed as an arbitrator in any arbitration under the Contract;

(b) be called as a witness to give evidence concerning any dispute before arbitrator(s) appointed for any arbitration under the Contract; or

(c) be liable for any claims for anything done or omitted in the discharge or purported discharge of the Member's functions, unless the act or omission is shown to have been in bad faith.

The Employer and the Contractor hereby jointly and severally indemnify and hold the Member harmless against and from claims from which he is relieved from liability under the preceding paragraph.

Whenever the Employer or the Contractor refers a dispute to the DB under Sub-Clause 20.4 of the Conditions of Contract, which will require the Member to make a site visit and attend a hearing, the Employer or the Contractor shall provide appropriate security for a sum equivalent to the reasonable expenses to be incurred by the Member. No account shall be taken of any other payments due or paid to the Member.

6. Payment

The Member shall be paid as follows, in the currency named in the Dispute Board Agreement:

(a) a retainer fee per calendar month, which shall be considered as payment in full for:

(i) being available on 28 days' notice for all site visits and hearings;

(ii) becoming and remaining conversant with all project developments and maintaining relevant files;

(iii) all office and overhead expenses including secretarial services, photocopying and office supplies incurred in connection with his duties; and

(iv) all services performed hereunder except those referred to in sub-paragraphs (b) and (c) of this Clause.

The retainer fee shall be paid with effect from the last day of the calendar month in which the Dispute Board Agreement becomes effective; until the last day of the calendar month in which the Taking-Over Certificate is issued for the whole of the Works.

With effect from the first day of the calendar month following the month in which the Taking-Over Certificate is issued for the whole of the Works, the retainer fee shall be reduced by one third. This reduced fee shall be paid until the first day of the calendar month in which the Member resigns or the Dispute Board Agreement is otherwise terminated.

(b) a daily fee which shall be considered as payment in full for:

(i) each day or part of a day up to a maximum of two days' travel time in each direction for the journey between the Member's home and the site, or another location of a meeting with the Other Members (if any);

(ii) each working day on Site visits, hearings or preparing decisions; and

(iii) each day spent reading submissions in preparation for a hearing.

(c) all reasonable expenses including necessary travel expenses (air fare in less than first class, hotel and subsistence and other direct travel expenses) incurred in connection with the Member's duties, as well as the cost of telephone calls, courier charges, faxes and telexes: a receipt shall be required for each item in excess of five percent of the daily fee referred to in sub-paragraph (b) of this Clause;

(d) any taxes properly levied in the Country on payments made to the Member (unless a national or permanent resident of the Country) under this Clause 6.

The retainer and daily fees shall be as specified in the Dispute Board Agreement. Unless it specifies otherwise, these fees shall remain fixed for the first 24 calendar months, and shall thereafter be adjusted by agreement between the Employer, the Contractor and the Member, at each anniversary of the date on which the Dispute Board Agreement became effective.

If the parties fail to agree on the retainer fee or the daily fee, the appointing entity or official named in the Contract Data shall determine the amount of the fees to be used.

The Member shall submit invoices for payment of the monthly retainer and air fares quarterly in advance. Invoices for other expenses and for daily fees shall be submitted following the conclusion of a site visit or hearing. All invoices shall be accompanied by a brief description of activities performed during the relevant period and shall be addressed to the Contractor.

The Contractor shall pay each of the Member's invoices in full within 56 calendar days after receiving each invoice and shall apply to the Employer (in the Statements under the Contract) for reimbursement of one-half of the amounts of these invoices. The Employer shall then pay the Contractor in accordance with the Contract.

If the Contractor fails to pay to the Member the amount to which he/she is entitled under the Dispute Board Agreement, the Employer shall pay the amount due to the Member and any other amount which may be required

to maintain the operation of the DB; and without prejudice to the Employer's rights or remedies. In addition to all other rights arising from this default, the Employer shall be entitled to reimbursement of all sums paid in excess of one-half of these payments, plus all costs of recovering these sums and financing charges calculated at the rate specified in Sub-Clause 14.8 of the Conditions of Contract.

If the Member does not receive payment of the amount due within 70 days after submitting a valid invoice, the Member may (i) suspend his/her services (without notice) until the payment is received, and/or (ii) resign his/her appointment by giving notice under Clause 7.

7. Termination

At any time: (i) the Employer and the Contractor may jointly terminate the Dispute Board Agreement by giving 42 days' notice to the Member; or (ii) the Member may resign as provided for in Clause 2.

If the Member fails to comply with the Dispute Board Agreement, the Employer and the Contractor may, without prejudice to their other rights, terminate it by notice to the Member. The notice shall take effect when received by the Member.

If the Employer or the Contractor fails to comply with the Dispute Board Agreement, the Member may, without prejudice to his other rights, terminate it by notice to the Employer and the Contractor. The notice shall take effect when received by them both.

Any such notice, resignation and termination shall be final and binding on the Employer, the Contractor and the Member. However, a notice by the Employer or the Contractor, but not by both, shall be of no effect.

8. Default of the Member

If the Member fails to comply with any of his obligations under Clause 4 (a) - (d) above, he shall not be entitled to any fees or expenses hereunder and shall, without prejudice to their other rights, reimburse each of the Employer and the Contractor for any fees and expenses received by the Member and the Other Members (if any), for proceedings or decisions (if any) of the DB which are rendered void or ineffective by the said failure to comply.

If the Member fails to comply with any of his obligations under Clause 4 (e) - (k) above, he shall not be entitled to any fees or expenses hereunder from the date and to the extent of the non-compliance and shall, without prejudice to their other rights, reimburse each of the Employer and the Contractor for any fees and expenses already received by the Member, for proceedings or decisions (if any) of the DB which are rendered void or ineffective by the said failure to comply.

9. Disputes

Any dispute or claim arising out of or in connection with this Dispute Board Agreement, or the breach, termination or invalidity thereof, shall be finally settled by institutional arbitration. If no other arbitration institute is agreed, the arbitration shall be conducted under the Rules of Arbitration of the International Chamber of Commerce by one arbitrator appointed in accordance with these Rules of Arbitration.

PROCEDURAL RULES

Unless otherwise agreed by the Employer and the Contractor, the DB shall visit the site at intervals of not more than 140 days, including times of critical construction events, at the request of either the Employer or the Contractor. Unless otherwise agreed by the Employer, the Contractor and the DB, the period between consecutive visits shall not be less than 70 days, except as required to convene a hearing as described below.

The timing of and agenda for each site visit shall be as agreed jointly by the DB, the Employer and the Contractor, or in the absence of agreement, shall be decided by the DB. The purpose of site visits is to enable the DB to become and remain acquainted with the progress of the Works and of any actual or potential problems or claims, and, as far as reasonable, to endeavour to prevent potential problems or claims from becoming disputes.

Site visits shall be attended by the Employer, the Contractor and the Engineer and shall be co-ordinated by the Employer in co-operation with the Contractor. The Employer shall ensure the provision of appropriate conference facilities and secretarial and copying services. At the conclusion of each site visit and before leaving the site, the DB shall prepare a report on its activities during the visit and shall send copies to the Employer and the Contractor.

The Employer and the Contractor shall furnish to the DB one copy of all documents which the DB may request, including Contract documents, progress reports, variation instructions, certificates and other documents pertinent to the performance of the Contract. All communications between the DB and the Employer or the Contractor shall be copied to the other Party. If the DB comprises three persons, the Employer and the Contractor shall send copies of these requested documents and these communications to each of these persons.

If any dispute is referred to the DB in accordance with Sub-Clause 20.4 of the Conditions of Contract, the DB shall proceed in accordance with Sub-Clause 20.4 and these Rules. Subject to the time allowed to give notice of a decision and other relevant factors, the DB shall:

(a) act fairly and impartially as between the Employer and the Contractor, giving each of them a reasonable opportunity of putting his case and responding to the other's case, and

(b) adopt procedures suitable to the dispute, avoiding unnecessary delay or expense.

The DB may conduct a hearing on the dispute, in which event it will decide on the date and place for the hearing and may request that written documentation and arguments from the Employer and the Contractor be presented to it prior to or at the hearing.

Except as otherwise agreed in writing by the Employer and the Contractor, the DB shall have power to adopt an inquisitorial procedure, to refuse admission to hearings or audience at hearings to any persons other than representatives of the Employer, the Contractor and the Engineer, and to proceed in the absence of any party who the DB is satisfied received notice of the hearing; but shall have discretion to decide whether and to what extent this power may be exercised.

The Employer and the Contractor empower the DB, among other things, to:

(a) establish the procedure to be applied in deciding a dispute,

(b) decide upon the DB's own jurisdiction, and as to the scope of any dispute referred to it,

(c) conduct any hearing as it thinks fit, not being bound by any rules or procedures other than those contained in the Contract and these Rules,

(d) take the initiative in ascertaining the facts and matters required for a decision,

(e) make use of its own specialist knowledge, if any,

(f) decide upon the payment of financing charges in accordance with the Contract,

(g) decide upon any provisional relief such as interim or conservatory measures, and

(h) open up, review and revise any certificate, decision, determination, instruction, opinion or valuation of the Engineer, relevant to the dispute.

The DB shall not express any opinions during any hearing concerning the merits of any arguments advanced by the Parties. Thereafter, the DB shall make and give its decision in accordance with Sub-Clause 20.4, or as otherwise agreed by the Employer and the Contractor in writing. If the DB comprises three persons:

(a) it shall convene in private after a hearing, in order to have discussions and prepare its decision;

(b) it shall endeavour to reach a unanimous decision: if this proves impossible the applicable decision shall be made by a majority of the Members, who may require the minority Member to prepare a written report for submission to the Employer and the Contractor; and

(c) if a Member fails to attend a meeting or hearing, or to fulfil any required function, the other two Members may nevertheless proceed to make a decision, unless:

    (i) either the Employer or the Contractor does not agree that they do so, or

    (ii) the absent Member is the chairman and he/she instructs the other Members not to make a decision.

Section VII. Particular Conditions (PC)

The following Particular Conditions shall supplement the GC. Whenever there is a conflict, the provisions herein shall prevail over those in the GC.

Part A - Contract Data

Conditions	Sub-Clause	Data
Employer's name and address	1.1.2.2 & 1.3	The Managing Director, Limuru Water and Sewerage Co. Ltd Maji Center, Opp, Limuru Health Center P.O. Box 1286-00217 LIMURU, KENYA
Engineer's name and address	1.1.2.4 & 1.3	The Technical Manager, Limuru Water and Sewerage Co. Ltd Maji Center, Opp, Limuru Health Center P.O. Box 1286-00217 LIMURU, KENYA
Financier	1.1.2.11	**Government of Kenya**
Time for Completion	1.1.3.3	**3 Months**
Defects Notification Period	1.1.3.7	**6 Months**
Sections	1.1.5.6	**N/A**
Electronic transmission systems	1.3	**N/A**
Governing Law	1.4	**The Law of Kenya**
Ruling language	1.4	**English**
Language for communications	1.4	**English**
Time for access to the Site	2.1	**Immediate upon Contract signing**
Engineer's Duties and Authority	3.1(b)(ii)	**N/A**
Performance Security	4.2	The performance security will be in the form of a **Demand Guarantee** in the amount of **10%** of the Accepted Contract Amount and in the same currency(ies) of the Accepted Contract Amount.
Normal working hours	6.5	**As per Laws of Kenya**
Delay damages for the Works	8.7 & 14.15(b)	**0.04% of the Contract Price per day.**

Conditions	Sub-Clause	Data
Maximum amount of delay damages	8.7	**10% of the final Contract Price.**
Provisional Sums	13.5.(b)(ii)	**5%**
Adjustments for Changes in Cost	13.8	**N/A**
Total advance payment	14.2	**N/A**
Repayment amortization rate of advance payment	14.2(b)	**N/A**
Percentage of Retention	14.3	**10%**
Limit of Retention Money	14.3	**5%** of the Accepted Contract Amount
Plant and Materials	14.5(b)(i)	**N/A**
	14.5(c)(i)	**N/A**
Minimum Amount of Interim Payment Certificates	14.6	**30 %** of the Accepted Contract Amount.
Publishing source of commercial interest rates for financial charges in case of delayed payment	14.8	1% per annum above the average lending rate prepared by the Central Bank of Kenya and published in Kenya Monthly Economic Reviews
Maximum total liability of the Contractor to the Employer	17.6	**The Accepted Contract Amount**
Periods for submission of insurance: a. evidence of insurance. b. relevant policies	18.1	 14 days upon notification of Award 28 days upon notification of Award
Maximum amount of deductibles for insurance of the Employer's risks	18.2(d)	**Kshs 400,000/-**
Minimum amount of third party insurance	18.3	**Kshs. 5,000,000 (Kenya Shillings Five Millions) per occurrence, with unlimited number of occurrences.**

Conditions	Sub-Clause	Data
Date by which the DB shall be appointed	20.2	**On need basis**
The DB shall be comprised of	20.2	**One Member**
List of potential DB sole members	20.2	**To Be Determined**
Appointment (if not agreed) to be made by	20.3	**Chartered Institute of Arbitrators (Kenya Chapter)**
Rules of arbitration	20.6(a)	**International Arbitration with proceedings administered by Charted Institute of Arbitrators (Kenya Chapter) and conducted in accordance with UNCITRAL Arbitration Rules.**

Table: Summary of Sections

Section Name/Description (Sub-Clause 1.1.5.6)	Time for Completion (Sub-Clause 1.1.3.3)	Damages for Delay (Sub-Clause 8.7)
N/A	**N/A**	**N/A**

Section VIII. Annex to the Particular Conditions - Contract Forms

Table of Forms

Notification of Award 229

Contract Agreement 229

Performance Security 229

Advance Payment Security 229

Retention Money Security 229

Notification of Award

LETTER OF ACCEPTANCE

[letterhead paper of the Employer]

[date]

To: *[name and address of the Contractor]*

This is to notify you that your Bid dated *[date]* for execution of the **RELOCATION OF WATER SUPPLY AND SEWERAGE INFRASTRUCTURE ALONG THE PROJECT ROAD SECTION I: RIRONI – MAGUMU FLYOVER AND RIRONI – MUTARAKWA**

Contract No. LIWASCO/001/KENHA/2020/21 for the Accepted Contract Amount of the equivalent of *[amount in numbers and words] [name of currency]*, as corrected and modified in accordance with the Instructions to Bidders, is hereby accepted by our Agency.

You are requested to furnish the Performance Security within 14 days in accordance with the Conditions of Contract, using for that purpose one of the Performance Security Form*s* included in Section VIII, Annex to the Particular Conditions - Contract Forms, of the Bidding Document

Authorized Signature: _____
Name and Title of Signatory: _____
Name of Agency: _____

Attachment: Contract Agreement

Contract Agreement

THIS AGREEMENT made on the _____ day of _____, _____, between**,** **Limuru Water and Sewerage Company of P.O. Box 1286-00217 Limuru, Kenya** (hereinafter "the Employer"), of the one part, and _____ of _____ (hereinafter "the Contractor"), of the other part;

WHEREAS the Employer desires that the Works known as **RELOCATION OF WATER SUPPLY AND SEWERAGE INFRASTRUCTURE ALONG THE PROJECT ROAD SECTION I: RIRONI – MAGUMU FLYOVER AND RIRONI – MUTARAKWA**
Contract No. LIWASCO/001/KENHA/2020/21should be executed by the Contractor, and has accepted a Bid by the Contractor for the execution and completion of these Works and the remedying of any defects therein for the Contract price of kenya shilling …….. [Amount in figures] for a contract duration of 9 months (inclusive of 6 months of Defects Notification Period);

The Employer and the Contractor agree as follows:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Contract documents referred to.

2. The following documents shall be deemed to form and be read and construed as part of this Agreement. This Agreement shall prevail over all other Contract documents.

(i) The Notification of Award

(ii) the Letter of Bid (Bid Submission form)

(iii) the addenda Nos _____(if any)

(iv) the Particular Conditions

(v) the General Conditions;

(vi) the Specifications

(vii) the Drawings*;* and

(viii) the completed Schedules.

3. In consideration of the payments to be made by the Employer to the Contractor as indicated in this Agreement, the Contractor hereby covenants with the Employer to execute the Works and to remedy defects therein in conformity in all respects with the provisions of the Contract.

4. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects therein, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

In witness whereof the Parties have executed and delivered this Agreement as of the day, month and year first above written

The Employer

Signed, **sealed** and **delivered** by)
[**])
duly authorised for and on behalf of)
Limuru Water and Sewerage Company) _____

In the presence of:

[**]

Contractor

Signed, **sealed** and **delivered** by)
[**])
duly authorised for and on behalf of)
) _____

In the presence of:

[**]

Performance Security

(Demand Guarantee)

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

Beneficiary: Managing Director, Limuru Water and Sewerage Company

Date: _____

PERFORMANCE GUARANTEE No.: _____

We have been informed that _____ *[name of Contractor]* (hereinafter called "the Contractor") has entered into **Contract No. LIWASCO/001/KENHA/2020/21** dated _____ with you, for the execution of Relocation Of Water Suppy and Sewerage Infrastructure along the Project Road **Section I: Rironi – Magumu Flyover And Rironi – Mutarakwa**

Contract No. **LIWASCO/001/KENHA/2020/21**(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 _____ *[name of Bank]* hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of _____ *[amount in figures]* (_____) *[amount in words]*,[1] 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.

This guarantee shall expire, no later than the …. Day of ……, 2… [2], and any demand for payment under it must be received by us at this office on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 458, except that subparagraph (ii) of Sub-article 20(a) is hereby excluded.

_____

[signature(s)]

Note: All italicized text (including footnotes) is for use in preparing this form and shall be deleted from the final product.

---

[1] *The Guarantor shall insert an amount representing the percentage of the Contract Price specified in the Contract and denominated either in the currency(cies) of the Contract or a freely convertible currency acceptable to the Employer.*

[2] *Insert the date twenty-eight days after the expected completion date. The Employer should note that in the event of an extension of the time for completion of the Contract, the Employer would need to request an extension of this guarantee from the Guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee. In preparing this guarantee, the Employer might consider adding the following text to the form, at the end of the penultimate paragraph: "The Guarantor agrees to a one-time extension of this guarantee for a period not to exceed [six months][one year], in response to the Employer's written request for such extension, such request to be presented to the Guarantor before the expiry of the guarantee."*

Advance Payment Security

Not Used(Not apploicable)

PART 3 –WORKS REQUIREMENTS

Section IX. Works Requirements

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Scope of Works

The Works in this Contract will be executed along the Nairobi-Nakuru-Mau Summit road (A8). The Scope of Works include:

- Lay of 11km of various diameter pipelines and Interconnections through microtunneling and along the road reserve
- Supply and installation of Bulk Water Meters and other Pipe Fittings including Gate Valves, Sluice valves etc
- Other Ancillary Works including, but not limited to:
- Construction of Valve Chambers, Meter Chambers, Washout chambers and Thrust blocks etc.

The construction period is **3 Months**

Specifications

1. The Specification to be used for the Works is the General and Technical Specifications given in Volume II of the Bid Documents.

2. "Standards, brand names, catalog numbers or similar classifications provided in the Specifications are indicative of performance requirements and offers which have similar characteristics and which provide performance and quality equal or higher to the performance requirements specified would be accepted."

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

Technical Specifications

Contents

Specifications Background

List of Clauses

Section 1	General Requirements
Section 2	Earthworks, Backfilling and Restoration
Section 3	Concrete Works - General
Section 4	Pipelines, Pipework and Manholes
Section 5	Buildings and Structures
Section 6	Roads and Surfacing
Section 7	Safety, Health and Environment
Section 8	Contractor's Site Check List
Section 9	Construction Environmental Management Plan
Section 11	Instrumentation and Control

Specifications Background

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

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

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

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

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

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

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Section 1. General Requirements

101 Project Background

Limuru Water and Sewerage Company Limited (LIWASECO) is in Kiambu County. The company is privately limited by shares under the companies Act. The total population in the area of jurisdiction is 252,652.

There are three (3 No.) existing main water supply schemes within the jurisdiction area of LIWASECO namely:

- Limuru Water Supply Scheme is supplied by boreholes with an approximate combined production of 3,000 m^3/day;
- Bathi Water Supply Scheme is supplied by water from Bathi Dam with an average production of 1,150 m^3/day;
- Thigio Rural Scheme with an average production of 600 m^3/day.

LIWASECO currently operates 17 boreholes with a present production of approximately 3,000 m^3/day. Water from the boreholes is treated by disinfection using chlorine. Most of the boreholes pump to storage tanks and thereafter the supply water gravitates from the tanks to their respective supply areas, while some boreholes pump directly to the distribution.

The Bathi River Water Scheme serves a total area of 197 km^2. The distribution system is generally in good condition with exception of a few areas whose network is old and requires replacement. There are 4,683 registered connections, out of which 2,543 are active according to the WSP records.

The distribution network in the three schemes is in fair condition with NRW reported to be 34% in Limuru, 27% in Bathi Rural and 33% in Thigio Rural Schemes. There is need for expansion of the network to adequately serve the underserved and unserved areas. The high NRW occurs due to malfunction of the consumer meters as well as physical losses due to pipelines that are in poor conditions in some schemes.

There are a number of community water projects (CWPs) under the WSP service areas, some of which the WSP has already taken over for operation. The Company has taken over operation of 4No. community water projects; namely: Tigoni, Ndiuni, Kiawaroga and Thigio.

In addition, LIWASECO has constructed chambers to protect springs – namely Kijabe Springs where nearly 200 m^3/day is abstracted and serves consumers in Kijabe area.

The Company has also signed a third-party Service Provision Agreement (SPA) with Bibirioni and Kamirithu Community Water Projects.

Limuru town has a sewerage system which serves Limuru Township. The wastewater treatment works (WWTW) has a design capacity of 550 m^3/day (Dry Weather Flow). The WWTW was designed in 1974 and was to be implemented in two phases. Phase I was to serve a population of 4,500 persons in 1985.The phase two was to be implemented later to treat sewage from the estimated population of 10,950 in the year 2000.

The wastewater from the present service area is conveyed to the WWTW by gravity. The urban and peri-urban areas which are not served by the sewerage network use septic tanks as an alternative mode of sanitation while the rural areas use VIP/pit latrines.

The project area is characterized by hills, plateaus, and high-elevation plains. The water resources within the project area are fed by precipitation. The water resources comprise both surface and groundwater including permanent rivers, springs, swamps and wells. Groundwater potential in the project area is generally good and has been exploited extensively. Primarily, all streams in the project area drain to the Athi River.

Annual rainfall over the area ranges from 2,000mm in the high areas and drops to 900mm in the low areas. As is

characteristic to the climate within the project area, rainfall seasons are in to main periods from March-May and October-December.

The project area lies between 2270m and 2320m ASL.

Limuru has temperature of $10o^C$ to $28o^C$ year-round.

The geology is composed to a large extent of volcanic rocks overlain by deep dark brown to greyish brown soils.

102 Quality and Approvals

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

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

Where the Contractor is responsible for the preparation of Construction Documents to describe the permanent works such Construction Documents shall be approved prior to the procurement of any materials or commencement of any work to which the documents relate.
No materials, Plant or equipment shall be procured for the Contract and no work, permanent or temporary, shall commence without first obtaining the Project Manager's approval.
All materials, Plant and equipment supplied shall be designed for operation under the above described conditions.

103 Construction Documents

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

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

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

Drawings and documents submitted for approval shall be delivered to the Project Manager's office as designated by the Project Manager.
Unless otherwise specified the Contractor shall allow a minimum of 21 days, after the date of receipt by the Project Manager for approval of drawings and documents by the Project Manager.

104 Operation and Maintenance Manuals

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

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

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

105 Level Datum

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

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

106 Setting Out of the Works

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

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

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

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

107 Boundaries of Works

The Employer shall provide the Site upon which the Permanent Works are to be constructed. Where a drain or pipeline is to be within an existing road or track reservation or is otherwise located in land designated Public Domain the Site width will be restricted to the limit of the public land. The existing boundary fences and walls shall not be disturbed without prior approval of the Project Manager and, unless road diversions and closure notices are approved and posted, carriageways shall be left available for the safe passage of traffic.

The Contractor shall not enter upon or occupy with men, tools, equipment or materials any land other than the site without the written consent of the owner of such land.
On occupation of the Site or other land the Contractor shall provide such fencing, as required.

108 Work through Private Land

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

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

109 Public Utility Mains and Services

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

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

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

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

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

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

110 Safeguards to Existing Pipes, Cables, Structures

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

111 Record Drawings

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

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

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

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

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

112 Connections to Existing Pipes, Cables and Equipment

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

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

113 Lighting, Watching and Traffic Control

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

114 Contractor's Offices

The Contractor shall provide and maintain offices for the use of his representative and staff to which written instructions by the Project Manager can be delivered. Any instructions delivered to such offices shall be deemed to have been delivered to the Contractor.
Offices shall be located to give convenient access to the Works and shall be subject to the approval of the Project Manager. The Contractor shall be responsible for obtaining the land on which to establish any temporary site offices.

116 Vehicles for the Project Manager

The Contractor shall maintain for the duration of the Contract vehicles for the use of the Project Manager.

117 Contractor's Yards, Stores and Accommodation for Workmen

The Contractor shall be responsible for obtaining the land and for the provision of all temporary yards, stores, workshops, offices, mess rooms, shelters and for all services in connection therewith. The location of all such facilities shall be agreed beforehand with the Project Manager and shall be such as to avoid obstruction and nuisance to the public.
The Contractor shall construct secure storage compounds and storage building where he shall store at his own risk all equipment and Plant awaiting erection. The Contractor shall also provide secure covered storage for all samples submitted to the Project Manager for approval. Storage building shall be weatherproof and shall be of sufficient size to accommodate all items requiring covered storage.

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

118 Water and Electricity Supplies

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

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

119 Contractor's Staff and Workmen

The Contractor shall agree to employ Kenyan workers to the maximum extent possible. The Contractor shall

provide a competent Site Agent to the approval of the Project Manager to be in charge of the work who shall not be changed except with the consent of the Project Manager.

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

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

120 Training of Employers Workmen

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

121 Project Management

121.1 Project Control

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

a) Planning and programme preparation particularly in relation to the requirements of the Employer and the public authorities, and the requirements to maintain water supply and waste water disposal services where careful detailed arrangements have to be made and adhered to.

b) Planning the execution of the Works in a manner which minimizes disruption to the water supply system and will permit the efficient and effective commissioning of the water supply system and their respective components.

c) Ensuring adequate potable water supplies and wastewater disposal services are maintained to all consumers.

d) Continuous surveillance of progress and anticipation of factors likely to affect the timely performance of the Contract.

e) Making proposal for modification to forward planning and to the programme at an early stage in the light of factors resulting from (d) above.

f) Continuous appraisal of the Contractor's methods and routines particularly as to their effect on the community and property.

g) Forward planning for resource requirements taking due account of possible shortages and delays in the arrival on site of materials, equipment, plant and personnel and their mobilization for effective usage.

h) Acquisition and process of up-to-date information for progress meetings with the Project Manager. The preparation of monthly progress reports including an update of the detailed programme and cash flow forecast which shall include progress photographs as directed by the Project Manager.

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

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

value.

121.2 Monthly Statements and Certificates

Monthly statements and certificates shall be submitted in an approved manner and format. In addition to the statements submitted in hard copy the Contractor shall submit a computer copy using data base software as prescribed by the Project Manager. The statements and certificates shall detail the measured value of the work completed on each item of the Works in such detail that the Project Manager can identify location and measurement of each item. A location shall constitute a single structure such as a reservoir, pump station or section of a pipeline or a component of a system such as a pipeline valve complex.

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

121.3 Progress Meetings

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

122 Equipment for the Employer

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

123 Facilities for Survey and Inspection by the Project Manager

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

124 Inspections by the Project Manager during Defects Liability Period

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

125 Protective Clothing and Safety Equipment

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

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

126 Notice Boards

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

Manager. The display of any named Sub-contractors or any other information associated with the Works shall be to the approval of the Project Manager.

127 Language of Correspondence and Records

All communications from the Contractor to the Project Manager shall be in the English language. All books, timesheets, records, notes, drawings, documents, specifications and manufacturers' literature shall be in the English language. If any of the aforementioned is in another language a certified translation in English shall be submitted to the Project Manager.

128 Standards and Regulations

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

Such standards and codes shall include:

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

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

129 Equivalency of Standards and Codes

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

130 Quality Control

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

131 Units

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

132 Inspection and Testing during Manufacture

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

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

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

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

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

Section 2 Earthworks, Backfilling and Restoration

201 Conditions of Site

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

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

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

202 Site Clearance and Topsoil Removal

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

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

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

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

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

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

203 Erosion

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

204 Ground Levels

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

205 Trial Holes

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

206 Excavation Generally

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

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

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

In the event of soft or otherwise unsuitable ground being encountered at formation level or if the formation is damaged or allowed to deteriorate the Contractor shall forthwith inform the Project Manager, shall excavate to such extra depth and refill with compacted granular or other approved fill or C15 concrete (minimum compressor strength 15N/mm2) as the Project Manager may require. With respect to the side face of any excavation against which concrete or other work will be in contact the Project Manager may require that the net dimensions of the work be increased.
The Contractor shall be responsible for the disposal of Surplus excavated material off site, which shall be to a location approved by the Project Manager. No excavated material suitable for re-use shall be removed without the approval of the Project Manager.
The Contractor shall not deposit excavated materials on public or private land except where directed by the Project Manager or with the consent in writing of the relevant authority or of the owner or responsible representative of the owner of such land and only then in those places and under such conditions as the relevant authority, owner or responsible representative may prescribe.

207 Excavation in Excess

If any part of any excavation is in error excavated deeper and/or wider than is required the extra depth and/or width shall be filled with Grade C15P concrete or compacted granular or other approved fill to the original formation level and/or dimensions as the Project Manager directs.
In pipe trenches where the pipe is not bedded on or surrounded with concrete, excess excavation shall be filled with compacted granular material. Excess excavation in rock trenches shall be filled with concrete (15N/mm2 compressive strength) up to 150mm below the pipe invert.

208 Mechanical Excavation

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

209 Excavation for Pipelaying

The width of trench excavation shall be the minimum required for efficient working after allowance has been made for any timbering and strutting, and shall not exceed the widths described in the Contract. At any one spread the maximum length of open trench shall not, without the prior approval of the Project Manager, exceed 100 metres.

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

shall be increased to 150mm.

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

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

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

210 Headings

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

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

211 Excavation for Foundations of Structures

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

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

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

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

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

212 Rock Surfaces under Concrete Structures

212.1 Concrete Placed Directly on Rock

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

Rock surfaces shall be thoroughly cleaned by compressed air and water jet or such means as the Project Manager my direct before concrete is placed.

212.2 Concrete Placed on Capping Layer

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

BS heavy compaction tests to BS 1377.

213 Explosives

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

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

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

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

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

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

214 Excavated Materials Suitable for Re-use

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

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

The materials forming the surface and foundations of roads, road verges, tracks and footways shall when excavated, and if required for further use, be carefully separated. All hard materials shall be kept free from soil or other excavated materials.
During excavation of pipe trenches the Contractor shall ensure that all granular or other approved material suitable for filling around and over pipes shall be kept separate and re-used for this purpose.

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

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

215 Backfilling of Excavations

Backfilling shall be thoroughly compacted in layers not exceeding 150mm compacted thickness and by means which will not damage the Works.
Backfilling of reinforced concrete structures shall be with suitable material approved by the Project Manager.

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

216 Pipe Beddings

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

Pipe Nominal Diameter (mm)	Max Size (mm)	Grading (mm)
<50	sand	N/A
50	10	10 single-size
80	10	10 single-size
100	10	10 single-size
150	15	10 or 14 single-size or 14 to 5 graded
200 to500	20	10, 14 or 20 single-sized or 14 to 5 graded or 20 to 5 graded
>500	40	10,14 20 or single-size crushed rock or 14 to 5 graded or 20 to 5 graded or 40 to 5 graded

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

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

Sand bedding material shall consist of approved local sand which material shall have a Compaction Fraction ascertained by the test method described below of not greater than 0.3.
Class A bedding shall consist of Grade C15P concrete bed and surround.

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

Class B bedding shall comprise a 180 degrees bed of single-size granular material in accordance with the above table, with selected backfill material to a depth of 300mm above the crown of the pipe.

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

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

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

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

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

217 Compaction Fraction Test

217.1 Apparatus required:

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

217.2 Method

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

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

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

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

218 Selected Backfill Material

Backfill in contact with the pipes shall be selected material and shall not contain larges stones, rocks, tree roots or similar objects which through impact or by concentrating imposed loads might damage the pipes. The material shall be capable of being compacted without the use of heavy rammers and should be free of clay lumps or other material larger than 745mm or stones larger than the maximum particle size specified for pipe bedding.

219 Backfilling of Pipe Trenches

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

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

The material shall be placed in layers not exceeding 150mm thickness and compacted by the use of rammers to achieve a density of not less than 95% maximum density at optimum moisture content +5% to -2% as determined by the BS Heavy Compaction Test to BS 1377.
For trenches in fields and open areas where agreed by the Project Manager the trench backfill shall be compacted to obtain a density of not less than 85% maximum dry density at optimum moisture content +5% to -2% as determined by the BS Heavy Compaction Test to BS 1377.
The density of the compacted fill shall be determined by the Contractor using the "sand replacement" method as directed by the Project Manager.

Before backfilling trenches the Contractor shall obtain approval from the Project Manager of the methods he proposes to use and shall demonstrate by means of tests that the specified compaction can be achieved. The method of compaction shall at all times be to the approval of the Project Manager.
Where ground water conditions are such that the bedding material would be likely to act as a carrier for ground water from higher of lower ground, the Project Manager may instruct flow barriers of suitable selected earth or concrete to be inserted in lieu of bedding material. Such barriers to be erected at reasonable intervals close to flexible joints in the pipe.

220 Making Good Subsidence after Backfilling

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

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

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

221 Removal of Timbering from Excavations

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

222 Reinstatement of Surfaces

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

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

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

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

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

Reinstatement of surfaced roads shall be carried out to the approval of the relevant authority.
The responsible authority shall have the right to carry out permanent reinstatement at the Contractor's expense.
Trenches in open ground shall be reinstated to the condition in which the ground was before excavation was commenced. The final surface of the trench shall be flush with the surrounding ground.

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

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

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

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

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

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

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

223 Safety of Excavations in Roads

Where the surface of the road (other than that which lies immediately above the trench) is damaged either by the concentration of traffic caused by an open trench, by subsidence or other causes arising from the operations of the Contractor, he shall permanently reinstate the whole of the surface so damaged to its original condition.
The Contractor shall ensure that trenches and reinstatement are maintained in a safe condition and shall take immediate action to remedy any deterioration which renders the works unsafe. If in the opinion of the Project Manager any excavation or reinstatement is in a dangerous condition the Contractor shall immediately remedy the defect. Should the Contractor fail to carry out the reinstatement promptly the work any be carried out by others at the Contractor's expense.

224 Temporary Reinstatement of Asphalted Roads

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

material conforming to the following grading limits:

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

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

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

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

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

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

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

225 Temporary Reinstatement of Unmade Roads

In all unmade roads the trenches shall be refilled and compacted as specified in the Contract to within 150mm of the surface.
The trench shall be surfaced with 150mm compacted thickness of base layer material as specified above.

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

226 Permanent Reinstatement of Asphaltic Roads

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

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

227 Forming Banks and Filled Areas

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

228 Restoration of Borrow Areas, Spoil Tips and Quarries

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

229 Top soiling and Grassing

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

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

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

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

230 Free Draining Fill

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

231 Hardcore

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

Section 3. Concrete Works – General

301. Scope

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

(a)	British Standard Code of Practice BS 8110 The Structural Use of Concrete	Whichever is applicable to the particular structures
	Or	
(b)	British Standard Code of Practice BS 8007 Design of concrete structures for Retaining Aqueous Liquids	
(c)	Appropriate British Standards	
(d)	Approved Kenyan Standards	
	Or	
(e)	Other equivalent and approved international standards	

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

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

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

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

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

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

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

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

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

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

302 Concrete

302.1 Requirements

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

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

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

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

Table 3.1 Minimum Cement Contents

Normal Conditions

Type of Structural Element	Exposure Conditions (BS 8110)	Minimum Cement Content (kg/m3) Maximum Aggregate Size			Maximum Water/Cement Ratio
		40 mm	20 mm	10 mm	
Liquid Retaining Structures, Shafts and Tunnel Linings	Severe	295	325	356	0.55
All Foundations and Buried Structures	Moderate	270	300	340	0.60
Building Super-structure	Moderate	270	300	340	0.60

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

Concentration of Sulphates (expressed as SO3)		Minimum Cement Content (kg/m3) Maximum Aggregate Size				Maximum Water/ Cement Ratio
In soil (Total SO3)	In ground water Parts per 100,000	Type of Cement	40 mm	20 mm	10 mm	
≤ 0.2	≤ 30	No Special Precautions				-
0.2 - 0.5	30 - 120	OPC or CEM1,II or IV per KS1725	300	330	370	0.50
		SRPC	250	280	320	0.55
0.5 - 1.0	120 - 250	OPC or CEMI, II or IV per KS1725	Not permitted			-
		SRPC	300	330	370	0.50
1.0 - 2.0	250 - 500	OPC or CEMI, II or IV per KS1725	Not permitted			-
		SRPC	340	370	410	0.45
≥ 2.0	≥ 500	SRPC	Ditto but with protective coating			0.45

OPC - Ordinary Portland Cement
SRPC - Sulphate Resisting Portland Cement

302.2 Strength

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

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

Table 3.2 Concrete Strength Requirements

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

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

302.3 Mixes

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

Building Research Establishment and Bookshop
Garston
Watford
WD2 7JR
ENGLAND

Tel: +44 1923 894040
Fax: +44 1923 664010

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

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

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

(b) Prescribed Mixes

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

(d) Chloride Content

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

302.4 Quality Control

The principal basis of control shall be by comparison of the results of the compression cube tests at 28 days, except for small quantities of concrete whose strength can be otherwise derived and which is permitted for use by the Project Manager. 40 sample cubes shall be made initially in eight samples each day for five days of concreting and thereafter one sample per 25 m^3 of concrete but not less than one sample for each day's concreting.

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

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

(i) Not more than two results in 40 are less than the characteristic crushing strength.

(ii) No value of the average for any set of four results is less than the characteristic strength plus one-half of the design margin (Clause 302).

(iii) When 40 results have been obtained and the mean strength and standard deviation are calculated, the mean strength minus 1.64 times the standard deviation shall be greater than the characteristic strength.

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

- Adjustments to the mix shall be made to obtain the strength required.

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

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

302.5 Production

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

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

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

Batching mixing machines shall comply with the requirements of BS 1305. They shall be provided in

such numbers and of such capacity as to ensure a continuous supply of freshly mixed concrete at all times during construction.

Target strength for trial mix = 1.3 x Characteristic Strength

Target strength for works = 1.2 x Characteristic Strength

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

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

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

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

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

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

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

N/A not applicable

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

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

N/A implies 'Not Applicable'

Notes on the use of Tables 3.3 and 3.4

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

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

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

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

302.6 Cement

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

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

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

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

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

time of mixing.

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

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

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

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

302.7 Aggregates

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

(a) Location. Only Sources equipped with facilities adequate for the production of the materials as specified and in such quantities as shall be required for the prompt execution of the Contract shall be approved.

(b) Petrology of sources and possible or likely variability during the Contract period.

(c) Method of production

(d) Schedule of available and proposed processed aggregates by size, including details of actual screen sizes to produce each aggregate.

(e) Test data as applicable for each aggregate type and size based upon representative samples and tested in accordance with the appropriate British Standards.

(f) A detailed statement of the aggregate proposed for use in each grade of concrete.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Where allowed by the Project Manager to use reactive or potentially reactive aggregates in certain structures the Contractor shall take all suitable measures to prevent deterioration of concrete due to alkali-silica reaction. Such measures shall include the use of cement with an acid soluble equivalent of sodium oxide content (Na2 O + O.658K2 O) of less than 0.6%. The reactive alkali content of the concrete mix shall in no circumstances exceed 3 kg/m³.

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

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

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

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

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

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

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

(i) Coarse Aggregate:

(a) 10 mm max. size, graded, for all "fine" concrete.

(b) 20 mm max. size, graded, for all reinforced concrete in beams and for walls and slabs not greater than 400 mm thick.

(c) 40 mm max. size, graded, for all reinforced concrete walls and slabs in excess of 400 mm thick.

(ii) Fine Aggregate:

(a) Where aggregates conforming to Zones 2 or 3 of BS 882 are available they shall be used.

(b) For Prescribed Mixes, Zones 1, 2, or 3 aggregates only shall be used.

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

302.8 Water

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

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

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

302.9 Admixtures

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

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

BS 5075 (Concrete admixtures except chloride based admixtures).

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

(a) the quantity to be used, in kilograms per kilogram of cement and in kilograms per cubic metre of concrete;

(b) the detrimental effects caused by adding a greater or lesser quantity in kilograms per cubic metre of concrete;

(c) the chemical name (s) of the main active ingredients;

(d) whether by the Project Manager, the Contractor shall demonstrate the action of an admixture by means of trial mixes.

(ii) Calcium chloride. The use of calcium chloride in any form is prohibited.

302.10 Control of Alkali-Silica Reaction

The risk of cracking and expansion due to alkali-silica reaction shall be minimised by compliance with the specification and guidance notes set out in Technical Report No. 30 of the Concrete Society, Riverside House, 4

Meadows Business Park Station Approach, Blackwater, Camberley, Surrey, GU17 9AB Fax: +44 (0) 1276 607141, Website: www.concrete.org.uk.

303 Reinforcement

303.1 Steel

Reinforcement shall be:

(a) Plain round mild steel or High Yield steel bars conforming to BS 4449.

(b) Cold worked steel bars conforming to BS 4449: 1988.

(c) Fabric reinforcement made of cold drawn high tensile bars conforming to BS 4483.

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

303.2 Storage

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

303.3 Bending and Fixing

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

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

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

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

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

The reinforcement shall be fixed in strict accordance with the drawings as regards cover, spacing and position, and suitable precautions shall be taken by the Contractor to prevent the displacement of reinforcement during the placing and compaction of concrete.

During concreting a competent steel fixer must be in attendance to adjust and correct the positions of any

reinforcement which may be displaced. The vibrators are not to come into contact with the reinforcement.

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

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

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

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

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

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

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

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

303.4 Couplers

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

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

304 Formwork

304.1 Requirements

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

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

Formwork shall be of such accuracy, strength and rigidity as to carry the weight and pressure from the concrete to be placed on or against it, together with all constructional, wind or other loads likely to be imparted to it,

without producing deformation of the finished concrete in excess of the tolerances outlined in Clause 304 and Table 3.5.

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

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

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

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

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

Top formwork shall be counterweighted or otherwise anchored against flotation.

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

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

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

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

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

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

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

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

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

304.2 Sawn Formwork

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

304.3 Wrought Formwork

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

304.4 Special Wrought Formwork

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

304.5 Tolerances

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

Table 3.5 Tolerances of Dimensions for Finished Concrete

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

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

304.6 Striking and Removal

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

Table 3.6 Striking of Formwork

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

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

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

(a) the span of the structural member under consideration exceeds 6 metres for beams and 3 metres for slabs. An additional period of one day for each 500 mm of additional span shall then be allowed;

(b) the dead load of the structural member under consideration forms a large proportion of the total design load;

(c) constructional loads coming on to the structural member under consideration are being placed soon after the concreting operations and these loads form a large proportion of the total design load;

(d) the setting of the concrete has been retarded for any reasons;

(e) the temperature falls below 8°C. An additional period of half a day shall be added for each day on which the temperature falls below 8°C. For temperatures falling below 3°C the additional period to be added shall be one day for each day on which the temperature falls below 3°C;

(f) any combination of the above points and other considerations which would call for such a precaution to be taken.

(g) the span concerned is part of a continuous spanning system and the adjacent two spans have not been cured sufficiently.

Information regarding paragraph (b) above will be supplied by the Project Manager; any other design information relevant to the above shall be obtained by the Contractor from the Project Manager.

305 Concreting

305.1 Requirements

The finished concrete shall be dense, durable, impervious to the ingress of water, free from cracks and honeycombing, and resistant to wear and mild chemical attack. Special concretes will be the subject of their own particular sections of Special Concrete.

305.2 Transporting

Concrete shall be transported to the place of final deposit by approved means.

Barrows, spades and other equipment used in the process of transporting concrete shall be thoroughly cleaned before each day's work or after a long interruption and they shall be free from hardened concrete.

Concrete shall be transported as soon as possible after mixing, by methods which will prevent the segregation, loss or contamination of the ingredients.

Proper bridging arrangements for traffic over reinforcement shall be provided so that the reinforcement is not distorted, damaged or displaced.

Where approval is obtained for concrete to be conveyed by chutes, these shall have a slope (not exceeding 1 vertical to 2 horizontal) such as to ensure a continuous flow of concrete. Additional water shall not be introduced to assist the flow. If deposition is to be intermittent the chute shall be arranged to discharge into a storage hopper. In no case will a clear fall of more than 1 m be permitted at the discharge end of the chute.

Where approval is obtained for pumping the concrete, the pump manufacturer's recommendations shall be followed. The pumps used shall be of adequate capacity and power to ensure delivery of a continuous supply. The Contractor shall provide adequate alternative arrangements for transporting the concrete in case of a breakdown of the pumping equipment.

Wherever transport of concrete is interrupted for any length of time (periods of over half an hour shall be treated as such) the chutes, pumps, pipes and any other means of distribution shall be thoroughly flushed out and cleaned. These shall also be flushed out immediately prior to resumption of concreting and shall be kept free from hardened concrete. All washwater used shall be discharged outside the formwork and clear of any freshly placed concrete.

305.3 Placing and Compaction

No concrete shall be placed until the Contractor has obtained approval to do so from the Project Manager. When the Contractor intends to place concrete he shall inform the Project Manager in sufficient time to enable him to inspect the reinforcement, formwork and surface on which the concrete is to be placed and the Contractor shall provide all facilities for such inspection.

This approval shall be sought by presenting two copies of the completed “Structural Concrete Approval Form” (SCAF) to the Project Manager’s Representative at least 24 hours before intending to concrete. (See sample page 23).

Concrete shall be placed within 30 minutes of mixing, to uniform level, in layers not exceeding 500 mm deep in such manner as to avoid segregation, and each layer shall be compacted by means of approved vibrators to form a dense material free from honeycombing and other blemishes. Compaction by hand may be used only with the prior approval of the Project Manager.

At least one internal vibrator shall be operated for every four cubic metres of concrete placed per hour and at least one spare vibrator for every three shall be maintained on Site in case of breakdown during concreting operations.

Vibration time, the effective radius and other vibration characteristics shall be in accordance with the vibrator manufacturer's recommendations.
If internal vibrators are used, they shall be withdrawn immediately water or a thin film of mortar begins to appear on the surface of the concrete. Withdrawal shall be carried out slowly to avoid cavitation.

Internal vibrators shall not be inserted between layers of reinforcement less than one and one half times the diameter of the vibrators apart. Contact between vibrators and reinforcement and vibrators and formwork shall be avoided.

Vibrators shall not be used to move concrete from place to place in the formwork.

Where two distinct batches of concrete, placed at different periods of time and forming part of the same concreting operation are required to be formed monolithically with each other, the more mature concrete shall be penetrated by the vibrator to a sufficient depth to effect plastic movement between the two batches. Where the concrete does not respond to the action of the vibrator, it shall be deemed to have set, and no further disturbance will be permitted. Unless otherwise instructed by the Project Manager the condition shall be treated as for a "stoppage of work" and the marrying up of the two concretes shall be effected only when both concretes have properly set.

If external vibrators are used, the formwork shall be strong enough to withstand the forces of vibration.

Temporary or permanent stoppages of work shall be made only against stop ends (Clause 305).

Unless otherwise specified, before placing new concrete against concrete which has already hardened, the face of the older concrete shall be prepared by the removal of any laitance and loose aggregate, and shall be cleaned by a jet of compressed air.

When displacers are permitted to be used they shall be so placed that no displacer is within 300 mm of any finished face or within 500 mm of any other displacer. On completion of any lift, displacers shall be so arranged that they project for half their height above the surface.

STRUCTURAL CONCRETE APPROVAL FORM (SCAF)
(To be filled in duplicate before any concrete pour)

Contract Details

Job _____ Job No _____

Contractor _____ Site Engineer _____

Section and Concrete Details

Section / Block _____

Level _____ Member _____

Date / Time of Request_____ Date / Time of Pour _____

Concrete Class____ Mix: Design / Nominal (delete one) Batching: Site / Ready Mix (delete one)

Check List

Description of Check	Checked	Remarks
Reinforcement Fixing		
Chairs / Links, etc.		
Reinforcement Cover		
Shutters / Stop ends		
Shutter Props		
Tie Bolts		
Plumbness / Slope		
Dimensions		
Line and Level		
Preparation hacking of joints		
Water Stops		
Moulds for Cubes		
Materials for Curing		
Any other checks (specify)		

Approval

Approved ☐ Not Approved ☐

Date: _____Signature:_____

Note: Approval by the Project Manager or his Representative does not relieve the Contractor of any of his contractual obligations.

305.4 Concreting in Deep Lifts

(i) Limitations

Any height exceeding 2.5 m from which concrete is poured into formwork to form sections of wall will be considered within the terms of this Clause.

Concrete in columns may be placed to a height of 4.0 m with careful placing and vibration and satisfactory results. Where the height of the column exceeds 4.0 m suitable openings must be left in the shutters so that the maximum lift is not exceeded.

Deep lift construction will not be permitted where the reinforcing bars are to be placed closer than 100 mm to one another in any direction or, where the clear width at the point of admitting the concrete between one layer of reinforcement and another (or in the case of singly reinforced walls between reinforcement and formwork) is less than 200 mm.

The method shall only be used where trial sections revealed that, in the Project Manager's opinion it can be satisfactorily employed, in which case the requirements of this Specification shall apply except where they are in conflict with the requirements of this particular clause, when the latter shall prevail.

(ii) Concrete

In order to prevent segregation of aggregates, concrete mixes shall be designed for increased cohesion, or, where suitable, on a gap-graded basis. The use of approved admixtures may be made to achieve this end (302).

At the same time, the mix shall be such as to limit the amount of bleeding in the concrete, and where in the opinion of the Project Manager the quantity of free water rising to the surface is excessive, the mix shall be corrected before further concreting is undertaken.

In order to offset any increase in the water-cement ratio at the upper levels, the Project Manager may require the concrete mix to be modified for the upper depositions.

A slump of 80 mm shall not be exceeded.

(iii) Reinforcement

In order that reinforcement is not distorted or displaced during construction as a result of it being used for gaining access in or out of the formwork, all intersections of vertical and horizontal steel shall be properly fastened.

All obstructions caused by spacer blocks or chairs shall be eliminated so as to permit an unobstructed passage for the concrete to the bottom of the formwork. The Contractor may use sliding timber spacers instead of fixed concrete or plastic spacer blocks to position the reinforcement.

(iv) Formwork

In view of the high pressures to be expected from this form of construction extra attention shall be paid to the strength and stability of the formwork, to the prevention of loss of grout, and to the prevention of displacement of adjacent panels.

The use of through-bolts and other accessories which might interfere with the free passage of concrete between and around the reinforcement shall be reduced to a minimum by the use of properly designed formwork.

(v) Concreting

Particular attention shall be paid to the concreting of the initial sections at the bottom of the formwork to prevent segregation caused by rebound from the hard surface of the kicker, base and/or lower sections. The initial depositions shall therefore be made by using trunking methods, or by placing the concrete through openings formed in the sides of the formwork. Such openings shall not be higher from the hard surface than 2.5m.

In order to reduce differential settlement, and consequently, cracking between two sections of concrete placed at different intervals of time, concreting between one section and another shall be carried out on a gap-construction basis (Clause 305). The gap shall subsequently be concreted in distinct lifts each not exceeding 2.5m in height. For the same reason, when concreting two adjacent sections placed at the same time but of different heights (e.g. where boxing out is included), the difference in height shall not exceed 15% of the height of the deeper section.

Concreting from the upper level of the formwork shall be carried out in such manner as to ensure that concrete is admitted centrally between the faces of the formwork. For this purpose the Contractor shall make use of trunking or shall use funnel-shaped hoppers extending for a distance of not less than 1.5 m into the formwork. A sufficient number of such hoppers shall be provided, and/or they shall be capable of movement along the length of the formwork, to enable the concrete to be placed in contiguous heaps at the base of the pour. Such heaps shall not exceed 460 mm in height.

Where excessive bleeding is in evidence, the excess water shall be removed before placing further concrete.

(vi) Compaction

Compaction shall be carried out where possible by manual operation of poker vibrators within the formwork. Where this is not possible poker vibrators shall be suspended in sufficient numbers to ensure uniform compaction along the length of wall receiving the concrete, without the need for their withdrawal and re-insertion. The means of suspension shall be such that the vibrators may be progressively and systematically lifted as the concreting proceeds to ensure that every section of placed concrete is married into adjacent and underlying sections.

The use of vibrators to reposition deposited concrete is prohibited. Surface vibrators attached to the formwork may be used only to supplement the main means of compaction.

305.5 Continuous Concreting

Where the Contractor desires to use continuous concreting method in large sections (rafts and walls), he shall submit a written request to the Project Manager for approval. In the request he shall attach details which shall include but not be limited to the following :-

- Total amount of concrete to be placed in the shift.
- Stock of approved concrete materials on site.
- Capacity of the batching plant.
- Number and type of truck mixers to be deployed for the exercise and movement logistics.
- Number of skilled and other manpower to be deployed for the exercise in shifts.
- Number and capacity of plant to be used in placing concrete (pumps, vibrators, buckets, etc).
- Method(s) of monitoring and dealing with the heat of hydration.
- Details of protection against rain and floodwaters and how to cope with it.

The Project Manager shall consider the above details and other parameters (e.g. weather, satisfactory records of cube test results, availability of adequate working sections where reinforcement placement and the necessary formwork have been approved etc), before making his decision. The Project Manager may order that additional concrete cube moulds be made available as well as arrangements be made for cube crushing with an approved laboratory to cope with the increased demand.

The Project Manager may order that the concreting works be stopped immediately if in his opinion the quality of the works is threatened for whatever reason.

305.6 Hot Weather Concreting (for temperatures above 20 Degrees Centigrade)

Concreting shall not be permitted if its temperature at placing is in excess of 35°C. In order to maintain the temperature of the concrete below this value the following precautions shall be taken wholly or in part as instructed by the Project Manager:-

(i) All aggregate stockpiles, water lines and tanks as well as the mixer shall be protected from the direct rays of the sun;

(ii) Coarse aggregate shall be cooled by constant watering where possible;

(iii) Mixing water shall be cooled by the addition of ice to the storage tanks where necessary;

(iv) Rapid-hardening cement shall not be used;

(v) Where the above precautions are inadequate concreting shall be carried out during the cooler parts of the day or during the night as may be directed by the Project Manager.

When the air temperature is above 20°C loss of mixing water by evaporation shall be considered in arriving at the amount of water to be added to the mix (Clause 302). In order to maintain the water/cement ratio within permissible limits an approved water-reducing agent shall be included in the mix (Clause 302).

The maximum water/cement ratios indicated in Clause 302 may be increased with the Project Manager's permission by 0.05 (or 2.5 litres/50 kg of cement) during mixing, but on no account shall water be added to concrete directly or indirectly once it has left the mixer.

In order to reduce premature drying of the concrete during transporting and placing, all chutes, formwork and reinforcement shall be cooled by watering when possible, or shall otherwise be protected from the direct rays of the sun. Any water so used shall be removed by jetting with compressed air before placing the concrete in close contact.

As soon as possible after concreting, the formwork shall be stripped (Clause 304) and the surface of the concrete shall be treated in accordance with Clause 305.

Where drying winds are encountered, wind shields shall be positioned as directed by the Project Manager to protect exposed surfaces of the curing concrete.

305.7 Wet Weather Concreting

Concreting during periods of constant rain shall not be permitted unless aggregate stockpiles, mixers and transporting equipment, and the areas to be concreted are adequately covered.

During showery weather, the Contractor shall ensure that work can be concluded at short notice by the provision of stop ends. On no account shall work be terminated before each section, between one stop end and another, is complete. Adequate covering shall be provided to protect newly placed concrete from the rain.

305.8 Holes, Cavities and Fixings

The Contractor shall be responsible for the co-ordination of all requirements of his Sub-contractors as regards provision of holes, chases, cavities and fixings and shall, if required by the Project Manager, prepare drawings giving details of his and his Sub-contractor's requirements and shall send copies of such drawings to the Project Manager prior to construction.

Holes, etc. shall be accurately marked and boxed-out for before concreting operations commence and, without the Project Manager's prior approval, no such holes, etc. shall be formed after the concrete has set.

Where bars, if placed to specified spacing would foul holes of size less than 250 mm x 250 mm the full length of the bar shall be moved to one side and in the case of holes exceeding 250 mm x 250 mm the bars shall be cut on site and lapped with additional equivalent bars, or as otherwise indicated on the drawings.

Wherever possible, the Contractor shall build in all pipework, ironwork, etc. which passes through walls and floors, and the pipework, ironwork, etc. shall first be thoroughly cleaned and freed from any deleterious matter, and every care shall be taken to ensure that it is thoroughly encased in concrete.

Unless otherwise instructed by the Project Manager all electrical conduits to be positioned within the reinforced concrete shall be fixed inside the steel cages of beams and between the top and bottom steel layers in slabs and similar members.

The proposed position of all conduits 25 mm and over in diameter which are to be enclosed in the concrete shall be shown accurately on a plan to be submitted to the Project Manager, whose approval shall be obtained before any such conduit is placed.

Bolts, hooks and other fixings shall be embedded in concrete, or holes shall be drilled and fitted with threaded expanding anchors to receive the bolts. The Contractor shall ensure that bolts, hooks, etc. are accurately positioned. Holding down bolts for machinery shall be set by means of a template.

Where brick or stonework is to form a facing to the concrete or where the end of a brick or stone wall butts against a concrete face, galvanised metal ties of approved manufacture to BS 1243 shall be incorporated. The distance between ties shall be gauged with due regard for the bonding of the walls, and at intervals required by the Project Manager.

305.9 Protection and Curing

Newly placed concrete shall be protected by approved means from rain, drying winds, sun and contact with substances which can adversely affect it.

No traffic or constructional loads shall be permitted on newly placed concrete until it has hardened sufficiently to take such traffic or load, and only then with the approval of the Project Manager.

Concrete shall at no time be subjected to loading (including its own mass) including compressive stress until it has reached 0.40 of its specified 28 day strength.

Any concrete surfaces, risers and treads of stairways which might be damaged during the construction of the Works shall be adequately protected.

All structural concrete shall be cured using methods approved by the Project Manager.

The method of curing shall prevent loss of moisture from the concrete. Immediately after compaction and for 7 days thereafter concrete shall be protected against harmful effects of weather, including rain, rapid temperature changes and from drying out.

The curing time shall be the number of days given in Table 3.7 unless the average temperature of the concrete during the required number of days falls below 10oC in which case the period of curing shall be extended until the maturity of the concrete reaches the value given in the table.

Table 3.7 Normal Curing Methods

Minimum period of protection for different types of cement

Conditions under which concrete is maturing	Number of days (where the average temperatures of the concrete exceeds 10°C during the whole of the period)			Equivalent maturity (°C hours calculated as the age of the concrete in hours multiplied by the number of degrees Centigrade by which the average temperature of the concrete exceeds -10°C)		
	Type IV	Type I or Type V	Type III	Type IV	Type I or Type V	Type III
1. Hot weather or drying winds	7	4	2	3500	2000	1000
2. Conditions not covered by 1.	4	2	1	2000	1000	500

Type IV	-	Low Heat Portland Cement/Portland - Pozzolana Cement
Type I	-	Ordinary Portland Cement
Type V	-	Sulphate-resisting Portland Cement
Type III	-	Rapid-hardening Portland Cement
Hot weather	-	Temperature over 16oC

Curing shall be carried out using either of the following basic methods, or any other method agreed with the Project Manager. Methods involving the use of dampened hessian coverings shall not be used. The method adopted for any particular situation shall be agreed with the Project Manager.

A. Membrane Applied by Spray

Liquid membrane compounds shall be applied to moist concrete surfaces as follows:-

(i) Unformed Surfaces

The compound shall be applied immediately after the free water has left the surface.

(ii) Formed Surfaces

The compound shall be applied immediately after removing the forms. If there is appreciable drying, the surface shall be mist sprayed with water to produce a uniformly damp appearance before the compound is applied.

The compound shall be applied in one or two separate applications to produce complete and uniform coverage of the surface. If the compound is applied in two increments, the second application shall follow the first within 30 minutes. The method and rate of application shall be in accordance with the compound manufacturer's instructions.

If rain falls on the newly coated surface before the film has dried sufficiently to resist damage, or if the film is damaged in any other manner, a new coat of compound shall be applied to the affected area equal in curing value to that originally applied.

Compound applied to construction joint surfaces, or to other surfaces to which concrete is to be bonded, shall be removed prior to placing the fresh concrete.

Depending on the surface to which it is to be applied the compound shall conform to the following requirements of AASHTO M148.

(i) Exposed and vertical concrete surfaces - Type I-D (clear compound with fugitive dye).

(ii) Unexposed top surfaces of foundations and superstructures - Type 2 (white pigmented).

B. Polythene Sheeting

The concrete surfaces shall be covered with white polythene sheeting as follows:-

(i) Unformed Surfaces

The sheeting shall be laid over the surface as soon as possible without marring the surface, and not until initial stiffening has taken place if a brushed or tamped finish is required.

(ii) Formed Surfaces

The surfaces shall be covered immediately after the removal of the forms.

The sheeting may be in contact with the concrete or made into portable shelters on light weight frames. In both cases, the sheeting shall be jointed and sealed against the concrete surfaces to prevent wind blowing between the sheeting and the concrete.

The white polythene sheet shall conform with the requirements of AASHTO M171. On no account shall clear or any other colour of sheeting be used.

C. Other Curing Methods

These shall be agreed with the Project Manager. Methods involving the use of damped hessian coverings shall not be used, unless at least 2 layers of continuous hessian are used and they are kept continuously wet and protected from winds which cause accelerated drying.

Where the thickness of concrete placed exceeds 1.5 m, the Contractor shall submit for the Project Manager's approval proposals to ensure that, during the curing period:-

(a) the rate of rise of temperature in the concrete does not exceed 15°C per hour for the first 3 hours;

(b) thereafter the rate of rise and fall of temperature in the concrete does not exceed 35°C per hour;

(c) the maximum temperature in the concrete does not exceed 70°C; and

(d) the maximum difference in temperature between the core and the surface of the concrete does not exceed 20°C.

The proposals shall include consideration of:-

(a) concrete mix design;

temperature of mix at time of placing;

(c) method of curing.

Where required by the Project Manager, the Contractor shall carry out temperature measurements in the concrete. The method and procedure of temperature measurement shall be agreed with the Project Manager.

305.10 Joints

(i) Construction Joints

The position of construction joints, when not shown on the Drawings or otherwise required by this Specification, shall be decided on site having regard to the plant and labour made available by the Contractor for the manufacture, placing and compaction of the concrete as well as its curing, the climatic conditions prevailing at the time of concreting, the nature and size of the formwork, and the conditions of operation of the work. Waterstop shall be provided to all construction joints on water retaining or excluding structures. The Contractor shall submit his proposals to the Project Manager for his approval at least fourteen days before commencing the

work.

Construction joint surfaces shall be treated by the "wash-off" method explained below, except where it cannot be practically effected, in which case they shall be treated in accordance with Clause 305 as for the placing of new concrete against hardened concrete.

When expanded metal lathing is used for the formation of construction joints a rebate will not be required to be formed. The expanded metal lathing shall be left in the work and shall not extend closer to the finished surface of the concrete than 25 mm. It shall be securely fixed to the reinforcement.

The following particular requirements shall also be observed:-

* Slabs supported on the ground

In order to ensure control in the placing of concrete the Contractor shall provide control boards to form panels not larger than 15 m2 in area. These shall be lifted as the concreting proceeds except where they are of expanded metal in which case they may be left in position as part of the permanent works, provided that they shall not extend closer to the finished surface of the concrete than 25 mm. In the event of a breakdown in the supply of concrete the Contractor shall ensure that an alternative supply of concrete is made available (to finish the work against the control boards acting as stop ends). The joint so formed shall then be treated as a construction joint. Where Ready-mixed concrete is permitted the control boards shall be positioned so as to enclose a volume of concrete equal to that delivered by each truck.

Construction joints and control joints shall be formed normal to the surface of the retained concrete.

* Suspended Beams and Slabs

T-beams shall be formed to their full depth integrally with the adjacent slab and without horizontal joints.

* Columns

Where kickers are indicated on the drawings these shall be cast together with the slab or beam below. On no account shall kickers be cast as a separate operation. Alternatively, the Contractor may adopt “kickerless construction” methods providing he can satisfy the Project Manager that his system is reliable and does not compromise workmanship.

* Walls

Horizontal construction joints in walls shall be formed along straight lines coinciding with the full height of the formwork. The height of the formwork thus controlling the height of the pour shall be determined with reference to the availability of concrete, the size and amount of reinforcement and the means of compaction available.

Unless otherwise indicated on the drawings or otherwise permitted by the Project Manager for the construction of circular tanks, concreting shall be carried out continuously for the full circumference without vertical joints. Where permission is granted for the use of vertical joints the Project Manager may order, at no extra cost to the Employer, the inclusion of an approved type of water stop.

In the case of rectangular tanks, vertical joints shall not be positioned closer to any corner than one metre. They shall be formed with properly rebated stop ends or, where conditions permit, by the use of expanded metal lathing. Unreinforced manholes shall be constructed without vertical joints.

(ii) The "Wash-off Method" of preparing Construction Joints

As soon as possible after concreting, and while the surface is still green, the surface of the concrete forming the joint shall be freed of loose aggregate and sprayed with a fine spray of water to prevent the formation of laitance. Subsequently all excess water shall be removed by a jet of compressed air and the surface left clean to receive further concrete.

Where expanded metal lathing is used for construction joints, this method of surface preparation shall be used in every case.

(iii) Movement Joints

These shall include contraction and expansion joints and shall be as indicated on the drawings.

Contraction joints will be either full contraction joints or partial contraction joints. Where partial contraction joints are specified a period of at least five days shall elapse between the concreting of the section on each side of the joint.

Where the drawings indicate a contraction gap to be formed in any panel (this gap will not exceed one metre), concreting on either side of the gap shall be carried out so as to form partial contraction joints at each side of the gap. Prior to the concreting of the gap section, the joint surfaces shall be cleaned but otherwise left untreated. The concreting of the gap section shall not be carried out until a period of at least five days has elapsed after completion of the adjacent sections.

Alternate panel construction (other than contraction gap construction outlined above) will be permitted only with the approval of the Project Manager, or in those cases where either the reinforcement is not continuous through the joint or where the panels are separated by expansion or contraction joints.

Unless otherwise specified or permitted by the Project Manager all waterstop shall consist of rubber or PVC. Jointing of waterstop shall be by vulcanising, except where PVC is specified or permitted in which case joints shall be by fusing or welding. Materials shall be obtained from an approved manufacturer whose recommendations as to jointing shall be fully complied with.

(iv) Waterstop and Jointing Materials

Waterstop and jointing materials shall be obtained from an approved manufacturer.

All waterstop and jointing materials which are not required for immediate use shall be stored at all times in a cool damp place.

Waterstop shall be manufactured of rubber or PVC (polyvinylchloride) as shown on the drawings, and shall be of the type and size shown on the drawings. Site joints shall be made strictly in accordance with the manufacturer's instructions and all intersections and junctions shall be obtained prefabricated from the approved manufacturer.

Joint filler shall be manufactured of natural bonded cork or other approved material which remains serviceable when wet. Joint filler shall be cut and trimmed accurately to suit the joint profile and shall be maintained accurately in position by means of an approved adhesive. The compressibility of the filler shall be such that it can be compressed to 50% thickness with a pressure of not less than 0.07 N/m square and no greater than 0.4 N/mm square. After 50% compression, the material should recover to at least 70% original thickness within 30 minutes. On no account shall fibreboard or similar be used as filler.

Joint sealing compounds shall be approved polysulphide based compounds suitable for sealing joints in horizontal and vertical/sloping concrete surfaces as appropriate. Sealing compounds shall be applied strictly in accordance with the manufacturer's instructions and shall completely fill the joint recess. Surface primers shall be from the same manufacturer as the sealants themselves. Joint sealing compounds shall be entirely suitable for contact with potable water where these are used in water retaining structures.

Waterstop shall be located and maintained accurately in position and details of the proposed method of fixing shall be submitted to the Project Manager for approval. On no account shall waterstop be secured by nails or by any other means involving puncture of or damage to the waterstop material unless purpose made nailing flanges are incorporated in the design of the waterstop.

(v) Slip Membrane

The slip membrane shall be "slipstrip" as supplied by Serviced Limited, Ajax Avenue, Slough, Berkshire, UK or similar approved material. The slip membrane shall be not less than 1.5 mm thick and shall be a plastic preformed strip with low coefficient of friction specifically manufactured for use as a separating membrane in sliding joints between concrete surfaces. Each sliding joint shall comprise two layers of the membrane unless otherwise shown on the drawings.

The concrete surface to which the slip membrane is to be fixed shall be finished with a steel float to provide a smooth true surface free from dust and loose particles.

(vi) Expandafoam

Expandafoam shall be as supplied by Expandite Limited, 1-9 Chase Road, London, NW10 6PS, UK or similar approved material. Expandafoam is a closed cell flexible polyethylene joint filler used where a readily compressible low load transfer joint filler is required. Expandafoam shall be fixed in position using a suitable adhesive.

305.11 Finishes - General

All exposed faces of concrete unless otherwise specified shall be hard, smooth and free from honeycombing, air and water holes and other blemishes.

All projecting imperfections shall be rubbed down with carborundum stone or by other approved means and grit and dust therefrom shall be thoroughly washed off with clean water.

Surface Finishes

(a) Wood float finishes shall be formed by smooth floating the accurately levelled and screeded surface. Care shall be taken to ensure that the concrete is worked no more than is necessary to produce a uniform surface free from screed marks.

(b) Steel trowel finishes shall be formed while the concrete is still wet by means of a steel trowel applied to an accurately levelled and screeded surface (see also Clause 307).

(c) Granolithic finishes shall conform to the recommendations laid down in "Specification for Granolithic floor toppings laid in-situ concrete", as published by the UK Cement and Concrete Association with special reference to monolithic construction.

(d) Screeded finishes shall be formed by levelling and screeding the concrete to produce a uniform, plain or ridged surface as specified; surface hardners shall be applied strictly in accordance with the manufacturer's recommendations.

(e) Bush-hammered or pattern-worked finishes.

When exposed aggregate is to be the surface texture, the Contractor shall ensure that a uniform distribution of the coarse aggregate takes place at the face. The formwork shall be removed as soon as possible from the face to be treated; the surface shall be thoroughly wetted and wire brushed, and bush-hammered or pattern-worked as and when instructed. Surface retarders shall be used only when permitted by the Project Manager.

Bush-hammering or pattern-working shall not be relied upon to obscure any defects in the concrete face which arise from formwork imperfections.

Making Good

On no account shall any faulty honeycombed or otherwise defective concrete be repaired or patched until the Project Manager has made an inspection and issued instructions for the repair.

Honeycombed or damaged surfaces of concrete, which in the opinion of the Project Manager, are not such as to warrant the cutting out and replacement of the concrete, shall be made good as soon as possible after removal of the formwork as follows:-

1:1.5 Portland Cement and sand mixture shall be worked into the pores over the whole surface with a fine carborundum float in such a manner that no more material is left on the concrete face than is necessary to fill the pores completely so that a uniformly smooth and dense surface of uniform colour is finally presented.

Removal and Replacement of Unsatisfactory Concrete

The Contractor shall on the Project Manager's instructions to do so cut out and replace any concrete in any part of the structure if in the Project Manager's opinion:-

(a) the concrete does not conform to the Specification, or

(b) deleterious materials or materials which are likely to produce harmful effects have been included in the concrete, or

(c) the honeycombed or damaged surfaces are too extensive, or

(d) the finished concrete sizes are not in accordance with the drawings within permissible tolerances, or

(e) the setting-out is incorrect, or

(f) the steel cover has not been maintained, or

(g) the protection, including curing, of the concrete during the construction was inadequate, resulting in damage, or

(h) the work of making good or other remedial measures the Project Manager may indicate are not carried out to his satisfaction, or

(i) undue deformation of or damage to the works has taken place due to inadequate formwork, or to premature traffic or to excessive loading, or

(j) any combination of the above points has taken place resulting in unsatisfactory work.

306 Testing

306.1 Sampling and Testing - (see also Clauses 301 and 302)

The Contractor shall provide on the Site equipment, staff and labour for carrying out the sampling and testing outlined in columns 3 and 4 of Table 3.8, and he shall carry out any or all of these tests at such times and with such frequency as may be requested by the Project Manager.

All equipment shall be calibrated and checked from time to time by an approved agency, as the Project Manager may require.

The Contractor shall provide all samples required by the Project Manager. Those samples to be tested in an offsite laboratory shall be carefully forwarded by the Contractor to an approved laboratory. Results of laboratory and site tests shall be kept on site and copies of all test reports shall be forwarded in duplicate to the Project Manager.

Each cube shall be marked with a distinguishing number (numbers to run consecutively) and the date, and a record shall be kept on Site giving the following particulars:-

(a) Cube No.

(b) Date and time made

(c) Temperature and weather conditions

(d) Location in work

(e) 7-day Test

Date :

Strength

(f) 28-day Test

Date :

Strength

Cubes shall be forwarded, carriage paid, to an approved Testing laboratory in time to be tested two at 7 days and two at 28 days. No cube shall be dispatched within 3 days of casting.

Authentic copies of all Work Test results shall be forwarded to the Project Manager directly from the testing laboratory and one shall be retained on the site. The test certificates shall indicate all properties as required by BS 1881.

The Contractor must allow in his rates for concrete test cubes for all expenses in connection with the preparation and conveyance to the Testing Laboratory and testing of test cubes and no claim in respect of his failure to do so will be entertained.

Any batch of concrete which fails to achieve the required characteristic strength shall be removed and made good in accordance with this Specification. The Contractor shall carry out all such work at his own cost.

Frequency of tests and the number of samples required will be governed by the results of the previous tests, the quality of the materials revealed during the tests, and the uniformity of that quality (see Clause 302). Should it become evident that the quality of concrete is deteriorating the Project Manager may require additional samples to be taken and test cubes to be made and tested to determine the cause.

306.2 Loading Tests

The Project Manager may direct that a loading test be made on the works or any part thereof if he deems such test to be necessary for one or more of the following reasons:-

(a) failure of "Site Cubes" to attain the strength requirements of Clause 302;

(b) premature removal of formwork;

(c) overloading of structure during construction;

(d) improper compaction and/or curing of concrete;

(e) any other circumstances attributable to alleged negligence on the part of the Contractor, which, in the opinion of the Project Manager, may result in a structure being of less than the required strength;

If the loading test is ordered to be made solely or in part for reasons (a) to (d) the test shall be made at the Contractor's own cost.

If the loading test is ordered to be made for reason (e), the Contractor shall be reimbursed for the cost of the test if the result is satisfactory. No extensions to the Contract Duration shall be granted for delays and disruption resulting from these tests.

Loading test shall be carried out in accordance with the requirements of BS 8110 – 2 Section 9.

If the results of the test are not satisfactory, the Project Manager will direct that the part of the work concerned be taken down or removed and reconstructed to comply with the Specification, or that such other remedial measures as he may think fit be taken to make the work acceptable and the Contractor shall carry out such work at his own cost.

Table 3.8 Sampling, Testing and Acceptance Standards

Materials	Test	Site Sampling	Testing	Accepted Standards	Remarks
1	2	3	4	5	6
Cement	Ordinary Portland Rapid Hardening Sulphate Resisting		BS 4550	BS 12 BS 12 BS 4027 KS1725	Manufacturer's Test Certificate
Aggregates	Description and Classification		BS 812 Sec 2	BS 882	
	Particle Size	BS 812 Sec 1	BS 812 Sec 3	BS 882	)
	Particle Shape	BS 812 Sec 1	Visual and BS 812 Sec 3		)) Mix
	Specific Gravity	BS 812 Sec 1	BS 812 Sec 3		) Design
	Density	BS 812 Sec 1	BS 812 Sec 3		) Requirements
	Voids	BS 812 Sec 1	BS 812 Sec 4		)
	Absorption	BS 812 Sec 1	BS 812 Sec 4	BS 8007 Cl 6.2.2	See Freeze-thaw Test in this table
	Organic Impurities	BS 812 Sec 5			
	Moisture Content	BS 812 Sec 5			For adjustment of added water for concrete making
	Mechanical Properties	BS 812 Sec 6	BS 882		Ten per cent fines value
Water	Suitability	BS 3148	BS 3148	BS 3148	Not required for potable water
Concrete	Compacting Factor	BS 1881 Pt 101	BS 1881 Pt 103		)) Workability Test))
	Slump		BS 1881 Pt 102		
	Crushing		BS 1881	BS 5328, BS 8110	Cube test
	Water Absorption		BS 1881 Pt 122	BS 7263	Precast concrete Clause 308
	Freeze-thaw	BS 1881	BS 812 Sec. 1		Durability test for aggregate not complying with moisture absorption requirements of BS 5337 Cl. 21.2

Materials	Test	Site Sampling	Testing	Accepted Standards	Remarks
1	2	3	4	5	6
	Electrolytic Efflorescence				As required for salt-containing aggregate or saline water
	Cores	BS 1881 Pt 6 BS 1881 Pt 120	BS 1881 Pt 6 BS 1881 Pt 120	BS 1881 Pt 120 with ref to concrete strengths this Specification	See Clause 306
Admixers	Compatibility with cement	As required by Laboratory			Tests to be carried out by independent Laboratory as required

The Project Manager may also instruct the Contractor before a loading test takes place to take out cylindrical core specimens from the structures concerned and have them tested. The cutting equipment and the method of doing the work shall be to the Project Manager's approval. The specimens shall be dealt with in accordance with BS 1881. Prior to testing, the specimens shall be available for examination by the Project Manager. If the cores are ordered to be taken solely or in part for reasons (a) and (d) above, the work involved and the testing shall be made at the Contractor's own cost. If the cores are to be taken for reasons (b), (c) and (e) above, the Contractor will be reimbursed the cost if the loading test described in the previous paragraphs proves satisfactory.

307 Special Concrete

307.1 No-fines Concrete

No-fines concrete for use in subsoil drainage shall consist of a 1:8 cement/aggregate mix by volume. Aggregate shall be 20 mm to 10 mm graded with no more than 5% passing the 10 mm sieve. Only sufficient water shall be added to ensure complete coating of the aggregate. One half of this water shall be placed into the mixer first, after which the aggregate and cement shall be admitted. After partial mixing the balance of the water shall be added until a consistency of mix is achieved.

Preliminary tests shall be carried out on the site to prove the suitability of the finished concrete, and adjustments made to the proportions and or grading as may be required by the Project Manager.

307.2 Air-Entrained Concrete

Concrete for roads and those structures where specified, shall include an approved air-entraining agent capable of producing a 5% air-entrainment with a tolerance of 0.5% (Clause 302).

The mix shall be purposely designed, having regard for the nature of grading of the aggregates and air-entraining agent being used.

Preference shall be given to the use of air-entraining agents which can be administered in fixed calibrated amounts through a dependable mechanical dispenser or sachet, and which are added to the mixing water.

Frequent air meter tests shall be carried out and the consistency of the air-entrainment maintained to the above tolerances by adjustments in the mix, as may be necessary.

307.3 Concrete in Benching

Concreting for benching in manholes, pumping stations and works structures shall consist of Grade C25P concrete unless otherwise specified. It shall be placed with low workability to the approximate shape required and, while still green, shall be finished with not less than 50 mm of Grade C25P concrete to a steel trowelled finish and to the contours indicated on the drawings.

307.4 Ready Mixed Concrete

Unless otherwise stated the relevant clauses of BS 5328 shall apply.

Ready mixed concrete shall only be used with the prior approval of the Project Manager. The Contractor shall not be relieved of his obligation to provide concrete to the standard laid down in this Specification by virtue of any approval given for the use of concrete supplied by others, and the Project Manager reserves the right to withdraw his approval at any time consequent on any deterioration in the quality of the Concrete, or unsatisfactory delivery or any other reason he considers detrimental to the Works.

Ready mixed concrete manufactured off the site shall be transported in a revolving drum and shall be continuously agitated until it is used in the work unless otherwise approved. The time interval between adding water to the drum and placing shall not exceed 90 minutes. The time interval between completion of mixing and placing shall comply with Clause 305.

307.5 Granolithic Concrete

Refer to Clause 305.

307.6 Pneumatically Applied Mortar (Gunite)

(i) Requirements

The pneumatic application of mortar shall be carried out only by Contractors experienced in this type of work and who are in possession of proper Plant and equipment. Nozzlemen employed on the works shall be skilled operators.

The finished product shall be dense, of even texture and colour, and to the requirements of strength, tolerance and finish set out in this Specification.

(ii) Strength

After curing, the mortar shall be capable of producing cored samples with a 28-day characteristic strength of not less than 27.5N/mm2.

(iii) Materials

Sand, cement and water shall comply with the requirements of Clause 302 of this Specification except that the sand shall conform to the grading of Zone 2 of BS 882.

(iv) Proportions

The proportions to be used in the mix shall be determined with reference to the requirements outlined in sub-clause 307(i) and the mix shall be not weaker than one part of cement to four parts of sand by volume, having regard to the adjustments for bulking of the sand.

(v) Operation

Air and water pressures shall be such as to permit the proper application of the mortar, and shall be determined with reference to hose lengths and nozzle diameter.

Mortar rebound, recovered, cleaned and uncontaminated with extraneous matter, may be re-used but not for water-retaining structures. It shall be regarded as an equivalent volume of sand which shall not exceed 20 per cent of the total sand requirement. Rebound which has lodged in the formwork or between reinforcement shall be removed by compressed air.

Reinforcement shall be completely embedded in the mortar by the proper direction of the nozzle and the mortar shall be applied as a steady and uninterrupted flow from the nozzle.

Mortar application shall be discontinued at any section of the work where sagging of the mortar is in evidence.

(vi) Joints

These shall be formed by sloping the surface to a thin edge. Before applying new mortar, the surface shall be thoroughly wetted. Laitance shall be removed by the initial discharge of fresh mortar.

(vii) Tolerances

The thickness of applied mortar shall be not less than the dimensions shown on the Drawings nor greater than 10 mm over those dimensions, unless otherwise indicated on the Drawings or otherwise permitted.

(viii) Protection and Curing

Shall be carried out in accordance with the requirements of Clause 305.

(ix) Finishes

Unless otherwise specified all surfaces shall be brought to a granular textured finish by means of a wooden float.

(x) Cold Weather Work

No application of mortar shall be made against frozen surfaces nor when the air temperature is below 5oC.

(xi) Making Good

Any defective work shall be cut out immediately and made good with fresh mortar pneumatically applied.

307.7 Cement Grouts

Cement grout shall be mixed in the relevant proportions indicated in the following table using the minimum quantity of water to ensure the necessary fluidity and to render it capable of penetrating the work.

Class	Nominal Mix by Mass	
	Cement	Sand
G1	1	-
G2	1	3
G3	1	10

Cement grout shall be used within one hour of mixing, except where containing a retardant admixture.

307.8 Pumped Concrete

Where pumping of concrete is permitted to be used no relaxation of the requirements of this Specification will be permitted. Particular attention shall be paid to the proper grading of aggregates to prevent bleeding and/or segregation during the pumping operations. The inclusion of water-reducing additives or other materials, including flyash, to improve the flow characteristics of the concrete will only be permitted where it can be shown that they do not adversely affect the concrete either in the plastic phase or in the finished work.

308 Precast Concrete Units

308.1 Requirements

Unless otherwise agreed in writing by the Project Manager, all precast concrete units shall be manufactured on site and shall be true to dimension and shape, with true arises and with perfectly smooth exposed faces free from surface blemishes, air holes, crazing and other defects, whether developed before or after building-in. They shall comply with the appropriate BS. (Note: Coping blocks and similarly exposed units are particularly susceptible to crazing when the concrete is manufactured using high water/cement ratios)

The maximum size of coarse aggregate in precast concrete shall not exceed 20 mm except for thicknesses less than 75 mm where it shall not exceed 10 mm.

The compacting of precast concrete shall conform with requirements given elsewhere in this Specification except for thin slabs where use of immersion type vibrators is not practicable. The concrete in these slabs may be consolidated on a vibrating table or by any other methods approved by the Project Manager.

Steam curing of precast concrete will be permitted. The procedure for steam curing shall be subject to the approval of the Project Manager.

The precast work shall be made under cover and shall remain under the same for seven days. During this period and for a further seven days the concrete shall be shielded by sacking or other approved materials kept constantly wet. It shall then be stacked in the open for at least a further seven days to season before being set in position. Where steam curing is used these times may be reduced subject to the approval of the Project Manager.

Precast concrete units shall be constructed in individual forms. The method of handling the precast concrete units after casting, during curing and during transport and erection shall be subject to the approval of the Project Manager, providing that such approval shall not relieve the Contractor of responsibility for damage to precast concrete units resulting from careless handling.

Repair of damage to the precast concrete units, except for minor abrasions of the edges which will not impair the installation and/or appearance of the units, will not be permitted and the damaged units shall be replaced by the Contractor at his own expense.

Except where precast work is described as “fair face” or as having “exposed aggregate” or terrazzo finish the moulds shall be made of suitable strong sawn timber true in form to the shapes required. Unless otherwise described, faces are to be left rough from the sawn moulds.

Where precast work is described as “fair face” the moulds are to be made of metal or are to have metal or plywood linings or are to be other approved moulds which will produce a smooth dense fair face to the finished concrete suitable to receive a painted finish direct and free from all shutter marks, holes, pittances, etc. Where precast work is to have an “exposed aggregate” or terrazzo finish the moulds shall be constructed to the requirements given for moulds for “finished fair” work.

The method of achieving the exposed aggregate finish shall be “aggregate transfer” or other approved method.

308.2 Kerbs

Precast concrete kerb shall conform to BS 7263: Part 1: 1990, except that coarse aggregate shall conform to BS 882: 1983. Fine aggregate shall consist of sand resulting from the natural disintegration of rock.

Approved air-entraining agents may be permitted to be used providing that approved adjustments are made to the mix with regard to water and fine aggregate proportions (Clause 302). In such cases the moisture absorption limits set out in BS 340 may be neglected subject to the concrete satisfying the freeze thaw test laid down under the heading "Weir Blocks and Sills".

308.3 Paving Slabs

Paving slabs shall conform to BS 368 and shall be 50 mm thick unless otherwise specified.

308.4 Other Blocks

Blocks used for building work and filter bed walls shall conform to BS 6073: Part 1: 1981.

308.5 Wall Units

L-shaped wall units shall conform to the requirements of BS 8110. Where it is not intended to use coping blocks for the protection of the upper exposed surface of the units, the uppermost 150 mm, for the full width of the unit, shall be formed with concrete composed of aggregate complying with BS 882: 1992. Such concrete shall be formed integrally with the main body of the concrete.

308.6 Other Items

Manhole ring units, tapers, cover slabs, segments and concrete pipes are referred to under their particular heading.

309 Site Books And Standards

309.1 Instructions to be Recorded

The Contractor shall provide and keep permanently on the Site a numbered triplicate book wherein the Contractor shall record all instructions relating to concrete work issued by the Project Manager. One copy of every entry therein shall be sent to the Project Manager on the same day as the entry is made.

309.2 Site Diary

The Contractor shall provide and keep permanently on the Site a continuous entry diary wherein the Contractor shall record details of formwork, construction, placing of reinforcement, concreting and curing operations, striking of formwork, making good and daily temperature and weather conditions. This diary shall always be available for inspection by the Project Manager.

309.3 Copies of Standards and Codes

The Contractor shall provide and keep permanently on the Site copies of the following Standard Codes of Practice:-

BS 812
BS 882
BS 1881
BS 4466
BS 5328
BS 5628
BS 8007
BS 8110
KS1725

The Contractor shall in addition provide and keep permanently on the Site copies of such other Standards, Codes, Notes and Specifications as may be required by the Project Manager.

310 Water Retaining Structures - Special Clauses

Note: In the event of any differences between the "Special Clauses" and the previous Specification under Section 2.3 the provisions of these "Special Clauses" shall have precedence.

310.1 Making Good

The cement mortar used in filling recesses in the concrete formed by bobbins in connection with formwork shall contain an approved expanding admixture.

310.2 Construction Joints in Water Retaining Structures

In water retaining structures PVC waterstops not less than 130 mm wide manufactured by an approved manufacturer shall be built into all construction joints in external walls and construction joints in roofs of potable water retaining structures. Construction joints shall be formed at positions agreed by the Project Manager.

The cost of forming construction joints shall be included by the Contractor in his general concrete rates.

310.3 Watertightness of Structures

The Contractor shall be solely responsible for the watertightness of structures and any remedial measures necessary.

310.4 Hydrophilic Rubber Sealer

Hydrophilic rubber sealer shall be co-extruded from chloroprene and hydrophilic rubbers into a cellular strip approximately 25 mm x 7 mm thick which expands as it absorbs water. The strip shall incorporate an expansion delay coating to prevent activation during setting of the surrounding concrete.

Hydrophilic rubber sealer shall be applied to the perimeter of all pipes to be built into concrete structures, to existing concrete walls and slabs at or below water levels which have been demolished and require extension, and to other locations as indicated on the Drawings.

The strip sealer shall be bonded to the pipe diameter or on to the face of demolished structures on to which new concrete is to be placed so as to be at least 100 mm from the wall surface. Where dowel bars are incorporated in bonding new concrete to old, the sealer shall be placed above the dowel bars on the "wet" side of the structure. Bonding shall be accomplished using proprietary neoprene or epoxy adhesives to ensure the sealer is not disturbed during placement of the concrete.

The sealing strip shall be from an approved supplier and application shall be strictly in accordance with the manufacturer's recommendations.

310.5 Waterproof Membranes for Concrete Roofs and Gutters

Concrete roofs and gutters shall be waterproofed by the provision of a membrane to be laid on top of the slab. The membrane shall be a cold applied preformed waterproof laminated layer comprising a HDPE carrier film with a solar

reflective surface and a self-adhesive rubber bitumen compound complying with the requirements of BS 8102. The membrane shall exhibit a tear resistance of at least 250 N/mm when tested in accordance with ASTM D1004. Adhesion to primed concrete to itself shall exceed 1.75 N/mm when tested in accordance with ASTM D100, and a puncture resistance of 290 N 65 mm when tested in accordance with ASTM E154. Membranes shall exhibit a water resistance of not more than 0.14% after 24 hours when tested in accordance with ASTM D574. The contractor shall submit proposals for waterproof membranes for approval, together with manufacturer's catalogues and technical literature.

Waterproof membranes shall be installed entirely in accordance with the manufacturer's instructions. Membranes shall be continued up the internal face of the parapet wall and finished centrally under the coping. Adjacent strips of membrane shall be overlapped to provide a waterproof joint. The provision of a waterproof membrane on the roof slab shall not relieve the Contractor of his responsibilities to produce a waterproof roof slab which shall have successfully passed a watertightness test before the membrane is installed.

Section 4 Pipelines, Pipework

401 General

401.1 Equivalency of Goods, Materials and Plant

Wherever reference is made in the Contract, including Specifications, Drawings and Bill of Quantities, to specified manufacturers or suppliers for the supply of goods, materials and plant for the Works, goods, materials and plant from alternative manufacturers and suppliers will be permitted, unless otherwise expressly stated in the Contract, providing these other goods, materials and plant are substantially equal or of a higher quality than those of the specified manufacturer or supplier and are approved in writing by the Project Manager. Differences between the specified goods, materials or plant and the proposed alternative shall be described in writing by the Contractor and submitted to the Project Manager, together with such manufacturer's or supplier's technical literature and samples as the Project Manager may reasonably require. At least 28 days prior to the date when the Contractor desires the Project Manager's consent. In the event the Project Manager determines that such proposed alternative goods, materials or plant do not ensure substantially equal or higher quality, the Contractor shall obtain the goods, materials or plant from the manufacturer of supplier specified in the Contract.

401.2 Materials

Any material which will come into contact with potable water or water to be used for potable supply shall comply with the UK regulations on the use of materials for potable water supply. Water Supply (Water Quality) Regulations 1989 and 15th Statement of the Department of Environment Committee on Chemical and Materials of Construction for use in public water supplies and swimming pools, published by the Department of the Environment, UK or national standards adopted for use in Kenya.

401.3 Approval

As soon as possible after commencement of the Contract, the Contractor shall submit to the Project Manager for his approval a list of his proposed suppliers, sources of materials and proposed standards. No materials, plant or equipment shall be procured for the Contract without first obtaining the Project Manager's approval. Samples of materials shall be submitted to the Project Manager for approval as required by the Project Manager. Materials subsequently supplied shall conform to the quality of the samples which have been approved by the Project Manager. No standards, method of manufacture or specification shall be changed without the approval of the Project Manager. Where possible, plant shall be supplied to the same standards or to compatible standards.

The Contractor shall provide secure storage for all samples submitted to the Project Manager.

401.4 Dimensions

Plant and materials shall be supplied to the general arrangements and dimension, or to suit the dimensions, shown on the Drawings or otherwise indicated in the Contract. Where no such dimensions are shown the Contractor shall be responsible for sizing the Plant. Any redesign, extra design, additional construction or any other costs resulting from the use of Plant to other arrangements or to other dimensions shall be the responsibility of the Contractor.

401.5 Packaging and Protections

All items shall be adequately crated or packaged to withstand damage and prevent deterioration due to shipping, handling and storage. The methods of protection and shipping shall be to the approval of the Project Manager.

401.6 Marking

All Plant shall be marked in accordance with Clause 5 of BS EN 545 and Clause 37 of BS 5163. Before shipping, all items shall be clearly marked. Crates or packages shall be marked on two sides with indelible paint with the name of the project, the Employer and the Contract number shall bear marks indicating the contents.

401.7 Receipt, Storage, Handling and Transportation

Plant, equipment and materials shall be stored in such a manner as to preserve its quality and condition to the standards required by the Contract. The Project Manager shall refuse to accept or shall reject any materials of Plant that in his opinion is defective or otherwise fails to comply with the standards required by the Contract. All such defective items shall be removed from the Site as directed by the Project Manager. Repairs shall be carried out in accordance with procedures approved by the Project Manager and shall be completed to the Project Manager's satisfaction.

401.8 Manufacturer's Certificates

The Contractor shall furnish the Project Manager with a manufacturer's certificate conforming compliance to the specification in respect of all items of Plant, equipment and materials. The original and one copy of the manufacturer's certificate shall be delivered to the Project Manager not later than 14 days prior to the intended date of delivery of the item to Site.

401.9 Proprietary Materials

Proprietary materials shall be supplied in suitable containers and in appropriate batch sizes for the work to be undertaken. The containers shall be marked with the following information:

i. Storage instructions
ii. The manufacturer's name
iii. Shelf life and dates of manufacture
iv. Material identification
v. Batch reference number
vi. Net weight
vii. Mixing instructions
viii. Any warnings or precautions concerning the contents and their safe use.

The Contractor shall supply with each consignment of proprietary material delivered to the Site, certificates furnished by the manufacturer or his agent stating:

i. The manufacturer's name and address
ii. The agent's name and address where applicable
iii. Material identification
iv. Batch reference numbers, size of each batch and the number of containers in the consignment
v. Date of manufacture.

401.10 Rejected Materials

Should any item of plant, materials or manufactured articles be in the judgment of the Project Manager, unsound or of inferior quality or in any way unsuited for the purpose in which it is proposed to employ them, such items, materials or manufactured articles shall not be used upon the Works but shall be branded, if in the opinion of the Project Manager this is necessary, and shall forthwith be removed from the Site.

402 Samples and Storage of Materials

Where required by the Project Manager the Contractor shall submit to the Project Manager for approval samples of pipes, fittings and materials prior to procurement. The Contractor shall only store pipe, fittings and other material at places approved by the Project Manager and shall at all times provide adequate supervision and watchmen to prevent theft or damage. Any loss or damage incurred will be the Contractor's responsibility.

Pipes shall not be stacked higher than recommended by the manufacturer. The area on which the pipes are to be stacked shall be free draining, the grass or other vegetation shall be kept cut and suitable timber cradles shall be provided on which the pipes shall be laid. End stops to all stacks shall be provided.

Fittings and valves shall not be stacked more than one tier high and they shall be supported off the ground by suitable timbers.

Air valves, rubber joint rings, gaskets, bolts and similar fittings and materials shall be kept in approved locked premises and such fittings and materials shall not be distributed to the trench side until immediately prior to laying, fitting, jointing or assemble thereof. All rubber joint rings and gaskets must be stored in a cool damp location and all fittings and materials shall at all times be stored in the shade under cover and protected from the weather to the satisfaction of the Project Manager.

403 Flanges

Flanges shall be faced and drilled to conform to the dimensions specified in BS 4504. Flanges shall be compatible with the pressure rating of the adjacent pipework or as stated on the drawings. Bolts, nuts and washers (two washers per bolt) shall be to BS EN 1092-3; 2003. No bolt shall project less than two full threads beyond its nut after tightening. In no circumstances shall the shortening of excessively long bolts by cutting be allowed.
Gaskets shall comply with replaced by BS EN 1514 (1997) and replaced by BS EN 681-2 (200) and BS 681-1 (1996) Type W. Flanges shall be painted with two coats of epoxy resin paint. Puddle flanges shall be fitted to all pipework passing through water-retaining structures and manholes greater than 2.5m deep.

404 Mechanical Couplings

Unless otherwise specified or shown in the Drawings pipes and fittings shall be supplied with flexible joints. Mechanical couplings shall be of the Dresser, Viking Johnson type without a centre register. Joints rings used shall be of the ethylene propylene rubber (EPDM) or other material approved by the Project Manager. All mechanical couplings and flange adapters including nuts, bolts and washers shall be supplied with 'Rilsan' nylon thermoplastic polyamide applied by fluidized bed dipping or similar approved.

405 Materials for the Assembly of Flexible Joints

Lubricant shall be of a kind not conducive to the growth of bacteria and shall have no deleterious effects on either the joint rings or pipes. Lubricants for water supply shall not impart to water, taste, colour, or any effect known to be injurious to health.

406 Ductile Iron Pipes

406.1 General

Ductile iron pipes and fittings for water supply shall comply with BS EN 545 (1995). Pipes and fittings shall have spigot and socket joints unless otherwise specified. Pipes shall be class K9. Spigot and socket flexible joints shall be of the push-fit type with gaskets of ethylene propylene rubber (EPDM). The Contractor shall supply 5% of the straight pipes suitable for cutting on site and these shall be clearly marked.

406.2 Corrosion Protection

Pipes and fittings shall be protected externally with an extruded polyethylene or polyurethane coating complying with DIN 30674 Part 1. Pipes and fittings shall be lined internally with centrifugally applied cement mortar and complying with DIN 30674. Joint areas shall be coated with epoxy or polyurethane to DIN 30674. All lining and coating materials shall be approved for contact with potable water by an internationally recognized body like the Drinking Water Inspectorate of UK.

407 Galvanised Steel Pipes

Galvanised steel pipes shall be medium duty manufactured to BS 1387.

408 Steel Pipes

408.1 General

Steel pipes shall be manufactured to BS EN 10224 or AWWA C200 and shall be suitable for the pressure ratings required by the Contract. Fittings shall conform dimensionally to BS EN 10224, AWWA 208-59 or AWWA M11. Unless otherwise specified or necessary to meet the requirements of the Contract steel pipes shall be manufactured as follows:

a) DN300mm and below shall be manufactured to minimum of Grade L235 or API 5L Grade B
b) DN350mm and above shall be manufactured to a minimum of Grade L275 or API 5L Grade X42.

The pipes and fittings of diameter 600mm or less shall be supplied with push-fit spigot and socket type joints with integral gasket of EPDM rubber or similar to BS EN 10224 or BS CP 2010. Pipes greater than 600mm shall be supplied with ends cut square suitable for use with flexible couplings and the external weld ground back sufficiently.

The Contractor shall supply 5% of the straight pipes as half length pipes (not exceeding 6m).
Each pipe shall be supplied complete with a coupling for jointing.

408.2 Corrosion Protection

Steel pipes and fittings shall be protected externally at the manufacturer's works with fusion bonded epoxy resin in accordance with AWWA C213. Pipes greater than 600mm and all fittings shall also be lined internally with fusion bonded epoxy to AWWA C213. Pipes 600mm or less shall be lined with cement mortar to AWWA C205 or BS EN 10298. All lining and coating materials shall be approved for contact with potable water by an internationally recognized body like the Drinking Water Inspectorate of UK.

Where required by the Bills of Quantities, the Supplier shall also price for the provision of an alternative 3LPE coating to DIN 30670 or AWWA C215 of a triple wrap system of fusion bonded or sprayed epoxy primer, an intermediate polymer adhesive layer and an extruded high density polyethylene coating in general conformance with ISO/DIS 21809-1 Class B as appropriate.

409 Glass Reinforced Plastic (GRP) Pipes and Fittings

Glass reinforced plastic (GRP) pipes and fittings for pressure water supply shall be high stiffness and shall comply with the relevant provision of BS 5480. The minimum pipe stiffness shall be 5,000 N/m2.

Pipes and fittings shall be marked in accordance with Clause II g. BS 5480.

Pipes shall only be cut by techniques which can be shown not to impair the pipes pressure regression performance. Where any pipe is cut the exposed fibres at the cut pipe end shall be resealed to prevent potential long term degradation. Methods of cutting and resealing exposed fibres shall be submitted to the Project Manager for Approval. Elastomeric sealing rings and foils shall comply with BS EN 681.

On delivery to site and immediately prior to installation each pipe shall be visually inspected both externally, and where possible, internally for damage such as star cracking of the gel coat layer. Where any damage extends through the pipe wall the pipe shall be rejected or the damaged section cut out and replaced in accordance with repair methods approved by the Project Manager. If in the Project Manager's opinion the pipe is not suitable of repair it shall be rejected and removed from site.

410 uPVC Sewers and Pressure Pipes and Fittings

Unplasticised PVC pipes and fittings for water supply pressure pipes shall comply with British Standards 3505 current but also superseded by BS EN 1452 and 4346. They shall be obtained from an approved manufacturer and shall be minimum pressure rated (12 bars) unless otherwise stated.

Unplasticised PVC pipes and fittings for gravity sewers and drains shall comply with British Standards 4660 or 5481

and shall be obtained from an approved manufacturer. Restrained rubber ring type push fit flexible joints shall be used unless otherwise stated. Solvent weld joints will not normally be permitted. Pipes and fittings shall be protected from the direct rays of the sun at all times by means of reflective cover sheets.

411 Concrete Pipes, Bends and Junctions

Concrete pipes, bends and junctions for use in sewers shall be made with sulphate-resisting cement. Pipes, bends and junctions shall conform to the requirements of BS 5911 for the particular class of pipe required to be used. The internal dimensions shall be true and regular and the internal surface smooth and free from surface blemish. The actual diameter of the pipe shall be not less than the nominal diameter. All joints shall be of the gasket type with flexible spigot and socket approved by the Project Manager. Gaskets shall be elastomeric complying with BS EN 681.

The main pipe and branches of all junctions shall be of the same strength classification and shall have the same internal dimensions as the pipes with which they are to be used.

The pipes, bends and junctions delivered to the Site shall be certified by the pipe manufacturer to have complied with BS 5911, or other approved standard and one copy of the certificate shall be delivered to the Project Manager before the goods are unloaded.

Unless otherwise specified pipes are required to be of Extra Strength; they may, unless otherwise specifically called for, be reinforced either with cast-in steel or by an external wrapping of fibre glass and resin, applied by an approved manufacturer.

The Contractor shall provide all facilities for and shall carry out jointly with the Project Manager (if so required) a full visual inspection of all pipes, bends and junctions for manufacturer's defects and other faults or damage. Before any pipe, bend or junction is laid it shall again be carefully examined and sounded with a wooden mallet. Any pipe found to be cracked or otherwise defective shall not be used on the Works.

Concrete pipes shall be internally coated with a 100 percent solids coal tar epoxy lining 70 percent minimum epoxy content. Coat thickness 300 micron minimum.

412 HDPE Pipes and Fittings

412.1 General

Polyethylene pipes up to nominal size 63mm for below ground use shall be coloured blue and comply with the relevant provisions of BS 6572. Polyethylene pipes for use in nominal diameters greater than 63mm shall be as specified below.

The pipes shall be clearly and indelibly marked to show the name of the manufacturer, diameter, pressure class and date of manufacture.

House connection pipework downstream of the manifold shall be PE80; all other HDPE pipework shall be PE100.

412.2 Compound Material

The material from which the pipes are made shall be in accordance with ISO 4427-1. All pipes shall be manufactured using pre-compounded carbon black, bimodal, high density polyethylene MRS 10.0 material (PE100). The use of natural PE100 with a Carbon black master batch is strictly not allowed.

Carbon black should be well dispersed to give outstanding UV resistance, and should have a minimum carbon content of 2%. Pipes should be manufactured from certified PE100+ material with batch certification available with pipe delivery.

412.3 Identification compound

The compound used for identification stripes shall be manufactured from a PE polymer manufactured from the same type of base polymer as used in the compound for pipe production.

412.4 General appearance

When viewed without magnification, the internal and external surfaces of pipes shall be smooth, clean and free from scoring, cavities and other surface defects such as would prevent conformity of the pipe to ISO 4427. The pipe ends shall be cut cleanly and square to the axis of the pipe.

412.5 Color

The pipes shall be black with coloured identification stripes.

412.6 Dimensions

The dimensions of the pipe shall be measured in accordance with ISO 3126. Manufacturing shall be to ISO 4427 Standard, as per the approved dimensions chart.

Pipes should be manufactured in machinery capable of ultrasonic wall thickness detection with production reports provided with delivery of pipes. Where coiling is possible, the minimum internal diameter of the coil shall not be less than 18d.

The lengths shall be supplied to minimize the number of joints to be done in the field, and the size that is allowed to be legally transported on Kenyan roads by the traffic department.

412.7 Markings

All pipes shall be permanently and legibly marked in such a way that the marking does not initiate cracks or other types of failure and such that normal storage, weathering, handling, installation and use does not affect the legibility of the marking.

The colour of the printed information shall differ from the basic colour of the product. The marking shall be such that it is legible without magnification. The frequency of marking shall not be less than once per metre. Markings should be made using a hot embossed foil stamp printing.

Each pipe shall a minimum of 3 equispaced blue longitudinal stripes indicating medium of fluid transported in the pipes. A summary of marking requirements are given in the table below.

Minimum required marking

Aspect	Marking
Standard Number	ISO 4427
Manufacturer's identification	Name or symbol
Dimensions (*d*n × *e*n)	e.g. 125X11.4
SDR series (for DN > 32)	e.g. SDR 11
Material and designation	PE 100
Pressure rating in bar	e.g. PN 16
Production period (date or code)	e.g. 0204[a]
Country of Production	Kenya
Coils shall be sequentially marked with the metreage, indicating the length remaining on the coil.	

Aspect	Marking
[a] - In clear figures or in code providing traceability to the production period within year month and, if the manufacturer is producing at different sites, the production site.	

412.8 Jointing of Pipes

Unless otherwise specified or approved by the Project Manager, Polyethylene pipes shall be electro fusion welded. Joints between polyethylene pipes supplied from different manufactures or not manufactured from the same grade of polymer shall only be jointed by electro fusion or by push fit mechanical couplings. Mechanical couplers and compression type fittings shall incorporate a serrated internal liner to support the pipe against compression loads exerted by the fitting and to prevent pullout under axial load.

Butt or socket fusion joint techniques shall only be applied between pipes supplied from single source and manufactured from the same grade of base polymer. Fusion welding of polyethylene pipes shall only be undertaken by skilled operatives using appropriate specialized tooling. Pipes to be jointed shall be free from contamination and care shall be used to protect fusion jointing operations from wind and against the effects of inclement weather. Mechanical jigs or other approved methods shall be used to ensure correct alignment of the pipe when making butt fusion joints. Details of fusion welding procedures including details of tools, operatives, materials and method statements shall be submitted to the Project Manager for approval prior to any jointing.

Steel and iron pipe fittings shall comply with the relevant provision of BS EN 545 (1995) replaced by BS EN 10224 but also current.

412.1 General

Polyethylene pipes up to nominal size 63mm for below ground use shall be coloured blue and comply with the relevant provisions of BS 6572. Polyethylene pipes for use in nominal diameters greater than 63mm shall be coloured blue High Density Polyethylene (HDPE) suitable for a working pressure of 12 bars.

The pipes shall be clearly and indelibly marked to show the name of the manufacturer, diameter, pressure class and date of manufacture.

House connection pipework downstream of the manifold shall be PE80; all other HDPE pipework shall be PE100.

412.2 Joints

Unless otherwise specified or approved by the Project Manager Polyethylene pipes shall be electro fusion welded. Joints between polyethylene pipes supplied from different manufactures or not manufactured from the same grade of polymer shall only be jointed by electro fusion or by push fit mechanical couplings. Mechanical couplers and compression type fittings shall incorporate a serrated internal liner to support the pipe against compression loads exerted by the fitting and to prevent pullout under axial load.

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Steel and iron pipe fittings shall comply with the relevant provision of BS EN 545 (1995) replaced by BS EN 10224 but also current.

413 Gate Valves

413.1 General

Valves for normal duty on water pipelines with pressure ratings up to PN25 shall be key operated cast iron flanged gate valves for waterworks purposes generally complying with the requirements of BS 5163 (Type B). All Gate Valves shall be supplied with a 10 year manufacturer's warranty.

Cast iron gate valves for pressure ratings to PN14 shall be cast iron flanged valves complying with BS 5150 replaced by BS EN 1171 (both BS 5150 and BS 5151) or cast iron parallel slide valves complying with BS 5151.

Butterfly valves for pressure ratings of up to PN14 shall be double flanged wafer type butterfly valves complying with BS 5155.

Unless otherwise specified valves for use on steel pipes shall be flanged, where butt-weld ends are specified valves shall comply with BS EN 1984, or BS EN 13709.

413.2 Wedge Gate Valves for Manual Operation

Valves up to and including DN 300 shall be of the resilient seal type and valves larger than DN 300 shall have metal seals.

Spindles shall be of the non-rising type and screwed so as to close the valves when rotated in the clockwise direction. The direction of closing shall be clearly cast on the valve cap or hand wheel as appropriate. The valves shall be constructed of the following materials:

body	-	cast iron;
spindle	-	forged bronze or stainless steel;
metal faces and seal	-	Gunmetal.

The valves shall be suitable for the unbalanced head as specified or indicated in the schedules.

Suitable gearing and anti-friction devices such as ball bearing thrust collars shall be provided as necessary to enable opening and closing by manual operation at the pressure stated, using an effort no greater than 26kg on the tee key or hand wheel supplied. Hand wheels shall not exceed 500mm diameter. A bypass with gate valve forming an integral part of the valve shall be provided where recommended by the valve manufacturer for the pressures specified.

Gearing on valves of DN 300 and less shall be enclosed in a sealed gearbox suitable for buried installation and operated with a tee key. Except where shown in the Drawings, all valves exceeding DN 300 shall be provided with bevel gearing and hand wheels. Valves to be used for washouts and isolating air valves shall have screwed seats.

Extension spindles shall be galvanized or stainless steel adequately supported with cast iron brackets, and of sufficient diameter to prevent any whiplash effect through twisting when being used to operate the valves. The spindles shall be capped for key operation. Valve caps shall be fitted with hexagonal set screws.

Valves shall be coated with an approved epoxy complying with DIN 30674. Keys for valve operation shall be of sufficient length so that the valves can be operated by a man standing, but shall not exceed 1.2m in length, and shall have a detachable cross bar.

414 Butterfly Valves

414.1 General

Butterfly valves shall conform to BS EN 593. All Butterfly Valves shall be supplied with a 10 year manufacturer's warranty.

414.2 Construction

Butterfly valves shall have a high grade cast iron body to BS EN 1561 designed to the specified working and test pressures. The pressure rating valve shall be cast in the valve body. The disc shall be of high grade cast iron to BS EN 1561 or nodular cast iron to BS 2789 to the defined working and test pressures. It shall have a convex shape designed to achieve low head loss characteristics. The valve shafts shall be of stainless steel operating in self-lubricating bushes in the body.

The valve seat shall be of gunmetal to BS 1400. The sealing ring shall be a renewable Ethylene Propylene Diene Monomer (EPDM) rubber attached to the disc edge by a sectional bronze retaining ring to form a resilient and durable seal.

The valves shall be fitted with hand wheel actuators not exceeding 500mm diameter incorporating gearing to allow opening and closing by manual operation at the pressure stated using an effort no greater than 36kg on the hand wheel supplied.

In all cases the gearing shall be designed to close the valve, from fully open to fully close in a period of not less than ten minutes with this effort. Actuators shall be designed so as to close the valves when the hand wheel is turned in a clockwise direction; the direction of closing shall be clearly cast on the hand wheel. Position indicators shall be fitted to all actuators.

Where required valves shall be electrically actuated with a manual override. Remote actuation shall be provided with a visual indication of valve open, valve closed and percentage opening together with fault indication.

414.3 Valve Performance

A performance curve, relating percentage valve travel, open area and discharge coefficient shall be submitted to the Project Manager. The head loss coefficient with valve fully open shall be defined.

414.4 Testing

All valves shall be tested in accordance with BS EN 593 and pressure and material test certificates shall be submitted to the Project Manager for approval.

415 Air Valves

Air valves shall be either:

a. Single (small) orifice valves (SAV), for the discharge of air during the normal operation of the pipeline.

b. Double orifice valves (DAV), consisting of a large orifice and a small orifice. These shall permit the bulk discharge of air from the main during filling and air inflow when emptying in addition to the discharge of small quantities of air during normal operating conditions.

Air valves shall be supplied with an independent isolating butterfly valve (DAV) or cock (SAV) which permits the complete removal of the air valve from the main, without affecting the flow of water in the main.

Each air valve assembly shall be suitable for connection to a flange on the pipeline.
At the connection between the air valve and its isolating valve a BSP tapping shall be made suitable for fitting of a pressure gauge. All tapings shall be sealed by a brass plug and copper compression ring gasket.

Air valves shall operate automatically and be constructed so that the operating mechanism will not jam in either the open or closed positions.

416 Non-Return Valves

416.1 Swing Check Valves

Non-return valves shall be suitable for waterworks purposes and shall be manufactured to comply with the general requirements of BS EN 12334. They shall be double flanged type, non-slamming and recoilless on flow reversal.

Valves of DN 700 and larger shall be of the multi-disc type or tilting disc type. The valves shall have a high grade cast iron body and cover to BS EN 1561 Grade 220/260 with gun metal nickel bronze alloy door seating. The hinge pin shall be of stainless steel carried on non-corrodible bearings.

416.2 Nozzle Check Valves

Nozzle check valves shall be slam free closing with a streamlined cross section as manufactured by Mannesmann Demag or similar.

417 Flow Control Valves

Flow controls unless otherwise specified shall be butterfly valves. They shall be installed complete with a headstock and position indicator showing the degree of opening.

418 Pressure Reducing Valves

Pressure reducing valves shall automatically reduce a higher inlet pressure to a steady lower downstream pressure regardless of changing flow rate or varying inlet pressure. The valve shall be a hydraulically operated pilot controlled diaphragm type, globe or angle valve.

The main valve shall have a single removable seat and a resilient disc.

419 Ball Float Valves

Ball float valves which are to be installed within reservoirs shall be the delayed action type to eliminate inflow at small valve openings. They shall be fitted with a stilling chamber, auxiliary float valve and inlet bellmouth with regulating valve. The main valve shall be fitted with a long actuating lever to provide a long float travel for slow valve closure.

Valves shall be of the right angle pattern type with flanged inlet and have a resilient synthetic rubber disc which forms a drop tight seal against a removable seat insert. Valves shall be free of cavitation and vibration under the specified working conditions. Flanged tapers shall be provided on the inlets as necessary to suit the size of valves proposed.
Valves shall be capable of withstanding the maximum static pressure and of passing the maximum flow rate shown. Orifice plates shall be provided as necessary to absorb excess working pressure at the initial flow rates indicated.

The pressure rating of the valve shall be cast into the body of the valve.

420 Constant Flow Valves

Constant flow valves shall maintain a constant rate of flow regardless of fluctuations in upstream pressure.

Valves shall be hydraulically operated, diaphragm actuated globe pattern. They shall have a resilient synthetic rubber disc which forms a drop tight seal against a removable seat insert. The diaphragm assembly and valve stem shall be fully guided at both ends by bearings in the valve cover and valve seat. The diaphragm shall consist of nylon fabric bonded with synthetic rubber. Packing glands and stuffing boxes are not permitted and there shall be no

pistons operating the valve or pilot controls.

The pilot control shall be direct acting diaphragm valve designed to close when the actuating differential increases beyond the spring setting. The actuating differential pressure shall be produced by a thin edged orifice plate installed in an orifices flange downstream of the valve.
Any necessary repairs to the valve shall be accomplished without removing the valve from the main.

Valves shall be sized to pass the maximum continuous flow stated on the drawings at the working pressure given. The pressure rating of the valve shall be cast into the body of the valve.

421 Surface Boxes and Chamber Covers

Surface boxes and chamber covers shall be either cast iron or ductile iron and coated with black bituminous solution.

Surface boxes over gate valves shall be hinged and chained and shall generally comply with BS 5834.

In roads, tracks, verges: Heavy duty with 150 x 150mm nominal clear opening.
In fields and areas subjected to light wheeled or pedestrian traffic: Medium duty with 150 x 150 mm nominal clear opening.

Surface boxes for hydrant chambers shall have a 150 x 150mm clear opening and shall comply with BS 750 and shall be suitable for heavy traffic loading.

Covers to air valve and other chambers shall be to the dimensions and loading requirements shown on the Drawings or as stated in the Bill of Quantities.

Covers shall be suitable for the following maximum safe centre static loads:

Light duty	- 250kg
Medium duty	- 1500kg
Heavy duty	- 5000kg

Where applicable, covers shall comply with BS EN 124 or other appropriate Standard.
Lifting keys shall be provided for each type surface box or cover supplies. One set of keys shall be provided for every ten surface boxes or covers subject to a minimum of ten sets of keys or the actual number of covers if less than ten.

422 Gully Gratings and Frames

Road gully gratings and frames shall be of approved type and manufacture in cast Grey Ductile Iron and shall be of Heavy Duty Non-rocking Pattern designed for wheel load of 11.5 tonne and generally in accordance with BS EN 124. Single gullies of nominal size 1050mm x 750mm. Inlet gratings of other plan dimensions shall have a minimum water way area of 49% of the total inlet grating area.

Gully frames shall be set in cement mortar and haunched with Class C25 concrete. It shall be the Contractor's responsibility to establish the finished road levels from the appropriate authority and fix the gratings accordingly.

423 Manhole Safety Chains

Mild steel chain shall be 8 mm nominal size Grade M (4) non-calibrated chain, Type 1, complying with BS withdrawn. After manufacture, mild steel safety chains shall be hot dip galvanized in accordance with BS EN 124.

424 Manhole and Chamber Access Covers

The manhole and chamber access covers shall comply with BS 497 Part 1 and be obtained from an approved manufacturer and shall be to the internal minimum clear opening as detailed in the Contract.

All manhole and chamber access covers in road shall be to an approved Heavy Duty pattern and in footpaths shall be medium/heavy duty unless otherwise specified. The frame and lid shall have key holes formed with sealed pockets underneath to prevent ingress of sand, grit and surface water and shall be of an approved non-rocking pattern. The covers and frames shall have accurate seating faces to prevent rocking and the ingress of sand or water, and it shall be tight fitting to resist overflow conditions or unauthorized removal. The seating faces shall be coated with graphite grease before installation of the cover.

A supply of keys for use with every type of manhole cover and surface box shall be handed over by the Contractor at the completion of the Contract on the basis of one set of keys for each 50 covers or part thereof.

Manhole and chamber cover frames shall be set in cement mortar and haunched with Class C30/10 concrete and shall be set to the camber or fall of the finished road surface. It shall be the Contractor's responsibility to establish the finished road surface levels from the appropriate authority and to fix the covers accordingly.

425 Manhole Step Irons

Manhole step irons shall be of galvanized malleable iron and shall conform in all particulars to BS EN 13101.

Section 4B. Pipeline Construction

426 General

The requirement of this section shall apply to the construction of potable and raw water pipelines and pipework.

Within this section 'Plant' refers to pipe fittings, valves, surface boxes and chamber covers, and other such materials required for pipelines, mains and pipework at reservoirs and elevated tanks.

All Plant shall be suitable for waterworks purposes for the conveyance of potable water in the climatic conditions prevailing in Kenya and in particular at the location of the Works.

The Project Manager shall provide details of each pipeline diameter, pressure rating, hydraulic characteristics and the approximate alignment. The Contractor shall, in consultation with the Project Manager set out the proposed pipeline alignments, making any changes that the Project Manager may deem necessary, confirming also the exact locations of all manholes, valves, air valves, washouts, hydrants, and the like.

427 Topographic Surveys

Topographic surveys along pipeline routes shall be either:-

- Plan and profile surveys, or
- Line and level traverse surveys,

as instructed by the Project Manager.

Plan and profile surveys shall cover a strip of 10.0m wide centrally on the proposed centre line of the pipeline. The survey shall be carried out in accordance with the specification detailed in Clause 106.

Line and level surveys shall comprise a traverse line along the centre line of the pipeline as established by the Project Manager.

428 Handling and Transport of Pipes and Fittings

The loading, transporting, unloading and handling of pipes and fittings shall be carried out such that no damage is caused. All in accordance with the recommendations of the manufacturer and to the approval of the Project Manager. The use of lifting hooks is not permitted. Pillows shall be provided between lashing (ropes, wires or chains) and the pipes. All cradles and lashings shall be of such widths as to prevent damage to the coating of the pipe, or distortion of the pipes.

Valves and fittings shall be transported in timber packing and where possible in the manufacturer's original packaging.
Protective cover and other protective materials provided by the manufacturer shall not be permanently removed until immediately prior to installation.

In the event of any damage being caused to a pipe, the Project Manager shall determine whether damaged piece shall be replaced or repaired. Repair to coating only shall be allowed and shall be as directed by the Project Manager.

In all instances when along trench sides, ferrous pipes shall be supported within 1 metre of either end on sand filled bags such that no part of the wall of the pipe touches the ground, and in the case of pipes over 6 metres long with additional central sand bags.

When pipes are being loaded into vehicles care shall be taken to avoid their coming into contact with any sharp corners such as cope irons, loose nail heads, etc. Whilst in transit, pipes shall be well secured over their entire length

and not allowed to project unsecured over the tailboard of the lorry.

Pipes may not be offloaded from lorries by rolling them, suitable carnage shall be used. Pipes shall not be rolled or dragged along the ground.

429 Stringing and Examination of Pipes Prior to Laying

All DI and Steel Pipes and their coatings and linings shall be carefully inspected on Site prior to laying.

Inspection of the pipe will be made by the Project Manager after delivery and again immediately prior to laying. Any pipe shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall immediately be removed from the site.

All pipe or fittings shall be examined before laying and no piece shall be installed which is found to be defective. Any damage to the pipe linings or coatings shall be repaired as directed by the Project Manager. Handling and laying of pipe and fittings shall be in accordance with the Manufacturer's written instructions and as specified herein.

Before lowering into the trench or placing in position each ductile iron pipe or casting shall be slung and sounded with a mallet to test for hair cracks. Pipes that do not ring true will be discarded.

All cement mortar linings shall be visually inspected for defects such as cracking or spalling and crack widths shall be measured to confirm that width is such that natural re-sealing will occur once put into service; otherwise cracks as well as any spalling shall be made good before laying in accordance with the manufacturer’s written instructions.

All epoxy linings and all coatings shall be subjected to holiday detection tests, in accordance with NACE RP 0490, the voltage of the holiday detector being selected appropriate for the material and its thickness. No pipe shall be laid having failed the holiday tests until the defective area is made good in accordance with the manufacturer’s written instructions and retested satisfactorily before use.

All pipe and fittings shall be thoroughly cleaned before laying, and shall be kept clean until they are used in the work, and when laid, shall conform to the lines and grades required. Pipe shall not be laid unless the trench is free of water and in a satisfactory condition. Ductile iron pipe and fittings shall be installed in accordance with the requirements of AWWA C600 except as otherwise provided herein. If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner by the Contractor, at his own expense.

When laying is not in progress, including any work break exceeding 30 minutes, the open ends of the pipe shall be closed by watertight plugs or other approved means. Good alignment shall be preserved in laying. The deflection at joints shall not exceed that recommended by the Manufacturer. End caps shall not be removed until such time as the pipe is to be inspected and laid.

Where the pipeline crosses roads, tracks or any other access or where directed by the Project Manager, the Contractor shall place the pipes so that access to the public is not in any way prohibited.

Shortly before laying or fixing any valve, pipe or fitting, the Contractor shall examine each valve, pipe and fitting to ascertain that there is no damage or defect. The Contractor shall give the Project Manager not less than 48 hours notice of his intention to undertake such examination. The Contractor shall not lay such pipes and fittings until he has received approval from the Project Manager.

Linings shall be inspected prior to laying and any defect made good.

430 Laying Pipes

Immediately before any pipe is lowered into the trench the plug shall be removed from the end of the last pipe laid

and the new pipe shall be carefully lowered into the trench.

Each pipe and fitting shall be laid true to alignment curve and gradient in accordance with the Drawings or as directed by the Project Manager. The minimum gradient shall not be flatter than 1 in 500.

Pipes shall be boned to gradient and sight rails shall be provided for this purpose at intervals not exceeding 50m and at all changes in grade. No dips or summits shall be permitted other than as shown on the Drawings.

430.1 Embedment and Compaction

All ductile iron and steel pipes shall be embedded using a sand or coarse grained soil with less than 12% fines, which if necessary shall be imported if excavated material is found to be unsuitable:

In areas prone to water logging or where specifically called for on the Drawings or in the Bills of Quantities a single size or graded gravel shall be used as a special lower bedding, with grading as indicated below.

Nominal Pipe Diameter (mm)	Grading for Special Lower Bedding [to ASTM Sieve Sizes]	
	Single size Gravel	**Graded gravels**
< 200	10 or 14 single-size gravel	14 to 5 graded
200 to 500	10, 14 or 20 single-size gravel	14 to 5 graded or 20 to 5 graded
> 500	10, 14, 20 single-size crushed rock, or gravel	14 to 5 graded or 20 to 5 graded

The suitability of as-dug trench material as an embedment material and where imported, the source shall be approved by the Project Manager. Any delays as a result of not seeking this approval in good time shall be entirely to the Contractor's account

All layers of the embedment shall be thoroughly compacted, and shall not exceed 150 mm and be raised evenly on both sides of the pipe as it is placed. A minimum compaction of 90% MPD shall be achieved at all times, this being confirmed by sampling and testing at intervals on different levels of embedment at intervals of not more than 50 m with testing in accordance with BS 1377 or ISO 22476 using the "sand replacement" method.

Should any results fail to achieve this absolute minimum level, then the pipes, embedment material and layer shall be removed for an equal distance on either side of the failed test, the total distance being equal to the length between adjacent sampling locations, and re-laid appropriately but with compacted layer thickness halved. In addition the distance between sampling and testing shall also be halved until in the opinion of the Project Manager's Representative a sufficient number of consecutive passes allows both individual layer thickness and the distance between sampling and testing to be returned to the previous thickness and spacing.

All backfill soil above the embedment shall be free from clay lumps, boulders and rock fragments greater than 50 mm and as far as practicable, given the nature of the soil, 90 % MPD shall be attained. However, this requirement may be relaxed to 85% MPD by the Project Manager's Representative if he considers the circumstance warrant it.

430.2 Pipes Laid in Trench

Pipes and fittings laid in trench shall have at least the minimum cover stated in the Drawings.
Long radius curves in buried pipelines shall be negotiated by deflections taken up in the joints of one or more pipes. The deflection at joints shall not exceed 75% of the manufacturer's maximum specified limits. Designs have been based upon the use of 6m long pipes. If the Contractor provides longer pipes sufficient short lengths shall be provided to enable the proposed pipe curvature without additional bends or deep excavation.

Pipes shall not be dragged along the trench bottom. Pipes laid in trenches shall be laid and firmly bedded on an even and uniform bed. Where pipes are not laid on a granular bed, the bottom of the trench shall be smooth and free from stones or other projections.
Joint holes shall be excavated below the trench bottom and shall be as small as possible and shall be filled in and compacted after the pipes are laid and before the refilling of the trench is commenced.

430.3 Pipe Bedding and Surround

For polyethylene, uPVC and GRP pipelines, Class S bedding shall be used where the cover is equal to or greater than 1.0m. Where there is less than 0.6m cover, Class A concrete surround shall be used. In between the Project Manager shall decide upon the bedding type dependent upon the assessed risk of damage to the pipe.

430.4 Pipes Laid Above Ground

Pipelines to be laid above ground shall be constructed of flanged ductile iron pipes with mechanical type expansion

joints. Supports shall be provided at a maximum spacing of one pipe length and adjacent to the flanged joints.

The expansion joints shall compensate for a variation of ambient temperature between zero and 40º C on the adjoining pipeline. Anchorages shall be provided immediately uphill of each expansion joint and at each change in vertical and horizontal alignment. The ground/rock surface under the pipeline shall be re-graded as necessary to allow a satisfactory vertical alignment of the pipeline.

The Contractor may propose, as an alternative to the use of mechanical expansion joints, either of the following methods for accommodating thermal expansion:

(1) A zigzag pipeline alignment whereby the thermal movement is accommodated by deflection of the bends.
(2) A rigid form of construction with the thermal movement being constrained within the pipe walls by the use of substantial anchor blocks.

Joints shall be made in compliance with the manufacturer's instructions as approved by the Project Manager. Care shall be taken to ensure the absolute cleanliness of the pipe ends and joint components. Only the recommended approved lubricants shall be used.
Jointing shall only be carried out by experienced personnel under close supervision by the Contractor.

The Contractor shall ensure that no dirty water or other extraneous matter is allowed to enter the pipes during or after laying. In the event of dirty water or extraneous matter entering the pipes the Contractor shall immediately carry out cleaning and disinfection as directed by the Project Manager.

Except when necessary for jointing, the end of the last pipe laid shall be kept plugged to the satisfaction of the Project Manager to prevent the ingress of dust, dirt, rocks and other debris.
The Contractor shall be liable for any damage caused to the Employer's Plant and apparatus or other equipment as a result of foreign matter of any kind not having been cleared out of pipelines before Taking-Over.

Pipe trenches shall not be backfilled until approved by the Project Manager. Once approved trenches shall be backfilled without delay to at least the minimum extent required for pressure testing.

431 Cutting Pipes

The edges of the cut pipes shall be clean, true and square. Ductile iron pipes shall only be cut with an approved mechanical pipe cutter in conformity with the pipe manufacturer's recommendations. The use of oxyacetylene flame cutter will not be permitted. The edges of the cut together with those parts of the pipes from which the coating has been removed shall be given two coats of bituminous paint and the internal lining repaired. When the cut pipe is to be inserted in a "Tyton" type joint it shall be bevelled for 10mm at 30º to pipe the axis.
Asbestos Cement, HDPE, uPVC and GRP pipes shall be cut with an approved mechanical pipe cutter and in conformity with the pipe manufacturer's recommendations. Where the cut end of the pipe is to be incorporated in a joint the pipe shall be turned down to the correct diameter required for forming the joint by and approved mechanical turning machine. The length of turning shall be accurately bevelled by mechanical means to the dimensions specified in the manufacturer's recommendations.

Steel pipes shall be cut by using a mechanical pipe cutter approved by the Project Manager. The use of an oxyacetylene flame cutter will not be permitted. The edges of the cut shall be given two coatings of liquid epoxy compatible with the original coating. The external coating and the internal lining shall be repaired to the approval of the Project Manager. The cut end shall be bevelled as required to suit the form of joint used.

432 Proprietary Joints and Couplings

Proprietary joints and couplings shall be assembled in accordance with the manufacturer's instruction as approved by the Project Manager. Where pipes are laid above ground and jointed with bolted couplings the joint shall be protected against vandalism by sheathing with an approved heat-shrink moulding as manufactured by Raychem of Swindon UK or similar approved.

433 Flanged Joints

Flanged joints shall be made with two washers per bolt, one under the bolt head and the other under the nut. The tightening of the bolts shall be carried out in the sequence and to the torque recommended by the manufacturer. A torque wrench shall be used.

Buried flange joints shall be protected by painting with approved bitumen paint and by wrapping using 'Denso' paste, mastic tape and outer wrap, or similar approved materials all in accordance with the manufacturer's instructions as approved by the Project Manager, unless supplied with epoxy coating and galvanized bolts.

Flanged adaptors and mechanical couplings shall have a RILSAN nylon coating applied by the manufacturer.

434 Steel Pipelines Welded Joints

If specifically required under the contract pipes shall not be welded. If permitted by the Project Manager for particular conditions the Contractor shall submit to the Project Manager a detailed method statement for constructing the pipeline using welded joints which shall include, but not be limited, to:

(i) details of the Contractor's skilled labour and supervision staff who have direct experience in the construction of welded steel pipe;
(ii) details of the Contractor's plant to be deployed;
(iii) details of temporary staging, access and craneage;
(iv) procedure for construction of supports and anchorages, and welding joints;
(v) quality assurance proposals for testing the integrity of the welds.

These details shall be submitted to the Project Manager for his approval not later than 21 days before the Contractor wishes to commence pipe laying.

All field welds shall be inspected visually with special attention given to the line up and down the root run or stringer beads. Non destructive testing of the completed weld shall be carried our using radiographic methods with procedures in accordance with BS 2910.

On completion and inspection of joint welding, remedial works shall be carried out on the internal lining and external coating. No more than five pipe joints shall be welded without completion of remedial works to joints.

435 Fixing Valves and Penstocks

Valves, penstocks and other fittings shall be securely fixed. Extension spindles and headstocks shall be properly aligned and fixed in a vertical position and valve caps shall be fixed securely using the locking nut.

436 Thrust and Anchor Blocks

Concrete thrust and anchor blocks shall be formed at bends, tees and valves in accordance with the details shown on the Drawings or as directed by the Project Manager. Excavation shall be made after pipelaying and the blocks concreted immediately after excavation. The back supports and blocks shall abut in to solid undisturbed ground with all loose material being removed before concreting.

No pressure shall be applied in any section of main until the concrete has achieved adequate strength and at least three day's curing.

Flexible joints shall not normally be cast in. Where the size of the block does not make this possible, additional flexible joints shall be provided no greater than half a pipe diameter beyond each face of the block.

437 Concrete Surround to Pipes

Where pipelines pass under streams and rivers or where directed by the Project Manager, the pipeline shall be surrounded with concrete as shown on the Drawings.

Concrete surround shall be "broken" at all pipe joints to retain flexibility in the pipeline. No joints shall be concreted in without the prior approval of the Project Manager.

438 Flotation of Pipelines

The Contractor shall ensure that flotation of the pipeline does not occur during construction. Sufficient backfill shall be placed over each pipe after laying and before testing to prevent flotation.

439 Pressure Rating

The pressure rating of pipes shall be as indicated on the drawing or Bill of Quantities or if not indicated then selected such that the maximum pressure in the pipeline inclusive of surge pressures shall not exceed the maximum allowable sustained working pressure rating of the pipe;
The surge pressure amplitude (the difference between maximum and minimum surge pressures) shall not exceed one half of the maximum allowable sustained working pressure rating of the pipe.

440 Testing of Water Supply Pipelines

All pressure pipelines shall be hydrostatically tested. Site test pressures shall be1.5 times the maximum working pressure or allowance pressure plus 5 bar whichever is the smaller measured at the lowest part of the pipeline, unless otherwise specified on the drawings.

The Contractor shall give the Project Manager not less than 48 hours notice of his intention to carry out a pressure test. Testing shall not commence without the Project Manager's approval. Before a length of pipe is tested, each pipe shall be securely anchored. All thrust and anchor blocks shall have been constructed and, the barrel of each pipe shall be backfilled to the extent necessary to prevent flotation or movement of the pipeline and shall be not less than 600mm.

Normally joints shall be left exposed until pressure testing has been satisfactorily completed. Any need to backfill a pipeline before pressure testing shall not relieve the Contractor of his responsibility to excavate to locate and repair

any leaks.

Pressure testing shall be carried out as the work proceeds in such lengths as are convenient but not exceeding 500m. The ends of the length of pipeline under test shall be closed by means of securely anchored caps or blank flanges. Pipeline valves shall not be used for this purpose. All washout valves shall be fitted with blank flanges and the valves opened before the commencement of any pressure test. At each air valve location, a special air release arrangement shall be provided to allow manual release of air during filling operations. Pressure testing shall not be carried out with permanent air valves in place.

The pipeline to be tested shall be filled slowly with water in such a manner that all air is expelled. Air vents shall be checked to ensure that no air is trapped at high points.

The pressure in the pipeline shall slowly be raised to the working pressure, the test pump disconnected and the pipeline left charged under pressure with air valves opened for a period of not less than 24 hours to allow air in the pipeline to be expelled and pipe linings and pipe walls of absorbent materials to become saturated. At the end of this period of time air valves shall be closed and the test pump shall be reconnected and the pressure in the pipeline raised to the test pressure and this pressure maintained for a period of 24 hours or such other period as directed by the Project Manager.

Throughout this period the pressure in the pipeline shall not be allowed to fall or rise more than 6m head of water above the test pressure and this shall be accomplished by pumping water into or releasing water from the pipeline as required. The volume of water pumped into or released from the pipelines shall be carefully measured. At the end of the test period the pressure in the pipeline shall be adjusted to the test pressure by pumping water into or releasing water from the pipeline as required.

The apparent leakage from the pipeline shall be ascertained from the net volume of water that has been pumped into the pipeline during the test period. The permissible loss shall not exceed 2 litres per metre nominal bore per kilometre length per m head per 24 hours.

During the pressure test exposed joints shall be inspected and any leakage or seeping joints shall be remedied. All signs of leakage shall be remedied whether total apparent leakage from the pipeline under test is less than the apparent allowable leakage or not. Should any length of pipeline fail to pass the pressure test the Contractor shall at his own expense carry out all work necessary to locate and remedy the faults and to retest the pipeline until it satisfactorily passes the test.

A low pressure air test (not exceeding 0.3 bar) may be used as a preliminary joint tightness test prior to backfilling and hydrostatic testing. The water used for pressure testing shall be provided by the contractor and shall be free from impurities and of such a quality which will not pollute or injure the pipeline. The Contractor shall be responsible for obtaining the water, transporting it and for its safe disposal on completion.

441 Cleansing and Sterilizing of Pipelines

After the pipelines have been completed and pressure tested satisfactorily as herein specified the Contractor shall flush out and cleanse the pipelines. Where water is provided by the Employer, the cost of this will be reimbursable under a provisional sum.

Diameters 300 mm and greater:

Pipelines shall be cleansed in sections and this shall be carried out by means of passing through polyurethane foam swabs. The swabs shall be to the approval of the Project Manager.

Diameters less than 300 mm:

Pipelines shall be cleansed in sections by flushing with potable water, for a period of time to be decided by the Project Manager's Representative.

Cleansing of any section shall be repeated as required by the Project Manager's Representative in the event of the initial or subsequent operation not being to his satisfaction. The cost of such water shall be charged to the Contractor.

The Contractor shall supply all necessary equipment for the cleansing and sterilizing operations, including all swabs and swab detectors which shall be handed over to the Employer on completion of the Works.

Swabs shall be passed through pipelines at speeds of between 0.2 and 0.4 metres per second to obtain. the best cleaning results with the minimum number of passes. Should it be apparent from the debris collected by the swab that damage to the lining has occurred, the Contractor shall be wholly responsible for repairing the lining to the satisfaction of the Project Manager's Representative.

The swabbing operation shall be controlled by an experienced Project Manager to ensure that no undue surges in the pipeline, heavy docking of the pig or pressurising of the pipeline occur causing damage to any of the permanent works. Any damage caused shall be made good by the Contractor to the satisfaction of the Project Manager's Representative.

The Contractor shall make all necessary arrangements for the transportation of water from the point of supply from the Employer to the required location, and make all arrangements for the disposal of the water. All disposal methods and locations shall be to the approval of the Project Manager's Representative.

When the pipelines have been cleansed to the satisfaction of the Project Manager's Representative the Contractor shall introduce at a slow rate of water flow by a portable chlorinator or other approved means of a solution of sterilizing agent in such quantity and of such strengths as will result in the concentration of chlorine throughout the length of the pipelines of not less than 30 parts per million. This sterilizing charge shall be allowed to remain in the pipelines for 24 hours after which time the pipelines shall be thoroughly flushed using the supply water to remove chlorine in excess of that in the supply water.

When this flushing has been satisfactorily completed samples of water will be taken by the Project Manager's Representative for bacteriological analysis by the Employer. If any of the results of the analyses are unsatisfactory when compared with those of the control sample of the supply water the sterilizing process shall be repeated until satisfactory results are obtained. On completion of sterilizing and flushing the pipelines shall be left full of supply water.

The Contractor shall be solely responsible for the provision of all labour, materials and chemicals necessary for carrying out the foregoing operations.

The cost of water used for repeated cleansing, sterilizing and flushing pipelines in accordance with this clause of the Specification will be charged to the Contractor and the Contractor shall be responsible for all temporary works and other arrangements in connection with cleansing, sterilizing and flushing the pipelines.

The costs of the initial sampling analyses and preparing reports on the bacteriological quality of the water shall be borne by the Employer but the costs of any subsequent sampling analyses and preparing reports should the initial reports be unsatisfactory shall be borne by the Contractor.

442 Painting

All steel or ductile iron pipes and fittings exposed to view including above ground pipelines shall be painted after making good the external protection with two coats of “Bitumastic Aluminium solution D. 5909” manufactured by Wailes Dove Bitumastic Ltd, Hebburn, Durham, England, or similar approved.

Pipes and fittings in chambers shall be painted with two coats of “Bituros Solution” manufactured by Wailes Dove

Bitumastic Ltd, or similar approved. Valves and Surface Boxes shall be similarly painted.

443 Connections to and Diversions to Existing Pipework

443.1 General

The Contractor shall be responsible for connecting new pipework and service connections laid under the Contract to existing pipework, and for blanking-off existing pipework and service connections. The connection shall be made in a manner to minimize any disruption to supply.

Before blanking-off or making a connection to existing pipework the Contractor shall notify the Project Manager in writing no less than 14 days in advance of the date on which he proposes to carry out the work. After giving such notice the Contractor shall obtain from the responsible Authority agreement on the precise date, times and method that the connection will be made. The connection or blanking-off shall be made at such times of the day or night as stipulated by the Project Manager.

The Contractor shall prepare a detailed method statement, programme of the work and a schedule of all plant and materials to be used and shall obtain the approval of the Project Manager not less than 72 hours before commencement of the work. The programme shall allow for the immediate re-commissioning on completion of the work.

The Contactor shall be responsible for locating the exact line and level of the existing pipework and service connections and shall agree with the Project Manager and the responsible Authority the precise location of the connection or blanking-off.

443.2 Materials

Before commencing the connection the Contractor shall excavate trial pits as necessary and shall check the outside diameter of the existing pipework and ensure that the couplings to be used for making connections to the existing pipework and the materials used for blanking-off existing pipework are dimensionally suitable.

The Contractor shall ensure that all the materials are on site not less than 24 hours before the commencement of the work.

443.3 Personnel

The Contractor shall ensure that at least one senior member of his field supervisory staff, who is experienced in such operations and fluent in both English and the language of his labourers is on site throughout the duration of the work.

The Contractor shall also ensure that all necessary skilled artisans and an adequate number of labourers for the operation are on site throughout the work.

443.4 Preliminary Work

The Contractor shall execute all works possible before disconnection of the supply including:-

a. Excavation and supports to the excavation.
b. Blinding with concrete the immediate working areas, but not less than the whole of the bottom of the excavation.
c. Putting in all drains, or where this is not possible a sump of adequate size from which a pump may operate.
d. Casting the floor of any chamber which is later to be constructed around any of the works.
e. Casting the thrust blocks or any other works which may be required.
f. Exposing and cleaning pipes in readiness for the work.

443.5 Carrying out the Work

The Contractor shall be responsible for emptying the section of existing pipework on which the work is to be carried

out, by a method agreed with the Authority and approved by the Project Manager.

The Contractor shall take all precautions necessary to prevent dirt and other foreign matter entering the pipelines.

The Contractor shall provide at the Site a sufficient quantity of clean water containing approximately 10 parts per million (10mg/l) of chlorine before proceeding with the cutting of the existing pipeline. Each item of pipework including the joints shall be submerged in the solution for a minimum period of 15 minutes immediately prior to installation.

443.6 Water Pipes and Chambers to be abandoned

Where existing water pipes are to be replaced with new pipework the existing pipework is to be abandoned. Where new works conflict with existing pipework to be abandoned, abandonment of pipework shall consist of removal and disposal to a site approved by the Project Manager. Water supply pipework shall not be abandoned until suitable alternative means of supply are in place and ready for connection.

Where chambers are to be abandoned these shall be broken down and disposed of and the void filled and compacted with suitable material approved by the Project Manager. Chambers deeper than 1 metre will be broken down to 1 metre below finished ground level and the remaining void filled and compacted with suitable material approved by the Project Manager.

Section 4C. Drains, Sewers and Manholes

444. Excavation for Drains, Sewers and Manholes

The ground shall be excavated to the lines and depths shown on the drawings or to such other lines and depths as the Project Manager may direct. Trenches shall be of sufficient width to enable the pipes to be properly laid and jointed. In case of pipes of greater diameter than 300mm, the width of trench shall be external diameter of pipe, plus 400mm.

When any excavation has been taken out and trimmed to the levels and dimensions shown on the drawings or as directed by the Project Manager, the Project Manager shall be informed accordingly so that he may inspect the completed trench and no excavation shall be filled in or covered with concrete until it has been so inspected and the Contractor has been authorised to proceed with the work. All surplus materials from such excavations not required for refilling shall be carted away to tips, or otherwise disposed of, as directed.

All excavations shall be kept dry, and all bailing and pumping, timbering, shoring and supporting of sides that may be required, and any refilling, ramming and disposal of surplus materials necessary in carrying out the excavations and backfilling of trenches shall be taken to provide a solid and even bed for barrels of the pipes and, where a concrete bed is not specified, the floor of the trench shall be properly shaped to receive the sockets and the backfill must be thoroughly rammed along the sides of the pipe.

445. Supports for Pits, Trenches and Other Excavations

The sides of pits, trenches and other excavations shall, where necessary, be adequately supported to the satisfaction of the Project Manager, and all such excavations shall be of sizes sufficient to enable the pipes and bedding to be laid accurately, and proper refilling and compacting to be carried out.

The Contractor shall take all precautions necessary for the safety of adjoining structures and building by shoring, opening in short lengths or otherwise, during the time the trenches are open.

446. Rock Cutting in Trenches for Pipes

Where solid rock is met within trenches, it shall be cut out to a depth of 100mm below the intended level of the bottom of the pipes, and replaced with 100mm of approved material as specified. In measuring such rock excavation the Contractor will be allowed a width of 400mm more than the external diameter of the pipes to a level of 100mm below the bottom of the pipes. The Contractor shall dispose of all surplus material arising from rock excavation in a manner to the approval of the Project Manager.

447. Water in Trenches for Pipelines

Trenches shall be kept free from water at all times during construction of works until, in the opinion of the Project Manager, any concrete or other works therein are sufficiently set, and the Contractor shall construct any sumps or temporary drains that the Project Manager may deem necessary.

The Contractor shall be responsible for the removal and disposal of all water entering the excavations from whatever source and shall deal with and dispose of such water in a manner approved by the Project Manager so as to ensure that excavations are kept dry while ensuring that the disposal of this water does not cause a nuisance to adjacent plot holders or works. The Contractor shall provide all plant, labour and materials required for such work.

448. Laying and Jointing Rigid Jointed Concrete Pipes

Concrete pipes shall be laid true to line and level, each pipe being separately boned between sight rails.

For spigot and socket joints, the spigot of each pipe shall be placed home in the socket of the one previously laid, and the pipe then adjusted and fixed in its correct position with the spigot of the pipe accurately centred in the

socket. A ring of tarred rope yarn shall next be inserted in the socket of each pipe previously laid and driven home with a wooden caulking tool and wooden mallet, such yarn when in position shall be 25mm in depth. The socket shall then be completely filled with cement mortar 1 to 2 and a fillet of the same worked all round the side. The fillet shall be levelled off and extend for a length of not less than 50mm from the face of the socket.

For 'Ogee' jointed pipes, the joints shall be thoroughly cleaned before laying, and cement mortar, shall be applied evenly to the ends for jointing so as to completely fill the joint. The pipes shall then be neatly pointed with a band of cement mortar approximately 125mm wide and 20mm thick. The inside of each joint shall also be pointed up as the work proceeds.

Special care shall be taken to see that any excess of cement mortar etc. is neatly cleaned off while each joint is being made and any earth, cement or other material cleaned out of the pipes by drawing a tight-fitting wad through them as the work proceeds, or by other approved means. A properly fitting plug shall be well secured at the end of the last laid pipe and shall be removed only when pipe laying is proceeding. The trenches, pipes and joint holes shall be kept free from water until the joints are thoroughly set.

Where shown on the drawings or directed by the Project Manager, concrete pipes shall be bedded and haunched or surrounded with concrete.

449. Pipes Laid with Open Joints

O.G. porous concrete pipes shall be laid unjointed with a space of 12mm between the spigot and the inner end of the socket.

All pipes shall be packed and surrounded as directed by the Project Manager with approved broken stone, sand or gravel aggregate, to the gradings as shown on the drawings or stated in the Bill of Quantities.

450. Drains to be Left Clean on Completion

On completion, all drains, manholes, etc. shall be flushed from end to end with water from an approved source and left clean and free from obstructions.

451. Refilling Trenches

Trenches shall be refilled with suitable excavated material of 100mm surround but not before the work has been measured and approved by the Project Manager. For pipes which are not surrounded with concrete, the first layer of filling material shall be free from stones and shall not be thrown directly on to the pipes, but shall be placed and packed with care all round them. All filling shall be deposited and compacted in layers, not exceeding 225mm loose depth, to a dry density not less than that of the adjoining soil. The last 450mm of filling must be returned in the order in which it has been removed. Timber and framing shall be withdrawn ahead of the layer to be compacted, care being taken to keep the sides of the trenches solid and to fill all the spaces left by the withdrawn timber.

452. Connections of Existing Sewers and Drains

Where shown on the drawings, existing sewers and drains shall be properly extended, connected and jointed to new sewers, culverts, drains or channels. All such connections shall be made during the construction of the main sewer, drain or other work and a record of their positions kept for future use or reference. Where pipe connections are made to a sewer, stone pitched or lined channel, the pipes shall be well and tightly built into the concrete, or masonry work and be so placed as to discharge in the direction of the main sewer, drain or channel and with the end of the pipe carefully cut to the necessary angle. Where the connections are between pipe sewers or drains, special connecting pipes as shown on the drawings shall be supplied and be truly laid and properly jointed.

453. Manholes and Inspection Chambers

Manholes and inspection chambers shall be constructed in accordance with the drawings and in the position shown on the drawings or directed by the Project Manager. The side walls shall be fair faced or rendered internally as specified on drawings. They shall be brought up vertically to receive a precast slab formed of concrete of the appropriate classes specified and reinforced all as shown on the drawings. Cast iron manhole covers and frames shall be provided and frames shall be bedded in cement mortar 1 to 3 and so set that the tops of the covers shall be flush at all points with surrounding surface of the footway, verge or carriageway, as the case may be. Any slight adjustment of the slab level which may be necessary to accomplish this shall be effected by topping the side walls with concrete integral with the slab.

If required, half channel pipes, bends and junctions as specified shall be laid and bedded in cement mortar 1 to 3 to the required lines and levels, and both sides of the channel pipes shall be benched up with concrete of the appropriate class and finished smooth to the slopes and levels as shown on the drawings or directed by the Project Manager. The ends of all pipes shall be neatly built in and finished flush with cement mortar 1 to 3. Where the depth of the invert exceeds 1 metre below the finished surface of the carriageway or the adjacent ground, iron steps shall be built in with alternate steps in line vertically and with such additional hand irons as the Project Manager may direct.

All manholes when completed shall be watertight and to the satisfaction of the Project Manager. The prices inserted in the Bill of Quantities shall include for excavation, provision of all materials, construction, refilling and disposal of surplus.

454. Precast Concrete Manholes

Precast concrete manholes shall be supplied and laid generally in accordance with the drawings.

455. Gully Connections

Connections from gullies to sewers and surface water drains or ditches shall consist of concrete pipes and fittings jointed with cement mortar 1 to 3. All pipes, bends and junctions shall be laid to the lines and levels shown on the drawings or as directed by the Project Manager.

456. Surface Boxes, Covers Etc.

Surface boxes, manholes and other covers lying within the site of the works, shall be raised, lowered, altered or removed as directed by the Project Manager.

457. Gullies

Gullies complete with gratings and with rodding eyes where necessary shall be supplied and laid in accordance with the drawings. Where directed by the Project Manager, precast concrete gullies shall be laid on and surrounded with 100mm of concrete of the appropriate grade. The concrete surround is to be brought up to the underside of the frame or flush with the top surface as the case may be. Masonry gullies shall be constructed from 225mm building stone and rendered internally. Gullies shall be trapped where leading into foul sewers or into combined foul and surface water sewers.

458. Completion of Drainage Works

All sub-soil and surface water drains shall be completed in advance of the construction.

459. Temporary Stoppers

Junction pipes which are laid but not immediately connected to gullies shall be fitted with temporary stoppers or seals, and the position of all such junctions shall be clearly defined by means of stakes or training wires properly marked and labelled.

460. Provision for Future Connection to Manholes

Inlet pipes of the required diameters shall be built into the walls of manholes and elsewhere for future use and shall be of the diameters shown on the drawings. The external ends of all such connections shall be sealed off with temporary stoppers, approved by the Project Manager. The pipes shall be laid and jointed and during the placing of the concrete they shall be adequately supported.

461. Surrounding or Haunching of Pipes with Concrete

Surrounding or haunching of pipes shall be carried out using fine concrete. In carrying out this work the Contractor shall take care to pack the concrete under and around the pipes to ensure even bedding and solidity in the concrete and the concrete shall not be thrown directly on to the pipes. The upper surface of the concrete shall be struck off with a wooden screed or template and neatly finished off.

462. Invert Block and Stone-Pitched Drains

Precast concrete invert blocks and side slabs shall be formed of concrete of the appropriate grade and dimensions shown on the drawings. Each course of side slabs required in the Bill of Quantities shall be interpreted as one complete row of side slabs to one side of the channel concerned. Stone used for channels shall be 225mm x 100mm building stone. Drains should not normally be laid to a radius of curvature less than 10 times the actual width of the drain.

Invert block and stone-pitched drains shall be constructed in the positions and to the levels and dimensions shown on the drawings and laid to true line and even fall. Where under-filling is required it shall be in 100mm maximum thickness layers of compacted murram. The earth sides to such channels shall be neatly finished to a slope of 1 to 1 or such other slope as the Project Manager may direct.

Invert blocks and side slabs shall be laid on a 100mm minimum thickness of compacted murram and be neatly jointed with cement mortar 1 to 3 as the work proceeds. The excavation, murram bedding, providing, laying and jointing invert blocks or stone, backfilling and disposal of surplus shall all be as specified and all in-situ connections shall be in concrete of the appropriate grade.

463. Testing of Jointed Pipes and Manholes

Sealed jointed drains, up to and including 600mm diameter shall be tested in sections (e.g. between manholes) by filling with water under a head of not less than 1 metre. Drains found to be water-tight after a period of 30 minutes will be passed as satisfactory but the water must be retained in the pipes until a depth of at least 450mm of filling has been deposited and compacted on top thereof. Drains failing to stand the test shall be taken out and the pipes re-laid and re-jointed until completely water-tight.

Drains exceeding 600mm in diameter shall be tested by means of a smoke test before they are covered up. Both ends of the lengths of drain to be tested shall be sealed to the satisfaction of the Project Manager, and smoke shall then be pumped into the section from an approved machine. Should any joint in the section show an escape of smoke, the section shall be taken out and the pipes re-laid and re-jointed until there is no further escape of smoke.

Should the Project Manager so direct, manholes shall be tested by completely filling with water, and there shall be no appreciable loss over a period of 2 hours.

On completion of the works, or at suitable intervals during construction, infiltration tests will be carried out. The permissible amount of infiltration shall be 1 litre per hour per linear metre of nominal internal diameter.

The Contractor shall provide all labour and apparatus for the above tests.

All testing will be done in accordance with the procedure of the British Standard Code.

464. Pipes with Rubber Ring Joints

Rubber rings shall be entirely suitable for the pipe being used and will be provided by the Contractor. They will be laid in the socket and the pipes then jointed as specified. The jointing of pipes shall be carried out in accordance with manufacturer's instructions and in conformity with any modifications proposed by the Project Manager.

465 Laying, Jointing and Backfilling for Flexible Jointed Pipes

The Contractor shall ensure that any hard spots and loose stones are removed from the formation prior to laying of bedding materials. The Contractor shall lay a bed of thickness 100mm consisting of granular material i.e. sand, gravel, or approved soil of friable nature.

After laying of pipes the Contractor shall lay bedding material on the sides of the pipe compacted by tamping into soffit of sewer.

After completion of this operation the Contractor shall lay the bedding material on top of the pipe in 150mm layers to a thickness of 300mm. The material is to be compacted by tamping. However, precautions are to be taken to avoid excessive tamping on top of the pipe. The remaining trench excavation is to be backfilled.

The pipes shall be laid with flexible ring seal joints provided that solvent cement joints could be used for fittings where necessary subject to the approval of the Project Manager. Pipes and fittings shall be checked for deformities prior to laying. Deformed pipes and fittings shall not be accepted.

Flexible Rubber Ring Joints

The Contractor shall ensure that the spigot end is free from grit, dust or dirt and sealing rings should be seated evenly in the socket grove. Pipe lengths and fittings are supplied with a chamfer on the spigot. Where pipes are to be cut or are supplied without a chamfer on the spigot end the Contractor shall ensure that the pipe is cut square and then form a chamfer on the spigot end with a medium file to an angle of 15 degrees. Remove saw flashing by scraping with a pen-knife.

Expansion Gap

It is necessary to leave a gap between the edge of the spigot end and the base of the socket to allow for expansion. Moulded fittings are supplied with an embossed line indicating the correct depth of insertion. In other cases where the marking is not done, the Contractor shall ensure that an expansion gap of at least 3mm per metre length of pipe or at least 15mm per pipe length is provided. This can be done by marking spigot ends or by pushing spigot fully home, making a small mark on pipe and then withdrawing the pipe by 15mm.

After completing jointing the pipe shall be laid on the prepared bed making sure that a suitable depression is created in the bed for the socket.

Solvent Cement Joints

For solvent cement joints make sure that mating surfaces are clean and free of grease and dirt. Roughen mating surface with sandpaper, clean both surfaces with cleansing fluid using a clean cloth. Apply solvent cement on both mating surfaces. Without delay bring mating surfaces together and hold in position firmly for a few seconds. A layer of cement should be visible at the edges. Joints should not be disturbed for at least 10 minutes after assembly.

Section 5. Building and Structures

501 Concrete Building Blocks

Concrete building blocks shall be of approved manufacture and shall be formed in a press. The blocks manufactured in Class C30 concrete shall be cured for at least 10 days before use.
Blocks shall be well and evenly formed with true corners and unbroken arises, and shall be carefully handled and stacked.

502 Laying Building Blocks

Joints between blocks shall be filled solid with mortar and shall be of regular thickness of 5 to 10mm. The blocks shall be laid in level courses and bonded so that each vertical joint is midway above the face of the block below, except at junctions and piers where a bond of not less than 100mm shall be provided. The walls shall be raised in lifts not exceeding three metres in height in any one day, and truly vertical. All blocks shall be wetted before being laid.

Joints of exposed work shall be raked out and neatly flush-pointed in the same mortar. The whole of the visible faces of the walls shall be left perfectly cleans and all surface mortar and droppings shall be removed before they have set.
Joints in work to be rendered shall be raked out to a depth of 8mm to provide a key for the rendering.

Blockwork shall be tied into adjoining structural members at the same level as blockwork reinforcement using 150mm long butterfly tangs or equivalent fixed and mortared into proprietary vertical strips.

503 Precast Concrete Units Generally

All precast concrete units shall include all fixing plugs and strips to enable screw ties or other fixing devices to be firmly attached. For all precast units to be set in block of masonry walls the plugs and strips shall be so positioned as to provide fixing at course and in no case exceeding 450mm centres.

504 Masonry Using Natural Irregular Stones

Stones shall come from selected quarry layers to the approval of the Project Manager. They shall be homogeneous, frost resistant, flawless, free of any cracks or bousins, solid, and of equal grain and shall have all the required quantities to give a regular facing. They shall give out a clear sound when hit by a hammer.
Mortar shall be removed from the external surface of the wall. The Contractor shall prepare a wall sample approved by the Project Manager which shall be kept at the construction site until all the masonry is completed.

505 Screen Walling

Screen walling shall consist of perorated precast concrete blocks 100mm thick of approved shape, design and manufacture laid to an approved pattern in cement mortar wit perfectly even joints which shall be neatly flush or recess pointed as directed.

506 Damp-Proof Course

All external walls of buildings are to be provided with damp-proof course (DPC) of textured PVC strip of width equal to the total thickness of the wall and any external rendering. The DPC is to be lapped with the damp-proof membrane and bedded in mortar specified for the type of block used. The greatest lengths possible are to be used for the DPC's but any end laps required are to be at least 200mm long made dry without intervening mortar. Piers are to have complete DPC's lapped with the wall DPC.

507 Damp-Proof Membrane

Damp-proof membranes shall be laid, as directed by the Project Manager, beneath all floor slabs resting on the ground. They shall be composed of single sheets of minimum thickness 0.300mm black polyethylene film of an

approved manufacturer specially made for use as damp-proof membrane.

The film shall be laid on sand and turned up around all edges of the slab and with 150 mm margin above the top of the slab to be tucked into the perimeter walls of the building. Where the building is so large as to exceed the maximum sheet size available, several sheets shall be used and the joints shall be lapped 150mm and fused together using a welding tool designed for that purpose. Every care should be taken by the following trades to prevent perforation of the membrane but in the event of the puncture the perforation shall be covered by a patch of similar material of dimensions exceeding the area of the puncture by 300mm and the two sheets welded together as described above.

508 Composition of Mortars

a. Cement mortar for bonding concrete shall be composed of cement and sand mixed in the proportion of the jointed concrete.

b. Cement mortar for setting precast concrete or pitching shall be composed of cement and sand mixed in the proportion of 50kg of cement to 0.14m3 of sand, with the addition of an approved plasticizer.

c. Cement mortar for blockwork in concrete blocks shall be composed of cement and sand mixed in the proportion of 50kg of cement to 0.14m3 of sand.

d. Sand and Cement for mortars shall be as described in the specification for concrete.

509 Mixing of Mortars

The materials of mortars shall be measured out in their correct proportions and shall first be thoroughly mixed together in a dry state by turning them over upon a clean wooden stage until they are of a homogeneous appearance in consistency and colour. Clean water shall then be added while the mixture is being turned over until it attains a suitable consistency. Plasticizer shall be added in accordance with the manufacturer's recommendations as approved by the Project Manager.

The mortar shall be used immediately after it has been mixed. No mortar which has commenced its first set shall be used, or mixed up again. Mortar shall, where possible in hot weather, be protected from too rapid action by covering with impervious material such as polyethylene film.

Mixing by hand will be allowed only if the Project Manager gives specific approval. Mixing by machine using the same sequence of operations described above shall be carried out whenever possible.

510 Cement Rendering

Rendering shall be in a 50 kg to 125kg cement: sand mix but where approval had been given to the use of a plasticizer or other additives these proportions may be modified to the approval of the Project Manager.

All surfaces to receive a finishing coat of cement rendering or fine concrete shall be thoroughly prepared and cleaned and the rendering or screeding shall be placed immediately after such surfaces have been thoroughly wetted.

All rendering shall be put to a minimum of two coats, the first being left rough to a minimum of 10 mm thickness, but the second coat shall be trowelled up to a fair faces as soon as possible after it is applied.

All internal rendering shall be finished to an even and polished surface with a float, trowel or other suitable tool, special care being taken to obtain perfectly smooth and glazed faces. It shall not be less than 15mm thickness when finished unless instructed otherwise.

All external rendering shall be brought to an even surface with a wood float following which a tyrolean finish of

approved colour shall be applied unless otherwise stated.

All rendering shall be protected from sun and rain by adequate and suitable coverings which shall be supplied and fixed in advance of these conditions arising. The renderings shall be kept damp while setting and protected from drying winds.

511 Tanking to Buried Concrete Surfaces

External concrete surfaces to be tanked shall be coated with a bituminous waterproofing membrane 3mm minimum thick. The tanking shall be dressed into structure as shown in the Drawings and be protected by non-rotting boarding prior to backfilling.

512 Waterproof Rendering

Waterproof rendering slurry shall comprise a 50kg to 125kg cement sand mix with an approved waterproofing admixture such as styrene arcrylate copolymer.

The material shall block capillaries and minor shrinkage cracks to prevent water ingress while allowing the passage of water vapour through the structure.

The render shall be applied to a total thickness of not less than 20mm the first coat shall be applied levelled scratched and left to dry for not less than 3 days.

513 Grouting in Ironwork

All brackets, rag-bolts and other ironwork for which holes have been boxed out or left in the concrete of a structure shall be carefully grouted in to their correct positions in all particulars. The grouting in shall be carried out with cement and sand grout in such a manner that there shall be no apparent difference in the texture or colour throughout the face of the finished structure and that there shall be no seepage of water either between the ironwork and the set grout or between the set grout and the surrounding structure.

The above instructions shall apply also to the building-in of pipes except that Class C25/10 concrete shall be used in lieu of cement grout.

All holes left for building-in shall be free from any sign of infiltration of water before the building-in is carried out. No reliance shall be placed upon the building-in process for the sealing of such leakage.

514 Cable Duct Covers and Frames

514.1 Recessed Covers

Cable duct covers recessed for flooring finishes shall be provided with galvanized rolled steel angles of height equal to the thickness of the floor finishing and fixed to the surface of the structural floor slab along all edges of the trenches so that the top edge is level with the finished floor level. The angle shall be laid so as to form seating for duct covers and all additional galvanized rolled steel tee sections shall also be provided to support the duct covers.

The duct covers shall be galvanized to suit the ducts and the seating described above. A lightweight galvanized steel mesh shall be fixed to the upper surface of the trays to provide a key for floor finishes. The seating and trays shall be so laid that the finished floor is perfectly level and all trays fully supported at all edges without the use of loose packing. At least one tray in every series of trays covering a length of duct shall be provided with cast-in lifting eyes and a pair of suitable lifting keys shall be handed to the Project Manager on completion.

514.2 Checker Plate Covers

Checker plate covers shall be hot dipped galvanized mild steel fitted flush with the floor surface and fully supported.

515 Fences and Gates

Fences generally shall be in accordance with the relevant parts of BS 1722 Part 1: 1986. Chain link fencing shall be Type PL.213 Grade A with 1.8 m high plastic covered chain link mesh. The mesh and line wires shall be galvanized prior to being plastic covered. The posts shall be reinforced concrete.

The straining posts, intermediate posts and struts shall be manufactured and erected complete as specified in BS 1722. The fencing shall be true to line and vertical, following profile of the ground, previously graded so as to prevent access beneath the bottom wire. Gates shall be hung on adequate post, and shall be truly vertical.

Ornamental fabricated metalwork fences and gates shall be constructed of mild steel bar, strip or tube in accordance with the Drawings. All welded joints and drillings for bolts shall be made before painting, and all bolts, nuts and washers shall be galvanized or plated in an approved manner. Any metalwork sunk into the ground shall be treated with two coats of bituminous paint.

516 Joint Sealing Compound and Sealants

Joint sealing compounds shall be impermeable ductile materials of a type suitable for the conditions of exposure in which they are to be placed, and capable of providing durable, flexible and watertight seal by adhesion to the concrete throughout the range of joint movement.

Hot poured joint sealants shall comply with BS 2499, Ordinary Type A1 sealant.
Cold poured polymer-based joint sealants shall comply with BS 5212: Part 1, Normal Type N sealant.

Two part polysulphide based sealants shall comply with the relevant provisions of BS 4254. Pouring Grade shall be applied to horizontal upward facing joints and Gun Grade to joints of any other aspect or inclination. Other two part polymer based sealants of Gun or Trowel Grade shall comply with the physical and test requirements of BS 4254.

Silicon bases building sealants shall comply with the relevant provisions of BS 5889. Primers for use with joint sealants shall be compatible with, and obtained from the same manufacturers as, the adjacent sealant. Primers shall have no harmful effects on the concrete.

Sealants and primers which will be in contact with water to be used for potable supply shall not impart to water taste, colour, or any effect known to be harmful to health, and shall be resistant to bacterial growth. Sealants and primers which will be in contact with sewage or sewage sludge shall be resistant to biodegradation.

517 Openings in Walls, Floors and Ceilings

The Contractor shall chase put and/or cut openings through walls, floors and ceilings for the passage of pipes and cables where described in the contract shall provide and fix in position approved tube sleeve cut off flush with the finished surface. All openings and ducts shall be sealed on completion to prevent the passage of toxic or explosive gases.

518 Structural Steelwork

Material for structural steel work shall comply with BS EN 10137 and workmanship with BS 5950. The steelwork shall be securely fixed to the foundations or building and designed to have such strength and stiffness that its deflection and movement under the loads to be applied shall be within tolerable limits.

All bolts and nuts shall comply with the requirements of BS 3693 except for High Strength Friction Grip Bolts which shall comply with BS 4395.

Mild steel electrode shall comply with the requirements of BS EN 499 and High Yield Steel with BS 2540.

All structural steel fabrication shall conform to the requirements of BS EN 5400. The use of High Strength Friction Grip Bolts shall be in accordance with BS withdrawn.

All structural steel work shall be fabricated using welded joints where possible for shop joints and bolted joints for field assemble.

519 Open Mesh Walkways and Covers

Open mesh type walkways, platforms and covers shall be of aluminium or galvanized steel, suitable for a superimposed load of not less than 6kN/m2. The walkways, platforms and covers shall include all necessary supports not detailed on the Drawings.

Open mesh panels shall be trimmed with full depth nosing bar along all edges and bolted to each other when in place to help ensure a firm walkway. Panels shall be cut in such a way and fixing so as to provide a continuity of pattern.

Covers shall incorporate a hinged lockable open mesh access panel with a 750 x 750mm clear opening, strong durable hinges and heavy duty non-corrodible padlock. Openings for valve keys shall be just sufficient in size for the valve key and shall incorporate a cover hinged only.

All panels shall be securely bolted to the supporting structure. Where the supporting structure is concrete, galvanized mild steel angle curbs shall be provided and securely grouted into rebates left in the concrete such that the tops of the panels are flush with the top of the concrete.

520 Handrailing

Hand railing shall be approximately 1000mm in height with an intermediate horizontal rail with standards not more than 2000mm apart. Hand railing shall be designed for a horizontal loading of not less than 220N/mm. Hoops shall be welded on where required for fixing guard chains. Standards and rails shall be manufactured from black mild steel tube to BS 1387:1985, from steel tubing to BS 1775 or from extruded aluminium alloy approved by the Project Manager. The nominal bore of steel tubing shall be not less than 32mm. Adequate provision shall be made for thermal movement. Steel hand railing shall be hot dipped galvanized after fabrication.

521 Guardrail

Guardrails shall be 750mm in height with a single top rail. In all other respects it shall comply with the specification for hand railing.

522 Chains

Chains across openings in handrails at tops of ladders shall be galvanized mild steel having 3 SWG x 3 links per 100mm and shall be supplied complete with ‘S’ hooks and split rings.

523 Steel Access Covers

Steel access covers shall be to the duty required and sized to suit the opening shown on the Drawings. They shall be complete with frame and shall be weatherproof (prevent ingress of water) when closed and shall in all respects be strong and durable.

The covers shall be hinged and lockable and provided with stays to prevent the covers opening more than 105º. The Contractor shall provide with each cover a heavy duty non-corrodible padlock and four keys. The covers and frames shall be galvanized.

524 Isolation of Aluminum

All items of aluminium construction shall be isolated from concrete by the use of bituminous felt or DPC material or two coats of bituminous paint. The aluminium shall be isolated from dissimilar metal by the use of fibre washers and spacers.

525 Galvanising

Where galvanizing has been specified the items shall after fabrication be hot dipped galvanized in accordance with BS 6530 Part 1 to a thickness of 0.15mm (005'). All items to be protected shall be prepared as specified in the above standards. Articles altered at the manufacturer's works in any way after galvanizing are to be re-galvanized as specified. Articles subject to minor alternations at site or requiring minor repair at site shall be wired brushed to remove all rust and coated with 3 coats of approved zinc rich cold galvanizing compound.

526 Fixings to Structure, etc.

Where fixings to structures previously constructed are to be made by setting a bolt system into performed holes, such fixings shall be made either by Rawlbolt Projecting Bolt Type or by using an approved proprietary resin anchor system. Where performed holes have not been provided a self-drilling expanding bolt system shall be used.

Where thin sections are involved or where stresses are likely to be set up which might cause damage to the structure the use of the resin anchor system only will be permitted. Only in special circumstances will the Project Manager or the Project Manager's Representative permit rawlbolts to be uses. Performed holes shall be accurately set to template prior to placing the surrounding concrete and shall be kept rigidly in place until the concrete has properly set.

Where resin anchorage is used the Contactor shall ensure that the setting time of the resin is appropriate to the requirements for setting up, plumbing and aligning the work before is sets. Bolts shall be set to template and hole diameters shall conform to the recommendation of the suppliers. Whatever system is used, all bolts shall be plated to resist corrosion.

Section 6. Roads and Surfacing

601 Access Tracks

Permanent access tracks shall be constructed only where shown on the Drawings. Tracks shall be unsurfaced. Filling to bring formation to the required level shall be locally excavated material which shall be placed in layers and compacted by tracking with the excavation plant. The road formation shall be tracked and graded with a dozer blade or bucket to give a cross fall of not less than 1 in 40. Surface undulations shall not exceed 200mm over a length of 3.0m, unless otherwise approved by the Project Manager.

The maximum gradient shall not exceed one vertical to 6 horizontal and the minimum tuning circle radius measured to track centre line shall not be less than 15.0m.

602 Access Roads

The road formation shall be the surface obtained after completion of any earthworks. Filling to bring the formation to the required level shall be selected material. It shall be laid and compacted in layers not exceeding 150mm in thickness, the compaction being carried out by a roller of not less than 8 tonne weight.

The Employer and the Contractor may at any time after the completion of the access road (after 14 days in the case of concrete surfaces) use them or allow their use by their employees or sub-contractors.

At such times during the Period of the contract of Period of Maintenance as the Project Manager may direct, the Contractor shall at his own expense make good any deterioration which may have occurred in the condition of the roads, whether as result of the use of roads by the Employer or otherwise. In particular, any parts of the foundations into which soil has penetrated shall be dug out and replaced with clean materials.

602.1 Macadam Roads and Macadam Hardstandings

(i) The sub-base shall consist of 150mm compacted thickness of free draining granular material conforming to the grading limits specified in the contract. The plasticity index shall be 0-6% maximum and the California Bearing Ratio at maximum density (Test 12, BS 1377:1990) shall be 25% minimum. The material shall be compacted to 95% of the maximum density as determined by Test No. 13, BS 1377:1990 (heavy compaction) by means of a roller of not less than 8 tonnes weight.

If the quality of foundation soil is considered inadequate, the Project Manager may direct that the sub-base be 300mm thick, in which case construction shall be carried out as described above but as two 150mm thick layers.

The road base shall consist of 150mm compacted thickness of free draining crushed limestone conforming to the grading limits stated in the Contract. The plasticity index shall be 0-6% maximum and the California Bearing Ratio at maximum density (Test 13, BS 1377:1990) shall be 80% minimum.
The base shall have a prime coat applied not more than seven days after the completion of the base and not later than twenty four hours after approval by the Project Manager. The asphalt used for the prime coat shall generally conform to the relevant AASHTO specification.
Before laying the tarmacadam base course onto the primed base, all loose blinding material shall be brushed off the road and removed. The tarmacadam base course shall consist of 60mm compacted thickness of 20mm nominal size dense base course macadam. The aggregate and asphalt shall be generally in accordance with the relevant AASHTO specification.

A tack coat shall be applied between successive layers of asphalt material and shall generally conform to the relevant AASHTO specification. Machine laying shall normally be used and compaction shall be carried out with a roller of not less than 12 tonnes weight so as to achieve a dense, smooth and even surface. Where new road construction is to be joined to an existing road, the surface shall be cut back to a straight line and primed.

(ii) Should the Contractor wish to lay Macadam on the roads early in the

Contract for use by the construction traffic, he may do so provided construction is stopped at completion of the Macadam base course and this single layer blinded with bituminous grit to seal the surface.

When all concreting, earth moving and heavy crainage and haulage has been completed, and in general towards the end of the Contract, the base course so provided shall be thoroughly cleaned off and repaired, and re-levelled where necessary, and a suitable cold bituminous emulsion tack coat generously applied by spray in accordance with the manufacturer's instructions, care being taken to avoid spattering kerbs or other adjacent concrete. The wearing course may then be laid and blinded as described in sub-section (i) above. Any additional costs involved in the adoption of the method of laying described in this sub-section shall be included by the Contractor in his rates for road making.

(iii) Notwithstanding the time of placing of the roadworks, the condition of the finished road at the completion of the Contract shall be of 'as new' quality, with clean, accurately profiled, rolled and sealed surface throughout, free from concrete spotting or staining, patch marks, trench outlines, paint, oil or fuel spillages or other visible or structural defects.

602.2 Unsurfaced Roads and Hardstandings

Unsurfaced roads and hardstandings shall be constructed from 300mm of crushed lime stone conforming to the grading limits specified in the Contract, laid in two layers of 150mm.

Each layer shall be compacted to 95% of the maximum density (Test 12, BS 1377:1990).

602.3 Pea Shingle Surfaced Areas

The sub-base to pea shingle areas shall be as defined in 801.1 above. Pea shingle consisting or 20mm thick 5mm nominal single sized stone laid and raked to a level finish.

603 Precast Concrete Kerbs and Channels

Kerbs shall be laid before the adjacent carriageway is constructed and sufficiently in advance to meet the Project Manager's requirements. Kerbs shall be bedded solidly and accurately in their concrete foundations before the initial set of the concrete has started. Each kerb shall be set solidly and accurately to the required line and level with joint no more than 6 mm wide, neatly pointed with cement mortar and filled for their full depth with cement grout as specified. At every tenth kerb joint, the pointing and grout shall be omitted. A piece of 4mm thick approved jointing material shall be placed in these joints, neatly trimmed to be flush with the face of the kerb. The bedding shall be well haunched up to the back of the kerb, to within 100mm of the top of the kerb. All cutting shall be neatly formed so as to show no damage to the exposed faces and to leave the ends square for the full width of the kerb.

The kerbs and channels shall be 130mm wide by 250mm deep. Kerbs shall be half battered. Kerbs damaged at the exposed faces will not be accepted.

604 Precast Concreting Edging

Edging shall be 50mm x 150mm in size. Edging shall be laid in the same manner as kerning and in short lengths, where required to be circular on the plan.

605 Footpaths and Paving

For surfaced footpaths and similar paved the base material shall be laid on hard fill or selected materials as directed by the Project Manager's Representative and compacted by a roller of 0.75 to 3 tonnes weight. The footpath base shall be formed of crushed rock graded from 50mm to 10mm suitable for the purpose and laid as wet-mix or dry macadam and rolled or compacted to the final form and grading of the final surfacing to a thickness of 100mm.

The base course shall consist of 100 mm compacted thickness of bituminous macadam of 14mm nominal sized material. After laying and rolling the base course, a wearing course shall be laid to provide a final finish. This shall

consist of 15mm compacted thickness of 100mm nominal size bituminous macadam. As soon as possible after laying the wearing course, it shall be blinded with bituminous grit (fine cold asphalt) to weather-seal.
For concrete paving, the precast concrete flags shall be of approved colour and size not less than 30mm thick unless otherwise indicated. They shall be laid and bedded in cement mortar upon a 100mm thick bed of compacted crushed limestone.

The Contractor will be required to lift and relay at his expense flags which have sunk through consolidation of settlement of the ground beneath and the Project Manager's maintenance certificate will not be issued until such work has been completed to his satisfaction.

606 Laying to Grade

All new and reinstated roads, alleyways and hard standings shall be completed in a manner that ensures cross-falls are towards the storm water drainage intakes.

Section 7 Safety, Health and Environment

701 Introduction

The prevention of injury and/or illness to the site personnel and the public, damage to the Works and to public and private property, protection of the environment, and compliance with applicable laws, are primary objectives of the Employer. Because of the importance the Employer places on meeting these objectives, selected minimum requirements are outlined in these Safety, Health and Environmental Specifications with which Contractors shall comply while working on this contract. Given that these Specifications cannot cover every eventuality, the Contractor shall be expected to exercise good judgment in all such matters, even though not mentioned in these Specifications, and shall take any and all additional measures, as required or necessary, to meet his responsibility for safety, health and environmental matters during the period of the Contract.

The Employer nor its representatives shall not be held liable for any actions taken by the Contractor that are attributed to following the minimum requirements stated hereinafter.
The Contractor shall throughout the execution and completion of the Works and the remedying of any defects therein:

(a) have full regard for the safety of all persons on the Site and keep the Site and the Works in an orderly state appropriate to the avoidance of danger to any person;

(b) know and understand all laws governing his activities along with any site requirements and work site hazards. Such information shall be communicated by the Contractor to his personnel and subcontractors;

(c) take all necessary measures to protect his personnel, the Employer's personnel, other persons, the general public and the environment;

(d) avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequent of carrying out the Works.

702 Compliance with Specifications

The Contractor shall comply with the requirements of these Safety, Health and Environmental Specifications and all other applicable regulations or requirements under Kenyan laws, laid down by relevant authorities or issued by the Employer or the Project Manager concerning safety, health and the environment, in force or introduced or issued from time to time during the period of the Contract.

In so far as these Specifications are applicable, they shall apply to sites and personnel outside the Site associated with the performance of the Contract.

The Specifications equally apply to subcontractors and all other parties engaged by the Contractor and their personnel. The Contractor shall ensure all such parties are fully aware of and comply with the Specifications.

The Contractor shall comply with all notifications and written or verbal instruction regarding safety issued pursuant to these Specifications by the Employer, Project Manager or relevant authorities within the time specified in the notification or instruction.

The Contractor shall adopt a positive approach, awareness and responsibility towards safety, health and the environment, and take appropriate action, by:

(a) ensuring the Specifications are enforced and followed by the Contractor's personnel. Any failure by the Contractor's personnel to follow the Specifications shall be regarded as a failure by the Contractor.

(b) paying attention to possible injury to unauthorized persons entering the site, particularly children.

Whenever in these Specifications the Contractor is required to provide test certificates for equipment and personnel and to comply with the relevant authorities' requirements and no independent test facilities are available or no relevant authorities exist in Kenya, the Contractor shall provide:

(a) in lieu of independent test certificates:
- for equipment – details of the tests that have been carried out by the Contractor and a written statement that the Contractor has satisfied himself that the item of equipment is fit and safe for use;
- for personnel – details of the training and experience of the personnel and a written statement that the Contractor has satisfied himself that they have the required level of competency;

(b) in lieu of relevant authorities' requirements – details of the Contractor's own rules, regulations, requirements and procedures regarding safety, health and the environment.

If the Project Manager is dissatisfied with the details provided by the Contractor, the Contractor shall provide further details or carry out further tests or provide further written statements as may be reasonably required by the Project Manager.

When the Project Manager has satisfied himself regarding the Contractor's own rules, regulations, requirements and procedures provided in accordance with (b) above, such rules, etc. shall be deemed to form part of these Specifications and to which Clause 3 shall equally apply.

703 Failure to Comply with Specifications

703.1 General

Should the Contractor fail to comply with any of the Specifications or requirements of the Project Manager:

(a) the Project Manager may suspend the Works of part of the Works until the Contractor has taken the necessary steps, to the satisfaction of the Project Manager, to comply with the Specifications or requirements.

(b) the Employer may, following written notice to the Contractor, carry out themselves or arrange for another contractor to carry out such measures as they may consider appropriate on behalf of the Contractor. Any such actions by the Employer shall not affect or diminish the Contractor's obligations or responsibilities under the Contract.

(c) the Project Manager may, by written notice of suspension to the Contractor, suspend all payment to the Contractor under the Contract if the Contractor fails to rectify any breach of the Specifications within the period specified by the Project Manager, provided that such notice of suspension:

(i) shall specify the nature of the failure or failures; and

(ii) shall request the Contractor to remedy each such failure within a specified period after receipt by the Contractor of such notice of suspension.

Such suspension of payment shall remain in force until such time as the Contractor has rectified the breach or breaches to the satisfaction of the Project Manager. No interest shall be paid on the suspended payments.

Failure to comply with the Specifications or requirements shall be considered a breach of the Contract by the Contractor and may result in termination of the Contract by the Employer. In the event of the Employer taking

action based on this Clause, the Contractor shall not be entitled to any additional costs or extension to the Contract Completion Date. All costs incurred by the Employer pursuant to Sub-Clause 703.1.1 (b) shall be deducted from the amounts otherwise due to the Contractor.

704 General Requirements

704.1 Preamble

All references to safety shall be deemed to include health and the environment.

704.2 Safety Officer

The Contractor shall appoint a competent Safety Officer who shall be responsible for safety, health and the environment. The Safety Officer shall be given sufficient time by the Contractor to carry out his duties; minimum requirements shall be as follows:

Workforce on site of over 250	-	full time Safety Officer;
Workforce on Site of 100 – 250	-	50% of Safety Officer's time;
Workforce on site below 100	-	as required for the Works but a minimum of 5 hours per week of Safety Officer's time where more than 20 workers.

The Contractor shall provide the Safety Officer with appropriate identification, including a white hard hat with red cross symbol and an identification badge. The appointment of the Safety Officer shall be in writing and copied to the Project Manager. The appointment shall include specific instructions to enforce these Specifications and delegated authority to take any action, measure or to issue instruction regarding their enforcement. All persons on Site shall be made aware of the name and authority of the Safety Officer and instructed to comply with any instruction or direction in safety matters, verbal or in writing issued by the Safety Officer.

The Safety Officer shall be provided with a mobile phone or other similar means of communication. The Safety Officer shall be accessible and available at all times including normal working hours.

704.3 Safety Training

The Contractor shall provide safety induction training for all site personnel upon starting on site.

The Contractor shall provide safety refresher/reinforcement training at regular intervals for his staff.

704.4 Safety Meetings

The Contractor shall hold regular safety meetings to provide safety instructions and receive feedback from site personnel on safety, health and environmental matters. A weekly safety Meeting shall be chaired by the Safety Officer and minutes shall be taken of the meeting. The meeting/minutes shall be given to the Project Manager. The Safety Officer should attend the Contractor's weekly site meetings and "Safety" shall be an item on the agenda.

704.5 Safety Inspections

The Safety Officer shall make regular safety inspection of the work site. The Safety Officer shall prepare a report of each inspection. This report shall include details of all breaches of these Specifications and any other matters or situations relating to safety found during the inspection, instructions issued by the Safety Offices and actions taken by the Contractor. A copy of the Safety Officer's reports shall be given to the Project Manager.

704.6 Control of Substances Hazardous to Health

Hazardous materials shall be stored in approved safety containers and handled in a manner specified by the manufacturers and/or prescribed by relevant authorities.

Only properly trained and equipped personnel shall handle hazardous materials.

704.7 Potential Hazards

The Contractor shall inform employees of potential hazards, take the appropriate steps to reduce hazards and be prepared for emergency situations. The Contractor shall make an assessment of every operation involving hazardous substances. The assessment shall be recorded on a Hazardous and Flammable Substances Assessment Method Statement which shall be submitted to the Project Manager prior to the delivery and use of the substance on Site.

704.8 Accident Reporting

The Contractor shall report all accidents and dangerous occurrences to the Project Manager. The Contractor shall prepare a report on each accident or dangerous occurrence and a copy of the report, together with witness statements and any other relevant information, shall be submitted to the Project Manager. A reportable accident or dangerous occurrence shall include any accident to any person on site requiring medical attention or resulting in the loss of working hours or any incident that resulted, or could have resulted, in injury, damage or a danger to the Works, persons, property or the environment.

In the event of an accident or dangerous occurrence, the Contractor shall be responsible for completing all statutory notifications and reports. Copies of all statutory notifications and reports shall be passed to the Project Manager.

All accidents and dangerous occurrences shall be recorded in a Site Accident Book. The Site Accident Book shall be available at all times for inspection by the Project Manager.

The Contractor shall immediately rectify any situation or condition that could result in injury, damage or a danger to the Works, person, property or the environment. If the situation or condition cannot be corrected immediately, the Contractor shall provide temporary barriers and appropriate warning signs and devices and/or take other appropriate action necessary for the protection of persons, property and the environment.

704.9 Notices, Signs, Etc.

All safety, health, environmental and other notices and signs shall be clearly displayed and written in English. All requirements, instructions, procedures, etc. issued by the Contractor concerning these Specifications shall be printed in English and displayed and readily available to the Contractor's personnel.

704.10 First Aid and Medical Attention

The Contractor shall have comprehensive First Aid Kit(s) on Site at all times. First Aid Kits shall be conveniently located and clearly identifiable.

The Contractor shall have one employee on site trained in first aid for every 25 employees. Such persons shall be provided with appropriate identification, including a red hard hat with a white "red cross" symbol; and an identification badge.

The Contractor shall make contingency arrangements for calling a Doctor and transporting injured persons to hospital. The telephone numbers of the emergency services and the name, address and telephone number of the Doctor and nearest hospital shall be prominently displayed in the Contractor's site office.

704.11 Employee Qualification and Conduct

The Contractor shall employ only persons who are fit, qualified and skilled in the work to be performed. All persons shall be above the minimum working age. Contractor's personnel shall use the toilet facilities provided by the

Contractor.

The Contractor shall ensure:

(a) that no firearms, weapons, controlled or illegal substances or alcoholic beverages are brought onto the Site and that no personnel under the influence of alcohol or drugs are permitted on Site.

(b) That all personnel obey warning signs, product or process labels and posted instructions.

(c) That drivers or operators of vehicles, machinery, plant and equipment follow the rules for safe operations. Drivers shall wear seat belts and obey all signs and posted speed limits.

705 Safety Requirements

705.1 Personal Protective Equipment

The Contractor shall provide personal protective equipment, including hard hats, safety glasses, respirators, gloves, safety shoes, and such other equipment as required, and shall take all measures or actions for the protection and safety of Contractor's personnel.

Non-metallic hard hats shall be worn at all times by all personnel at the worksite with the exception of those areas where the Project Manager has indicated it is not necessary to do so. Safety glasses shall meet international standards and be available for use and worn in specified worksite areas. As a minimum, safety glasses shall be worn for the following types of work: hammering, chipping, welding, grinding, use of electrically powered or pneumatic equipment, insulation handling, spray painting, working with solvents, and other jobs where the potential of an eye injury exists. Face shields and/or goggles shall be worn where possible exposure to hazardous chemicals, cryogenic fluids, acids, caustics or dust exists and where safety glasses may not provide adequate protection.

When handling acids, caustics and chemicals with corrosive or toxic properties, suitable protection, such as acid suits or chemical resistant aprons and gloves, shall be worn to prevent accidental contact with the substance.

Personnel shall not be permitted to work whilst wearing personal clothing or footwear likely to be hazardous to themselves or others.

The wearing of safety shoes with steel reinforced toes is recommended for all Contractor's personnel on site. In all cases, Contractor's personnel shall wear substantial work shoes that are commensurate with hazards of the work and the work site area.

Hearing protection, including muffs, plugs or a combination thereof, shall be provided for all personnel operating in areas where the noise level exceeds 90 decibels. Such protections shall also be provided for operators working with equipment exceeding such a level. This may include equipment such as excavators, shovels, jackhammers, saws, drills, grinders and the like are being used.

The Contactor shall encourage employees to wear substantial work gloves whenever practical and safe to do so.

705.2 Fire Protection and Prevention

The Contractor shall comply with fire protection instructions given by the Authorities having jurisdiction in regard to fire protection regulations. The Contractor shall, upon moving on site, provide to the Project Manager and the Authorities a fire prevention and evacuation plan. This shall include drawing(s) showing the fire assembly points. The fire prevention and evacuation plan and drawing(s) shall be updated from time to time as the Works progress. The Contractor shall ensure all personnel are fully informed on escape routes and assembly points and any changes thereto. Fuel storage will not be permitted in construction work areas. Contractors may establish fuel storage tanks in specified areas set aside for the purpose and approved by the Project Manager. Storage tanks shall be adequately bunded to control spillage. Fire extinguishers shall be provided and installed in a suitable nearby location.

Highly combustible or volatile materials shall be stored separately from other materials and as prescribed by relevant authorities and under no circumstances within buildings or structures forming part of the permanent Works. All such materials shall be protected and not exposed to open flame of other situations which could result in a fire risk.

No combustible material shall be located inside or within 10 metres of a building if structure forming part of the permanent Works. Where units have to be used in these circumstances, they shall be constructed of non-combustible materials and have a half-hour fire rating inside to outside and outside to inside. Non-combustible furniture shall be used where practical.

All temporary accommodation and stores shall be provided with smoke detectors and fire alarms.

Smoking shall be banned in high risk areas.

Expanded polystyrene with or without flame retarding additive, polythene, cardboard and hardwood shall not be used as protection materials. Plywood and chipboard shall only be used as protection on floors. Vertical protection shall be non-combustible. Debris netting and weather protection sheeting shall be fire retardant.

When using cutting or welding torches or other equipment with an open flame, the Contractor shall provide a fire extinguisher close by at all times. All flammable materials shall be cleared from areas of hot works or work locations prior to welding or oxy/gas burning operations. All hot works shall cease half an hour before the end of a work shift to allow for thorough checking for smouldering materials. Where appropriate, areas of hot works are to be soused in water before the shift ends.

An adequate number of fire extinguishers of types suited to the fire risk and the material exposed shall be provided. These shall be placed in accessible, well-marked locations throughout the job site. Contractor's personnel shall be trained in their use. Extinguishers shall be checked monthly for service condition and replaced or recharged, as appropriate after use.

Only approved containers shall be used for storage, transport and dispensing of flammable substances. Portable containers used for transporting or transferring gasoline or other flammable liquids shall be approved safety cans. Fuel burning engines shall be shut off while being refuelled. Adequate ventilation to prevent an accumulation of flammable vapours shall be provided where solvents or volatile cleaning agents are used.

Flammables shall not be stored under overhead pipelines, cable trays, electrical wires or stairways used for emergency egress. Paints shall be stored and mixed in a room assigned for the purpose. This room shall be kept under lock and key.

Oily waste, rags and other such combustible materials shall be stored in proper metal containers with self-closing lids and removed every night to a safe area or off site. Every precaution shall be taken to prevent spontaneous combustion.

705.3 Electrical Safety

All temporary electrical installations, tools and equipment shall comply with current regulations dealing with on-site electrical installations. The Contractor shall establish a permit-to-work system for work in or in proximity to energized circuits of any voltage. Contractor's personnel shall not commence work on such circuits unless a permit to work has been issued and adequate safety measures have been taken and the work operation has been reviewed and approved by the Project Manager.

Only authorized personnel shall be allowed to work or repair electrical installations and equipment. Portable tools and equipment shall be 240 volt, unless otherwise agreed by the Project Manager.

When portable or semi-portable equipment operates at voltages in excess of 240 volts, the supply shall be protected

by a Residual Current Device (RCD) regardless of any such device fitted to the equipment. The RCD must have a tripping characteristic of 30 milliamps at 30 milliseconds maximum.

All static, electrically powered equipment, including motors, transformers, generators, welders and other machinery, shall be properly earthed, insulated, and/or protected by a ground fault interruption device. In addition, the skin metal buildings and trailers with electric service shall be earthed. Metal steps, when used shall be securely fixed to the trailer.
Lampholders on festoon lighting shall be moulded to flexible cable and be of the screw in type. Clip on guards shall be fitted to each lamp unit.

All tungsten-halogen lamps shall be fitted with a glass guard to the element. These lamps must be permanently fixed at high level.
Electrical equipment shall be periodically inspected and repaired as necessary by competent persons.

Any work in electrical equipment and systems shall be made safe through locking, tagging, and/or isolation of the equipment before work commences. Prior to the start of the work, the equipment or systems shall be tested to ensure that they have been properly de-energised and isolated.

Electrical repair work on energized systems shall be avoided whenever possible.
Electrical trouble shooting shall be conducted only after getting written approval of the Project Manager.

Unauthorized personnel shall not enter enclosures or area containing high voltage equipment such as switchgear, transformers or substations.

705.4 Oxygen/Acetylene/Fuel Gases/Cartridge Tools

Compressed oxygen shall never be used in the place of compressed air. Flash-back (Spar) arrestors shall be fitted to all gas equipment. Liquid petroleum Gas (LPG) cylinders shall not be stored or left in areas below ground level overnight. Cylinders must be stored upright.

The quantity of oxygen, acetylene and LPG cylinders at the point of work shall be restricted to a maximum of one day's supply. Cylinders shall be kept in upright vertical rack containers or be safely secured to a vertical support.
Cartridge tools shall be of the low velocity type. Operators must have received adequate training in the safe use and operation of the tool to be used.

705.5 Scaffolding/Temporary Works

No aluminium tube shall be used, except for proprietary mobile towers, unless otherwise agreed with the Project Manager.

Drawings and calculations shall be submitted to the Project Manager, prior to commencement of work on the site, for all Temporary Works, including excavations, falsework, tower cranes, hoists, services and scaffolding. Designs shall conform to international standards.
The Project Manager will not approve Temporary Work designs but the Contractor shall take account of any comments on such designs made by the Project Manager.

The Contractor shall inspect and approve all Temporary Works after erection and before access, loading or use is allowed. Completed and approved Temporary Works shall be tagged with a scaff-tag or similar safety system and the Safe Structure insert displayed. For scaffolding, one tag shall be displayed every 32 m2 of face area. A central record system shall be kept on all Temporary Work. Temporary Works shall be inspected weekly and similarly recorded.

All mobile scaffold towers shall be erected in accordance with the manufacturer's instructions and a copy of these shall be submitted to the Project Manager prior to any use on site. Additionally, all towers shall be erected complete

with access ladder, safety rails and kick boards whatever the height.

The Contractor shall repair or replace, immediately, any scaffold, including accessories, damaged or weakened from any cause.

The Contractor shall ensure that any slippery conditions on scaffolds are eliminated as soon as possible after they occur.

All scaffolds used for storing materials, for brick or block laying, for access to formwork or for any other purpose where materials may be accidentally fall, shall be provided with wire mesh guards of a substantial material, in addition to kick boards.

705.6 Use of Ladders

Manufactured ladders shall meet the applicable safety codes for wood or metal ladders. Metal ladders shall not be used where there is any likelihood of contact with electric cables and equipment. All metal ladders shall be clearly marked: "Caution – Do not use around electrical equipment". Job made ladders shall not be permitted.

Extension or straight ladders shall be equipped with non-skid safety feet, and shall be no more than 12 m in height. The maximum height of a step ladder shall be 2 m. Ladders shall not be used as platforms or scaffold planks.

Ladders rungs and steps shall be kept clean and free of grease and oil.
Extension and straight ladders shall be tied off at the top and/or bottom when in use. Only one person shall be allowed in a ladder at a time.

Defective ladder shall be taken out of service and not used. Ladders shall not be painted and shall be inspected for defects prior to use.

705.7 Elevated Work

The Contractor shall provide all personnel, while working at an elevated position, with adequate protection from falls. Details of such protections shall be submitted to the Project Manager.
The Contractor shall carry out daily inspections of all elevated work platforms. Defects shall be corrected prior to use.

- **705.7.1 Roofing and Sheet Metal Laying**
  (a) A Method Statement detailing the procedures to be adopted shall be submitted to and agreed with the Project Manager prior to commencement of work on the site.
  (b) Mobile elevating work platforms or the equivalent shall be used to install roofing and sheet materials wherever practicable and a suitable base is available.

- **705.7.2 Erection of Structures**
  (a) A Method Statement detailing the procedures to be adopted shall be submitted to and agreed with the Project Manager prior to commencement of work on the site.
  (b) Safety harness and lines shall be provided by the Contractor for use by the erection personnel and worn at all times.
  (c) Mobile elevating work platforms or the equivalent shall be used to erect structures wherever practicable and a suitable base is available.

- **705.7.3 Mobile Elevating Work Platforms**
  Operators shall be trained in the safe use of such platforms and hold a current Certificate of Competence.

- **705.7.4 Hoists**
  (a) A copy of the current Test Certificate shall be submitted to the Project Manager before any hoist (personnel or material) is brought into operation on the site. Where the range of travel is increased or reduced a copy of the revised Test Certificate shall be submitted.
  (b) Each landing gate shall be fitted with a mechanical or electrical interlock to prevent movement of the hoist when any such gates is in the open position.
  (c) Safety harness must be worn and used by personnel erecting, altering and dismantling hoists.

- **705.7.5 Suspended Cradles**
  (a) Suspended cradles shall be installed, moved and dismantled by a specialist contractor.
  (b) Suspended cradles shall comply with local regulations.
  (c) All powered suspended cradles shall incorporate independent safety lines to overspeed braking devices and independent suspension lines for personal safety harness attachment.

705.8 Use of Temporary Equipment

The safe design of any piece of equipment shall not be exceeded, nor shall the equipment be modified in any manner that alters the original factor of safety or capacity. Mobile equipment shall be fitted with suitable alarm and motion sensing devices, including back-up alarm, when required. The Contractor shall ensure that the installation and use of equipment are in accordance with the safety rules and recommendations laid down by the manufacturer, taking into account the other installations already in place or to be installed in the future.

The contractor shall inspect Equipment prior to its use on the Works and periodically thereafter to ensure it is in safe working order. Special attention shall be given to such items as cables, hoses, guards, booms, blocks, hooks and safety devices. Equipment found to be defective shall not be used and immediately removed from services, and a warning tag attached.

Natural and synthetic fibre rope made of material such as manila, nylon, polyester, or polypropylene shall not be used as slings. Only trained, qualified and authorized personnel shall operate equipment. All drivers and operators shall hold a current Certificate of Training Achievement for the equipment being used. A safety observer shall be assigned to watch movements of heavy mobile equipment where hazards may exist to other personnel from the movement if such equipment, or where equipment could hit overhead lines or structures. The observer shall also ensure that people are kept clear of mobile equipment and suspended tools.

When mobile or heavy equipment is travelling onto a public thoroughfare or roadway, a flagman shall ensure that traffic has been stopped prior to such equipment proceeding. While the mobile or heavy equipment is travelling on a public roadway, a trailing escort vehicle with a sign warning of a slow-moving vehicle that is dangerous to pass shall be provided.

705.9 Cranes:

(a) The Contractor shall give a minimum of 48 hours' notice to the Project Manager prior to bringing a crane on site.

(b) No cranes shall be erected in the site without the prior approval of the Project Manager. The Project Manager may direct the Contractor as to location where cranes may not be located. The Contractor shall take such directions into account when submitting his proposals for crane location points, base footings, pick up points and swing radius. Compliance with any such direction shall not entitle the Contractor to any extension of the Period of Completion or to any increase of the Contract Price.

(c) Safety harness shall be worn and used at all times by personnel engaged on the erection, alterations and dismantling of tower cranes.

(d) The Contractor shall provide a copy of the current Test Certificate (see Sub-Clause 702) to the Project Manager before any crane (tower or mobile) is brought into operation on the Site.

(e) All lifting tackle must hold a current Test Certificate. All lifting tackle must be thoroughly examined every 6 months and an inspection report raised.

(f) All fibrous/web slings shall be destroyed and replaced 6 months after first use.

(g) All crane drivers/operators shall hold a Certificate of Training Achievement for the class of crane operated.

(h) All banksman/slingers shall hold a Training Certificate from a recognized training agency.

(i) The maximum weekly working hours of a crane driver or banksman shall be restricted to 60 hours.

(j) Under no circumstances shall a crane or load come within 4 m of any energized overhead power line or other critical structure.

705.10 Locking-out, Isolating and Tagging Equipment.

Equipment that could present a hazard to personnel if accidentally activated during the performance of installation, repair, alteration, cleaning, or inspection work shall be made inoperable and free of stored energy and/or material prior to the start of work. Such equipment shall include circuit breakers, compressors, conveyors, elevators, machine tools, pipelines, pumps, valves, and similar equipment.

Where equipment is subject to unexpected external physical movement such as rotating, turning, dropping, falling, rolling, sliding, etc., mechanical and/or structural constraints shall be applied to prevent such movement.

Equipment which has been locked-out, immobilized, or taken out of services for repair or because of a potentially hazardous condition shall be appropriately tagged indicting the reason it has been isolated and/or taken out of service.

Where safety locks are used for locking out or isolating equipment, the lock shall be specially identified and easily recognized as a safety lock.

705.11 Installation of Temporary or Permanent Equipment

During installation and testing the Contractor's specialists Project Manager shall be in attendance. All control mechanism panel and wiring diagrams shall be available and printed in English.

705.12 Laser Survey Instruments

Details of the types and use of laser instruments shall be submitted and agreed with the Project Manager.

705.13 Working in Confined Spaces

Confined spaces, including tanks, vessels, containers, pits, bins, vaults, tunnels, shafts, trenches, ventilations ducts, or other enclosures where known or potential hazards may exist, shall not be entered without prior inspection by and authorization from the Site Safety Officer and the issuance of a Hazardous Work Permit.

Prior to entering the confined space, the area shall be completely isolated to prevent the entry of any hazardous substances or materials which could cause an oxygen deficient atmosphere. All equipment that could become energized or mobilized shall be physically restrained and tagged. All lines going into the confined space shall be isolated and/or blanked.

Personnel working in a confined space where emergency escape or rescue could be difficult, shall wear a safety harness attached to a lifeline. A qualified attendant(s), trained and knowledgeable in job-relater emergency procedures, shall be present at all times while persons are working within the confined space. The attendant shall be capable of effecting a rescue, have necessary rescue equipment immediately available, and be equipped with at least the same protective equipments as the person making entry.

All equipment to be used in a confined space shall be inspected to determine its acceptability for use. Where a hazard from electricity may exist, equipment utilized shall be of law voltage type. The atmosphere within the confined space shall be tested to determine if it is safe to enter. Acceptable limits are:

- oxygen: 19.5% lower, 22% higher;
- flammable gas: not to exceed 10% of lower explosion limit;
- toxic contaminants: not to exceed the permissible exposure limit.

Subsequent testing shall be done after each interruption and before re-entering the confined space, as well as at intervals not exceeding 4 hours. Continuous monitoring is preferable and may be necessary in certain situations.

Adequate ventilation shall be provided to ensure the atmosphere is maintained within acceptable limits.

705.14 Demolition

A detailed Method Statement detailing the demolition procedures/techniques to be used shall be submitted to and approved by the Project Manager prior to commencement of work on site.

The Method Statement must include full details of measures to be taken to ensure that there are no persons remaining in the building/structure and to distance members of the public and Contractor's personnel from the building/structure prior to demolition.

705.15 Use of Explosives

The Contractor shall not use explosives without the written permission from the Project Manager and relevant authorities.

The Contractor shall observe all regulations regarding proper purchasing, transportation, storage, handling and use of explosives.

The Contractor shall ensure that explosives and detonators are stored in separate special building. These secured buildings shall be constructed, located and clearly marked in English:

"DANGER – EXPLOSIVES"

all as approved by the Project Manager and relevant authorities. The Contractor shall ensure that all possible precautions are taken against accidental fire or explosion, and ensure that explosives and detonators are kept in a proper and safe condition. The contractor shall ensure that explosives and detonators are always transported in separate vehicles and kept apart until the last possible moment and that metallic tools are not used to open boxes of explosives or detonators.

Blasting Procedure: the contractor shall carry out blasting operations in a manner that will not endanger the safety of persons or property. The Contractor shall, along with other necessary precautions:

(a) clear all persons from building and the area affected by the blasting. All such persons shall be given adequate notice of the actual time and date of blasting;

(b) ensure that police and other local authorities are kept fully informed, in advance, of the blasting

programme so that they may be present when blasting takes place if they so require;

(c) erect warning notices around the area affected that blasting operation are in progress;

(d) carry out a thorough search of buildings and the area affected prior to blasting;

(e) ensure that blasting is only carried out by experienced shot firers. Priming, charging, stemming and shot firing shall be carried out with greatest regard for safety and in strict accordance with the rules and regulations of the relevant authorities.

(f) ensure that explosive charges are not excessive, charged boreholes are properly protected and proper precautions are taken for the safety of persons and property.

The Contractor shall maintain an up-to-date inventory of all explosives and explosive devices and shall submit a monthly report to the Project Manager, detailing the use of all explosives by date and location.

705.16 Excavation and Trenching

An excavation permit signed by the Project Manager must be issued before excavation proceeds in any work location. The contractor shall investigate and identify the location of existing services by study of the drawings, a visual/physical study of the site, sweeping by appropriate detection equipment and where necessary hand excavation of trial holes.

Following this investigation, the Contractor shall submit a written request for an excavation permit to the Project Manager.

The Project Manager will return the permit signed and dated to indicate:

- services which are to be maintained.
- services which are to be isolated.
- any special precautions to be taken.

A sample Excavation Permit is given in Annex 1 to this Specification. The issue of an Excavation Permit by the Project Manager shall not relieve the Contractor of his responsibilities under the Contract.

The side of all excavations and trenches which in the opinion of the Project Manager might expose personnel or facilities to danger resulting from shifting earths shall be protected by adequate temporary supports or sloped to the appropriate angle of repose.

All excavations, slopes and temporary supports shall be inspected daily and after each rain, before allowing personnel to enter the excavation.

Excavations 1.3 metres or more in depth and occupied by personnel shall be provided with ladders as a means for entrance and egress. Ladders shall extend not less than 1 metre above the top of the excavation.

The Contractor shall provide adequate barrier protection to all excavations. Barriers shall be readily visible by day of night.

Excavated or other materials shall be stored at least 0.65 metres from the sides of excavations.

705.17 Concrete Reinforcement Starter Bars

The Contractor shall ensure concrete reinforcement starter bars are not a danger to personnel. Where permitted by the Project Manager, starter bars shall be bent down. Alternatively, the starter bars shall be protected using either hooked starters, plastic caps, plywood covers or other methods agreed with the Project Manager.

706 Environmental and Health Requirements

706.1 Contractor environmental and social management plan

The Contractor shall develop his own Environmental and Social Management Plan to ensure actions and mitigation necessary to protect the environment as contained in the Project ESIA Report and License, are incorporated into all site procedures. At a minimum, the contractor's ESMP must address the following:

- Policy
- Planning
- Implementation and Operation

706.1.1 Policy

The Contractor shall develop an environmental policy that includes, as a minimum, the following:

- A commitment to comply with applicable regulations and other requirements that the construction company subscribes to;
- A commitment to provide a safe work environment;
- A commitment to provide the training and equipment necessary for employees to conduct their work safely;
- A commitment to continuously improve performance and to pollution prevention; and
- A commitment to communicate the policy to all persons working for and on behalf of the company.

706.1.2 Planning

Environmental issues and the legal and other requirements in construction of the project have been identified in the project's ESIA Report. The Contractor must demonstrate within his plan that he has read and understood the ESIA Report and its provisions for environmental management and monitoring.

706.1.3 Implementation and Operation

Roles, responsibilities and authorities must be defined, documented and communicated to ensure effective environmental and social management. A specific management representative with requisite qualifications shall be assigned the responsibility for ensuring that the ESMP is established, implemented and maintained and shall be responsible for reporting performance, reviewing the Plan and making recommendations for improvement. Documented confirmation is required that the training needs of all persons working for or on the company's behalf whose work pose significant hazards to their health and safety and/or may create a significant impact on the environment has been identified. Records of all training must be maintained.

Management, supervisory, and employee responsibilities must be communicated to all employees through training, formal job descriptions, work experience, hiring practices, etc. Awareness training shall be provided that include the importance of conforming to the policy and procedures, the significant environmental issues, and the roles and responsibilities of management and staff.

Records shall be legible, identifiable and traceable to the activity. Records shall be stored and maintained in such a way that they are retrievable and protected against damage, deterioration or loss.

The Contractor shall establish, implement and maintain procedures to identify potential emergency situations and potential accidents that can have an impact on the environment, surrounding communities, the employees, and/or the public.

The Contractor shall be prepared to respond to actual emergency situations and accidents and prevent or mitigate associated adverse environmental or social impacts. The ESMP must also address how the Contractor will receive, document and respond to external interested parties.

706.2 Protection of the Environment

The Contractor shall be knowledgeable of and comply with the Environmental Management Plan (EMP) and with all environmental laws, rules and regulations for materials, including hazardous substances or wastes under his control. The contractor shall not dump, release or otherwise discharge or dispose of any such materials without the authorization of the Project Manager.

Any release of a hazardous substance to the environment, whether air, water or ground, must be reported to the Project Manager immediately. When releases resulting from Contractor action occur, the Contractor shall take proper precautionary measures to counter any known environmental or health hazards associated with such release. These would include remedial procedures such as spill control and containment and notification of the proper authorities.

706.3 Air Pollution

The Contractor, depending on the type and quantity of materials being used, may be required to have an emergency episode plan for any releases to the atmosphere. The Contractor shall also be aware of local ordinances affecting air pollution.

The Contractor shall take all necessary measures to limit pollution from dust and any windblown materials during the Works, including damping down with water on a regular basis during dry climatic conditions.

The contractor shall ensure that all trucks leaving the Site are properly covered to prevent discharge of dust, rocks, sand, etc.

706.3 Water Pollution

The contractor shall not dispose of waste solvents, petroleum products, toxic chemicals or solutions on the city drainage system or watercourse, and shall not dump or bury garbage on the Site. These types of waste shall be taken to an approved disposal facility regularly, and in accordance with requirements of relevant Authorities. The Contractor shall also be responsible for the control of all run-offs, erosion, etc.

706.4 Solid Waste

706.4.1 General Housekeeping

(a) The Contractor shall maintain the site and any ancillary areas used and occupied for performance of the Works in a clean, tidy and rubbish-free condition at all times.

(b) Upon the issue of any Taking-Over Certificate, the Contractor shall clear away and remove from the Works and the Site to which the Taking-Over Certificate relates, all Contractor's Equipment, surplus material, rubbish and Temporary Works of every kind, and leave the said Works and Site in a clean condition to the satisfaction of the Project Manager. Provided that the Contractor shall be entitled to retain on Site, until the end of the Defects Liability Period, such materials, Contractor's Equipment and Temporary Works as are required by him for the purpose of fulfilling his obligations during the Defects Notification Period.

706.4.2 Rubbish Removal and Disposal

(a) The Contractor shall comply with statutory and municipal regulations and requirements for the disposal of rubbish and waste.

(b) The Contractor shall provide suitable metal containers for the temporary storage of waste.

(c) The Contractor shall provide suitable metal containers from site as soon as they are full. Rubbish containers shall not be allowed to overflow.

(d) The Contractor shall provide hard standings for and clear vehicle access to rubbish containers.

(e) The Contractor shall provide enclosed chutes of wood or metal where materials are dropped more than 7 meters. The area onto which the material is dropped shall be provided with suitable enclosed protection barriers and warning signs of the hazard of falling materials. Waste materials shall not be removed from the lower area until handling of materials above has ceased.

(f) Domestic and biodegradable waste from offices, canteens and welfare facilities shall be removed daily from the site.

(g) Toxic and hazardous waste shall be collected separately and be disposed of in accordance with current regulations.

706.4.3 Asbestos Handling and Removal

The Contractor shall comply with all local regulations regarding the handling of asbestos materials. In the absences of local regulations, relevant International Standards shall apply.

706.4.4 Pest Control

The Contractor shall be responsible for the rodent and pest control on the Site. If requested, the contractor shall submit to the Project Manager, for approval, a detailed programme of the measures to be taken for the control and eradication of rodents and pests.

706.5 Noise Control

The Contractor shall ensure that the works is conducted in a manner so as to comply with all restrictions of the Authorities having jurisdiction, as they relate to noise.

The Contractor shall, in all cases, adopt the best available plant/and or machinery shall be used. All equipment shall be maintained in good mechanical order and fitted with the appropriate silencers, mufflers or acoustic covers where applicable. Stationary noise sources shall be sited as far away as possible from noise-sensitive areas and, where necessary, acoustic barriers shall be used to shield them. Such barriers may be proprietary types, or may consist of site materials such as bricks or earth mounds as appropriate.

Compressors, percussion tools and vehicles shall be fitted with effective silencers of a type recommended by the manufacturers of the equipment. Pneumatic drills and other noisy appliances shall not be use during days of rest or after normal working hours without the consent of the Project Manager.

Areas where noise levels exceed 90 decibels, even on a temporary basis, shall be posted as high noise level areas.

707 Additional Requirements for Work in Public Areas

707.1 General

Those additional requirements shall apply to all works carried out in Public Areas.
Public Areas are defined as areas still used by or accessible to the public. These include public roads and pavements, occupied buildings and areas outside the Contractor's boundary fencing.

All work in Public Areas shall be carried out to minimize disturbance and avoid dangers to the public.

Before commencing work, the Contractor shall ensure that all necessary resources, including labour, plant and materials will be available when required and that the works will proceed without delays and be completed in the shortest possible time. Period of inactivity and slow progress or delays in meeting the agreed programme for the Works, resulting from the Contractor's failure to provide necessary resources or other causes within the control of the Contractor, will not be accepted. In the event of such inactivity, slow progress or delays, the Contractor shall take immediate action to rectify the situation, including all possible acceleration measures to complete the works within the agreed programme. Details of the actions and acceleration measures shall be submitted to the Project Manager. If the Project Manager is dissatisfied with the Contractor's proposals, the Contractor shall take such further actions or measures as required by the Project Manager. All costs incurred shall be the responsibility of the Contractor.

707.2 Method Statement

The Contractor shall submit to the Project Manager a method statement for each separate area or work in Public Areas. The Method Statement shall include:

(a) a general description of the Works and methodology of how it will be carried out.

(b) Details of the measures and temporary works to minimise disturbance and safeguard the public. These shall include temporary diversions, safety barriers, screens, signs, lighting, watchmen and arrangements for control of traffic and pedestrians and advance warning to be given to the public.

(c) Details of temporary reinstatement and maintenance of same prior to final reinstatement.

(d) For works involving long lengths of trenches or works to be completed in sections, the lengths or sections of each activity (e.g. up to temporary reinstatement, final reinstatement) to be carried out at any one time.

(e) Details of the availability of necessary resources (labour, plant, materials, etc.) to complete the work.

(f) A programme showing start and completion dates and period for all activities of each length or section, including temporary works, and the works overall.

(g) Such further information as necessary or required by the Project Manager.

The Contractor shall not commence work, including temporary works, until after the approval of the Contractor's Method Statement by the Project Manager.

Method Statements shall be updated bases on actual progress or as and when required by the Project Manager.

707.3 Closure of Roads, Etc.

The closure or partial closure of roads, pavements and other public areas will only be permitted if approved by the Project Manager and Relevant Authorities. The Contractor shall detail for each closure the extent of area to be closed, the reasons and duration of the closure, and where appropriate, proposed diversions. A sample Street Closure Permit is given at Annex 2 to this Specification.

707.4 Trench and Other Excavations

The requirements covering trench and other excavations will depend on the location and type of the excavation and the potential risks to the public.
The following guidelines apply particularly to trenches but shall also apply to other types of excavations:

(a) before commencing work the Contractor shall:
- notify the Project Manager of the location and duration of the work. An excavation permit signed by the Project Manager must be issued in accordance with Sub-Clause 705.16 before excavation proceeds in any work location;
- obtain permission from relevant authorities including the police when required;
- erect all temporary works such as barriers, warning signs, lighting, etc.;
- have available adequate materials for temporary supports to sides of excavations and necessary labour, plant and materials to complete the work within the shortest possible time.

(b) in carrying out the works the Contractor shall, unless otherwise permitted or required by the Project Manager:
- not open more than one excavation within a radius of 250 metes;
- limit the length of trench excavation open at one time to 150 metres;
- maintain and alter or adapt all temporary works including supports to sides of excavations;
- remove all surplus excavated material the same day it is excavated;
- complete the works, including final reinstatement within ten days;
- where final reinstatement is not achieved within the required time, to carry out temporary reinstatement;
- ensure that any temporary reinstatement is maintained at the correct level until final reinstatement is achieved.

The above guidelines shall not relieve the Contractor of his obligations and responsibilities.

707.5 Safety Barriers

Safety barriers shall be provided to the perimeter of work areas and to trench and other types of excavations and to existing openings such as manholes, draw pits and the like. When exposed to the public, safety barriers shall be provided to both sides and ends of trenches and around all sides of openings.

The Contractor shall provide details of the type or types of safety barriers for each excavation for the approval of the Project Manager prior to commencing work. No work shall commence until the safety barriers are in place.

The type of safety barrier used shall be appropriate to the particular location and the potential risks to the public. Examples of different types of safety barriers are given below:

- Type 1 - excavated material;
- Type 2 - non-rigid barrier of rope or florescent tape strung between metal rods driven into the ground;
- Type 3 - rigid barrier of timber, steel or concrete. Such barriers could be in the form of horizontal rail(s) or sheet material secured to posts driven or concreted onto the ground.

The following are guidelines on the type of safety barriers that could be used in differing situations. They apply particularly to trenches but also apply to other types of excavation, existing openings onto the perimeter of work areas:

- areas not subject to vehicular traffic - Types 1 or 2;
- roadways (low traffic speed) - Types 1 or 2;
- roadways (high traffic speed or where excavation are greater than 2 m) - Type 3.

The above examples of the types of barriers and the guidelines on situations in which they could be used shall not relieve the Contractor of his obligations and responsibilities.

Section 8 Contractor's Site Check List

801 Contractor's Site Check List

A sample Contractor's Site Check List is included in Annex 1,2 & 3 to this Specification. This is included to assist contractors should they wish to introduce such a system as part of their site management procedures. The list is not exhaustive and further items will need to be added by the Contractor.

The list is issued for guidance only, and does not, in any way, revise or limit the requirements covered elsewhere in these Specifications.

Annex 1
Sample Excavation Permit

To: ……... (Project Manager)

From: …….. (Contractor) Date: …….

Contract No:
Request for Excavation Permit No: ……

Please give approval for excavation to proceed in the following area:

Work to start on:

Existing services have been checked and identified by:

Drawings # Physical Survey #

Catscan # Trial Holes Excavation #

Signed (Contractor): ……

Approval by Project Manager

The above excavation may proceed, subject to the following:

Service to be maintained:

Services to be isolated before work proceeds:

Other matters:

Signed (Project Manager): …….

Date: ……

Annex 2
Sample Street Closure Permit

To: ……... (Project Manager)

From: …….. (Contractor) Date: …….

Contract No:
Request for Street Closure Permit No: ……

Please give approval for the closure of the following street(s) from …… to …… (dates)

Street(s):

Reasons:

Proposed diversions:

Signed (Contractor): …….

Approval of the Project Manager

The above street(s) may be closed for the periods stated subject to the following conditions:

Approval has been given by the relevant authorities and the police;

Other:

Signed (Project Manager): …….

Date: ……..

Annex 3
Sample Contractor's Site Check List

Safe Access:

- arrangements for visitors and new workers to the site
- safe access to working locations
- walkways free from obstructions
- edge protection to walkways over 2m above ground
- holes fenced or protected with fixed covers
- tidy site and safe storage of materials
- waste collection and disposal
- chutes for waste disposal, where applicable
- removal or hammering down of nails in timber
- safe lighting for dark or poor light conditions
- props or shores in place to secure structures, where applicable

Ladders:

- to be used only if appropriate
- good condition and properly positioned
- located on firm, level ground
- secure near top. If not possible, to be secured near bottom, weighted or footed to prevent slipping
- top of ladder minimum 1 metre above landing place

Scaffolding:

- design calculation submitted
- proper access to scaffold platform
- properly founded uprights with base plates
- secured to the building with strong ties to prevent collapse
- braced for stability
- load bearing fittings, where required
- uprights, ledgers, braces and struts not to be removed during use
- fully boarded working platforms, free from defects and arranged to avoid tipping or tripping
- securely fixed boards against strong winds
- adequate guard rails and toe boards where scaffold is 2m above ground
- designed for loading with materials, where appropriate
- evenly distributed materials
- barriers or warning notices for incomplete scaffold (i.e. not fully boarded)
- weekly inspections and after bad weather by competent person
- record of inspections

Excavation:

- underground services to be located and marked, precautions taken to avoid them
- adequate and suitable timber, trench sheets, props and other supporting materials available on site before excavation starts
- safe method for erecting and removal of timber supports
- sloped or battered sides to prevent collapse
- daily inspections after use of explosives or after unexpected falls of materials
- safe access to excavations (e.g. sufficiently long ladder)
- barriers o restrict personnel/plant
- stability of neighbouring buildings
- risk of flooding
- materials stacked, spoil and vehicles away from top of excavations to avoid collapse
- secured stop blocks for vehicles tipping into excavations

Roof Work:

- crawling ladders or boards on roofs more than 10 degrees

- if applicable, roof battens to provide a safe handhold and foothold
- barriers or other edge protection
- crawling boards for working on fragile roof materials such as asbestos cement sheets or glass. guard rails and notices to same
- roof lights properly covered or provided with barriers
- during sheeting operations, precautions to stop people falling from edge of sheet
- precautions to stop debris falling onto others working under the roof work

Transport and Mobile Plant:

- in good repair (e.g. steering, handbrake, footbrake)
- trained drivers and operators and safe use of plant
- secured loads on vehicles
- passengers prohibited from riding in dangerous positions
- propping raised bodies for tipping lorries prior to inspections
- control of on-site movements to avoid danger to pedestrians, etc.
- control of reversing vehicles by properly trained banksmen, following safe system of work

Machinery and Equipment:

- adequate secured guards in good repair to dangerous parts, e.g. exposed gears, chain drives, projecting engine shafts

Cranes and Lifting Appliances:

- weekly recorded inspections
- regular inspections by a competent person
- test certificates
- competent and trained drivers over 18 years of age
- clearly marked controls
- checks by driver and banksman on weight of load before lifting
- efficient automatic safe load indicator, inspected weekly, for jib cranes with a capacity of more than one tonne
- firm level base for cranes
- sufficient space for safe operation
- trained banksman/slinger to give signals and to attach loads correctly, with knowledge of lifting limitation of crane
- for cranes with varying operating radius, clearly marked safe working loads and corresponding radii
- regular maintenance
- lifting gear in good condition and regularly examined

Electricity:

- measures to protect portable electric tools and equipment from mechanical damage and wet conditions
- checks for damage to or interference with equipment, wires and cables
- use of correct plugs to connect to power points
- proper connections to plugs; firm cable grips to prevent earth wire from pulling out “permit-to-work” procedures, to ensure safety
- disconnection of supplies to overhead lines or other precautions where cranes, tipper lorries, scaffolding, etc. might touch lines or cause arcing

Cartridge Operated Tools:

- maker’s instruction being followed
- properly trained operators, awareness of dangers and ability to deal with misfires
- safety goggles
- regular cleaning of gun
- secure place for gun and cartridges when not in use

Falsework/formwork:

- design calculations submitted method statement dealing with preventing falls of workers
- appointment of falsework coordinator

- checks on design and the supports for shuttering and formwork
- safe erection from steps or proper platforms
- adequate bases and ground conditions for loads
- plumb props on level bases and properly set out
- correct pins used in the props
- timberwork in good condition
- inspection by competent person, against agreed design, before pouring concrete

Risks to the Public:

- identify all risks to members of the public on and off site, e.g. materials falling from scaffold etc., site plant and transport (access/egress) and implement precautions, e.g. scaffold fans/nets, banksmen, warning notices, etc.
- barriers to protect/isolate persons and vehicles
- adequate site perimeter fencing to keep out the public and particularly children. secure the site during non-working periods
- make safe specific dangers in site during non-working periods, e.g. excavations and openings covered or fenced, materials safely stacked, plant immobilized, ladders removed or boarded

Fire – General:

- sufficient number and types of fire extinguishers
- adequate escape routes, kept clear
- worker awareness of what to do in an emergency

Fire – Flammable Liquids:

- proper storage area
- amount of flammable liquid on site kept to a minimum for the day's work
- smoking prohibited; other ignition sources kept away from flammable liquids
- proper safety containers

Fire – Compressed Gases, e.g. Oxygen, LPG, Acetylene:

- properly stored cylinders
- valves fully closed on cylinders when not in use
- adopt "hot work" procedures
- site cylinders in use outside huts

Fire – Other Combustible Materials:

- minimum amount kept on site
- proper waste bins
- regular removal of waste material

Noise:

- assessment of noise risks
- noisy plant and machinery fitted with silencers/muffs
- ear protection for workers if they work in very noisy surroundings

Health:

- identify hazardous substances, e.g. asbestos, lead, solvents, etc., and assess the risks
- use of other substances where possible
- control exposure by means other than by using protective equipment
- safety information sheets available from the supplier
- safety equipment and instructions for use
- keep other workers who are not protected out of danger areas
- testing of atmosphere in confined spaces; provision of fresh air supply if necessary. Emergency procedures for rescue from confined spaces

Manual Handling:

- avoid where risk of injury
- if unavoidable, assess and reduce risks

Protective Clothing:

- suitable equipment to protect head, eyes, hands and feet here appropriate
- enforce wearing of protective equipment

Welfare:

- suitable toilets
- clean wash basin, hot/warm water, soap and towel
- room or area where clothes can be dried
- wet weather gear for those working in wet conditions
- heated site hut where workers can take shelter and have meals with the facility for boiling water
- suitable first aid facilities

Work in Public Areas:

- all risks to the public identified
- method statement approved
- road closures approved
- temporary diversions in place
- safety barriers erected/maintained
- labour, materials, plant and other resources sufficient to meet programme
- temporary reinstatement completed and properly maintained
- permanent reinstatement completed at earliest possible date.

909 Construction Environmental Management Plan

A Construction Environmental Management Plan (CEMP) is a practical and achievable plan of management to ensure that any environmental impact during the design, planning and construction phase are minimised. CEMP's have been proposed to deal with the following issues during Project construction:

Compensation and land take
Physical setting, flora and fauna;
Interruption of key infrastructure installations;
Water quality and energy management;
Dust and air quality;
Occupational health and safety;
Noise and vibration; and
Waste management.

Detailed CEMP's are presented below

CEMP for Compensation and land take

Objective	To ensure that the land owners are properly compensated and avail land for the proposed Project.			
Management strategy	Since compensation is an integral part of Project design ensure it is dealt with from the earliest stages of Project preparation and comply with the laws of Kenya.			
	Activities	Responsibility	Timing	Costs (KES)
Actions	Land take should be minimized where feasible, exploring all viable alternative Project designs e.g. realignment of the pipeline may significantly reduce compensation; and Where displacement is unavoidable, compensation and resettlement plans should be developed with adequate compensation under guidance of various lead agencies including Ministry of Lands, TWSB, Local Councils and the District Development Committees.	Proponent	Prior to construction	TBD
Performance indicators	Lack of complaints / Complaints.	Proponent	Construction Phase	
Monitoring requirements	Documentation; and Land easement	Proponent	Construction Phase	
Reporting	Documentation	Proponent	Construction Phase	
Corrective actions	Implement recommendations.	Proponent	Construction Phase	
Interface	Ensure compliance with the Law of Kenya and the requirements of any donors involved in the Project.	Proponent	Construction Phase	

CEMP for Physical setting, flora and fauna

Objective	Maintain the existing balance within the physical, fauna and flora components in the Project area setting.			
Management strategy	Provide for appropriate measures that guarantee the protection of habitats, flora and fauna.			
	Activities	Responsibility	Timing	Costs (KES)
Actions	Provide structures that will not hinder free movement of animals and dispersal of propagation components; Maintain as much as possible the natural drainage systems and patterns; Grade sites to original levels to maintain topography; As much as practical limit the amount of vegetation cleared during works; Discourage bush meat hunting; In the event that considerable damage to vegetation is envisaged, set out a plan for replacement or grading to encourage natural rejuvenation; and Design and plan for use of wayleave by pedestrians and non-motorised systems.	Consulting Engineers Contractor PROJECT MANAGER	Planning. Design & construction	TBD
Performance indicators	Presence of a good balance of flora and fauna; and Minimal or no flooding in Project area.	PROJECT MANAGER	Construction Phase	
Monitoring requirements	Baseline data/Project completion Baseline; and Changes in local hydrology.	PROJECT MANAGER	Commissioning stage.	
Reporting	Site log book and EMCA requirements.	Contractor	Construction Phase	
Corrective actions	Rehabilitation	PROJECT MANAGER	Commissioning stage	
Interface	EMP complies with the EMCA and other applicable laws.	PROJECT MANAGER	Construction	

CEMP for management of infrastructure installations

Objective	Plan construction activities to minimise interruptions of infrastructure and ensure smooth Project implementation while complying with the laws of Kenya			
Management strategy	Liaise with stakeholders in the project area to ensure that access on protected or private areas is granted in good time in order to achieve Project milestones.			
	Activities	Responsibility	Timing	Costs (KES)
Actions	Establish the nature of all stakeholders; Identify key interests of each of the stakeholders; Formally liaise with the stakeholder and communicate the Project details to them with a view of developing a work plan; Implement work plan; and Acquire notes on Satisfactory Completion of Works by each affected party.	PROJECT MANAGER Engineer Contractors	Planning, Design and Construction phase	TBD
Performance indicators	Level of complains.	All	Construction phase	
Monitoring requirements	Timely achievement of milestones; and Lack of interruption of services.	All	Construction	
Reporting	Site log book	Contractor	Construction phase	
Corrective actions	Investigate cause of interruptions; Implement corrective measures.	AWSB Stakeholders	Construction phase	
Interface	Comply with the EMP contained in this report.	Contractor	Construction phase	

CEMP for water and energy management

Objective	Minimise impact on water and energy resources within the Project area due to the construction works.			
Management strategy	Conserve water and energy resources, abate pollution and comply with the laws of Kenya.			
	Activities	Responsibility	Timing	Costs (KES)
Actions	Provide appropriate and adequate drainage infrastructure where required; Ensure machinery is regularly serviced to avoid leakages and/or spillages; Oils, fuels and other materials to be stored in accordance with the manufacturers' safety data sheets (MSDS); Train staff on spill response; Implement erosion and sedimentation controls; Proper handling/disposal of liquid waste; Energy management through use of sound/appropriate equipment; Application of rated equipment in welding and related works; and Use of efficient mechanical plant and energy savers on sites.	Contractor	Construction phase	TBD
Performance indicators	Minimal interference of water and energy resource in the area.	Contractor	Construction phase	
Monitoring requirements	Physical inspection; and Level of complains.	Engineer	Construction phase	
Reporting	Site activities log book.	Contractor	Construction phase	
Corrective actions	Implementation of monitoring findings and recommendations.	Contractor	Construction phase	
Interface	Comply with laws and guidelines.	Contractor	Construction phase	

CEMP for dust and air quality

Objective	Maintain the quality of the air and minimise any harmful emissions into the atmosphere and comply with the laws of Kenya			
Management strategy	Abate pollution of the atmosphere by airborne particulate matter.			
	Activities	Responsibility	Timing	Costs (KES)
Actions	Dampen work areas materials heaps and mulch bare ground to minimise dust emissions; Maintain equipment and machinery to manufacturers' specifications; Use environmentally friendly fuels; Minimise the period for machinery idling; Pursue good practices in energy use and sensitise staff; and Provide appropriate personnel protective equipment to site workers.	Contractor	Construction phase	TBD
Performance indicators	Lack of complaints / Complaints; and Reports / Log book entries.	PROJECT MANAGER	Construction phase	
Monitoring requirements	Physical inspection Site Log books	Engineer	Construction phase	
Reporting	Site logs of inspections and corrective actions.	Contractor	Construction phase	
Corrective actions	Implement recommendations	Contractor	Construction phase	
Interface	Review and comply with laws and regulations.	Contractor	Construction phase	

CEMP for occupational health and safety

Objective	Ensure the safety and health of all the Parties involved in the Project implementation and comply with the laws of Kenya			
Management strategy	Provide proper safety equipments, facilities and conditions that will eliminate or reduce the risk to the Project workers and all those present therein.			
	Activities	Responsibility	Timing	Costs (KES)
Actions	Comply to the OSHA; Provide for appropriate signage and warnings at work sites; Provide appropriate personnel protective equipment (PPE) to workers and any visitors; Provide for First Aid facilities as per the Occupational Safety and Health Act; Provide and clearly display emergency contacts; and Develop and implement a detailed and site specific Emergency Response Plans.	Engineer Consulting Engineers Contractor	Construction phase	TBD
Performance indicators	Health and safety awareness among staff; and Frequency of incidents/accidents and fatalities.	Engineer PROJECT MANAGER	Construction phase	
Monitoring requirements	Daily inspection of work sites; and Tool box meetings.	Engineer	Construction phase	
Reporting	Log incidents/accidents and fatalities; and Tool box minutes.	Engineer	Construction phase	
Corrective actions	Investigate incident/accidents and fatalities; and Follow up on complains and other issues from tool box meetings.	Engineer	Construction phase	
Interface	Updates on the OSHA and orders from Directorate	PROJECT MANAGER	Construction phase	

CEMP for noise and vibration management

Objective	Manage activities at construction sites to reduce impacts of noise on surrounding properties and comply with the laws of Kenya.			
Management strategy	Noise to be managed through administrative and maintenance controls during construction.			
	Activities	Responsibility	Timing	Costs (KES)
Actions	All construction activities to be limited to between 7am to 6pm; All equipment used during the construction phase to be regularly maintained to ensure efficient operation; Noise dampening materials to be used where excessive noise generating-equipment are in use; Use of appropriate cushioning for heavy equipment; and Use of personal protective equipment by operations staff.	Contractor	Construction phase	TBD
Performance indicators	Lack of complaints / Complaints.	Contractor	Construction phase	
Monitoring requirements	Periodic inspection of work sites; and Service log for equipment / machinery.	Contractor	Construction phase	
Reporting	Complaints / incidents should be recorded in a log book on location.	Engineer	Construction phase	
Corrective actions	Investigate cause of noise and vibrations; Implement corrective measures prior to commencement of works; and Consider possibility of rescheduling noise and vibration generating activities.	Contractor PROJECT MANAGER	Construction phase	
Interface	Ensure that if the Contractors or subcontractors have an EMP and that it complies with the EMP contained in this report.	PROJECT MANAGER	Construction phase	

CEMP for waste management

Objective	Minimise the potential for environmental impact of wastes generated due to the construction activities and comply with the laws of Kenya.			
Management strategy	Effectively manage the sites and activities that may lead to generation of wastes.			
	Activities	Responsibility	Timing	Costs (KES)

Actions	All wastes shall be contained on site prior to disposal using appropriate storage containers; All wastes shall be regularly cleared from the site and disposed of in approved manner; High level of housekeeping shall be maintained; and Staff shall be trained / sensitised about waste management at the start of the Project and regularly as may be found appropriate.	Contractor	Construction phase	TBD
Performance indicators	No waste at work sites except in approved and marked locations.	Contractor	Construction phase	
Monitoring requirements	Regular site inspections; and Waste disposal documentation and tracking.	Contractor	Construction phase	
Reporting	Review of waste handling slips and other related documentation.	Contractor	Construction phase	
Corrective actions	Provide reports, corrective actions and recommendations where non-conformities occur.	Contractor	Construction phase	
Interface	Ensure that Contractors or subcontractors EMP complies with the EMP contained in this report.	Contractor	Construction phase	

Section 11 Instrumentation and Control

1101 General

1101.1 Design and Electromagnetic Compatibility

All circuits and equipment shall be designed in accordance with good engineering practices and particular care should be taken to ensure that no component shall exceed its maximum voltage/current/power ratings at any time, including during transient surges.

All instrumentation equipment shall be protected from interference emanating from radio frequency transmissions, either radiated or cable borne, such that it shall not cause malfunction of the system or damage to the components.

All equipment supplied shall not radiate any form of electromagnetic energy in amounts that might interfere with external equipment or instrumentation.

The latest standards on interference shall be followed and the principles of electromagnetic compatibility (EMC) applied to the design and application of the plant.

1101.2 Interrelation with Other Sections

Requirements given in other sections shall be applicable whether relevant to equipment or materials specified in this Section.

Thus indicator gauges, metres, enclosures, panel construction, finish, components, wiring, terminations, cabling requirements and environmental operating conditions shall be in accordance with the relevant clauses of the Mechanical and Electrical Sections unless specifically amended in this Section.

1101.3 Interrelation with other Contracts

Where the location, installation or connection of any components of instrumentation are arranged by the Engineer under other contracts, it shall be the responsibility of the Instrumentation Contractor to advise and provide all relevant information on such matters to the Engineer in order that the correct and proper performance of the Contractors instrumentation is not prevented or impaired.

1101.4 Temperature and Humidity

All supplied equipment shall function without error and shall be constructed of such materials or so treated as to prevent the formation of mould, fungus or any corrosion over the ranges of temperature and relative humidity specified in the specific clauses for this site.

1101.5 Enclosure Protection

Instrumentation and hardware mounted in the field shall be contained in suitable enclosures to provide ingress protection to BS EN 60529 rating IP54 indoors and IP65 outdoors as a minimum. Sensors installed below water level or liable to submersion shall be rated IP 68. Where items are fitted in a panel or other enclosure, they shall preserve the design IP rating of that enclosure.

1101.6 Voltage and Frequency Tolerance

Equipment shall be capable of working from a supply whose voltage may vary ±15% and tolerate any transients that could be experienced in such an environment without programme corruption or system failure.

1101.7 Instruments

Each instrument and sensor shall be selected considering all the relevant performance parameters for the principle of measurement adopted, its intended use and the particular process in question.

All instrument output signals shall be volt-free, clean contacts rated at 220V AC 2A for digital and 4-20mA continuous proportional linear signal for analogue. Pulsed outputs suitable for integration counter drives shall be 24V DC.

1101.8 Inputs, Outputs and Signal Loops

Opto-isolation shall be provided on all input interfaces to card.

Digital signals shall be 24V DC with the power supply from either the associated power pack or the external instrument. Relays shall be used where more than one instrument including I/O are fed from a single signal.

Analogue signal shall be continuous linear scaled signals with a 4-20 mA operating range. Loops with instruments wired in series (e.g. panel mounted indicator and RTU input) shall have zener fitted across each subsequent instrument leg to ensure loop integrity.

1101.9 Terminals

Signal terminals shall be the disconnect type. Power supply terminals shall be shrouded and clearly marked with the appropriate warning tags. LED's shall be provided for fault tracing, if not supplied on the I/O cards. LED's in either case must be clearly visible from the front, with only the enclosure door open.

For each incoming screened cable, a separate earth terminal shall be provided for screen termination to earth.

All equipment, isolators, terminals and cables shall be clearly marked. 20% spare terminals shall be provided.

1101.10 Programming and Monitoring Unit

Hand-held portable devices shall be provided for the system allowing user configurable operation to enable the downloading or uploading of data or software and the local running of diagnostic software. For RTU plc's the device shall be fully compatible with the RTU and shall be supplied with:

- Software to enable the development of programmes and the subsequent downloading to the RTU.
- Software to enable full communications with the RTU and to:

- upload data or alter data in the RTU;
- access communications ports and I/O.
- Full page process mimic display capability.

1101.11 Discrete Components

All discrete resistors, capacitors, switches, relays, diodes, transistors and other electronic devices shall comply with the BS 9000 series specification for components of assessed quality.

The Engineer's agreement must be sought before using components that are not certified, but it will remain the Contractor's responsibility to ensure that all components are suitable for the application.

Similar types of components shall be of the same manufacture and design wherever possible.

1101.12Integrated Circuits

All integrated circuits shall be of a proven design and shall be clearly marked with the original manufacturer's identity and device number.

1101.13 Sub-Miniature Switches

Where DIL or other sub-miniature switches are used they shall be provided with a cover, or other means of protection, to prevent accidental switching during handling.

1101.14 Printed Circuit Boards

Printed circuit boards shall be made of glass fibre with copper trackwork, all exposed copper being tinned prior to assembly, and the board and components cleared of flux before a thin layer of clear varnish is applied for environmental protection.

The board and its components shall be identified by references relating to the corresponding circuit diagram which shall be printed on the component side of each board. Where a number of boards are mounted in a rack system, the rack and boards shall be clearly marked to identify each board to its particular position.

1101.15 Sockets and Connectors

The use of plug-in connectors for electronic equipment shall be kept to a minimum, and all circuit components including integrated circuit clips shall have soldered connections where this is permitted by the chip manufacturer.

Where sockets and connectors are incorporated in the design, they shall have self-cleaning, hard gold alloy plated, wiping action contact faces, and incorporate polarizing keys or similar means to prevent incorrect mating. Insulation displacement type connectors shall not be used.

All light current wiring having a cross-section of 1.0mm2 or less shall have tinned copper conductors.

1101.16 Test Facilities

The electronic equipment is to include built-in test facilities to permit the detection and replacement of faulty modules without the use of oscilloscopes, signal generators, or other sophisticated test equipment.

1101.17 Surge Protection

All telecommunication lines, data and signal cables and other items of equipment external to the building environment prone to damage resulting from induced surges due to lightning discharges, shall be fitted with lightning surge protection barrier devices at each end of the line to suppress and divert any transients likely to cause damage to the connected equipment.

All surge diverters/lightning arrestors fitted to telecommunication lines shall be of a design approved by the telecommunications authority.

Surge protection units shall be un-fused, solid state devices, designed to limit the transient over-voltages to mot more than twice the normal working voltage of the line. They shall have low in-line resistance and automatically return to normal operation after diverting a surge.

The units shall have provision for either DIN rail or individual panel mounting or direct bolted connection to a suitable copper earth bar.

The location of the units shall be arranged such that the earth connection shall be routed clear of the protected signal cables and have short, straight connections without sharp bends to the main earth points, using copper conductors not less than 16mm2 csa and not greater than 5 metres in length to provide a low impedance path.

Surge suppression devices to provide protection from mains switching or other supply network disturbances shall be incorporated or fitted to all sensitive monitoring or control devices. They shall be designed to filter un-wanted transients and limit the 'let-through' voltage to less than twice the working mains voltage, between all conductors and each conductor and earth. Protection monitoring status indication shall be fitted

1101.18 Control Panel

The contractor shall supply, install, test and commission an integral 1 No. Control panel for 5No.250 Kw, 2No. 60 kW, 2No. 18.5kW centrifugal Pumps and 0.75 Kw submersible pump , all located in the Pump House, 1No integrated control panel for 5 No. 40KW centrifugal pumps all located at Ole-Tepes. The control panel shall meet the below specifications. The Panel will include a frequency inverter for the 250 and 40Kw pumps to provide variable control during start-up of pumps and reduce the starting current. The starting method for the rest of the pumps will be as indicated on the pump schedule specified in other parts of this specification. The control panel shall incorporate input for two pressure transducers, duty and standby with automatic changeover in the event of failure of the duty unit. It shall also incorporate an allowance for remote transmission of alarm signals to user.

It shall also allow for fitting of a transducer to provide low water pump shut down protection to the pump set, with alarm signal.

The control panel will also incorporate run and fault indicator lights for each pump and as well as speed indication lights.

The Panel shall incorporate the following features:

- LCD panel with backlit dynamic buttons to enable the user to interrogate the panel.
- Automatic fans to cool down the cabinet if required according to EN60439-1
- Lockable mains breaker
- Individually breakers for each pump

<u>Control panel functionality</u>

The control panel shall operate the pumps to keep a required pressure at the discharge manifold. The system shall automatically start the required number of pumps to keep the required Pressure.

The system must ensure a minimum of pressure surges when starting and stopping pumps by ramping the pumps in according to a defined ramp.

On the control unit it must be possible to read out:

- Speed of individual pumps.

- State of individual pumps.
- Power consumption
- Energy consumption
- A measured or estimated flow rate.
- Process value and set point.

The Controller must incorporate a log that graphically shows the trend of:

- The Estimated/measured flow
- Speed of the pumps
- Set point
- Process value.

It must be possible to retrieve the data and open it in a spreadsheet.

The control shall store at least the last twenty fault conditions experienced by the pump set, for subsequent display when the panel is interrogated.

The alarms must be presented in plain text indicating the source of the alarm.

The control system shall incorporate password protection and shall fully segregate access to interrogate the pump operating history from the access level at which pump operating settings can be changed.

The control system shall incorporate automatic test run of each pump every 24 hours. The system must automatically ensure equal running hours of the pumps. It must be able to, once a day, evaluate the running hours of the pumps and alternate between them if an idle pump has less running hours than a running pump.

Standby pump

- It shall be possible from the controller to define a number of standby pumps.
- Where a pump is designated as standby it shall still be included in the duty change cycle.

1101.19 High Pressure protection

It shall be possible to program a "high-pressure" safety cut-out, set 1.5 bar above the duty pressure. The pumps set shall automatically shut down in the event of the above pressure being identified. Following a shut-down the controller shall (a) re-start the pump set automatically once the high condition has disappeared, or (b) will remain shut down until manually re-started by an authorised person. (The preferred option shall be agreed with the end user prior to hand over and the controller programmed accordingly).

1101.20 Low Pressure/pipe burst protection

It shall be possible to program a "Low-pressure" safety cut-out, set 1 bar below the duty pressure. The pumps set shall automatically shut down in the event of the above pressure being identified. Following a shut-down the controller shall (a) re-start the pump set automatically once the high condition has disappeared, or (b) will remain shut down until manually re-started by an authorised person. (The preferred option shall be agreed with the end user prior to hand over and the controller programmed accordingly).

1101.21 Soft pressure build-up

The panel shall incorporate a slow-speed/one-pump-only start up, following a power outage or maintenance shutdown to gradually fill up the pipeline and reduce risk of airlocks and water hammer.

1101.22 Redundant sensor

The controller shall have a feature that gives an alarm if there is incoherency between the two discharge sensor signals.

1101.23 Testing and Commissioning:

Once installed on site, with all necessary permanent water services, power supplies, control and alarm systems completed and tested. The panel manufacturer shall be invited to site to commission, test and demonstrate the operation of the panel to the full satisfaction of the Engineer and End User.

1102 Instrumentation

1102.1 General

Indicating instruments shall show the specified measured values in either electro-mechanical or electronic and analogue or digital form, as defined in the Specific Requirements.

Wherever possible, panel mounting indicating instruments shall be of matching size, appearance and orientation and suitably scaled, all in accordance with the general requirements for electrical panels.

1102.2 Strip Indicators

Strip indicators shall be provided for the specified functions and arranged as shown on the proposed panel layout.

The indicators shall be solid state electronic type employing a column of neon gas plasma bars, illuminated consecutively in proportion to the input signal. The scale length shall be at least 100mm and allow on-line span and zero adjustment.

All indications shall be driven from transducers or inputs giving analogue signals of 4-20 mA.

1102.3 Indicator/Recorders

Electro-mechanical indicator/recorder shall be a flush, panel, mounting, single/multi pen indicator/recorder, scaled and labeled as specified herein. The initiating signals for each pen and the trace colour(s) together with any event markers and/or alarm settings, shall be as specified.

Continuously running recorders shall run at a speed of 20mm/hour with date and time annotation at 4 hourly intervals. For intermittent running, as in storm pumping applications, the recorder chart speed shall be 60mm/hour and shall only be initiated when the level approaches the first pump start level and be stopped 30 minutes after the final pump cuts out. Starting and stopping times and dates shall be printed on the chart and each pump operation shall be individually annotated by means of a single trace for each pump showing its running time.

To provide minimum time lags between other channels on the recorder, dot print outs may be used where required.

The Z folded chart paper shall be 250/100mm wide, linearly scaled in half hourly divisions and the width shall be calibrated 0-50 divisions linearly or logarithmically scaled as specified to adequately show the normal range of operation and include the maximum possible signal. The chart shall run for a minimum period of 30 days and 24 spare charts shall be provided. Circular charts shall be 105mm wide, 7 day graduated.
Each channel shall provide a continuous ribbon strip visible indication over a calibrated scale (left hand zero) and an individually different coloured trace on the chart by means of either fibre tipped pens fed from disposable ink cartridges or electrical writing or sensitized paper.
Each input shall be separate and isolated from the conditioning amplifiers and all necessary computing modules shall be included in the unit to provide the required indications.
The following features shall be provided for the operator control, accessible from the front without withdrawing the unit during operation:

- Pen renewal (if relevant);
- Power on/off switch;
- Chart drive on/off switch;
- Chart replacement and adjustment.

Adjustable high and low, volt free alarm contacts shall be provided on each channel and incorporated into the control scheme as required to initiate the alarms as specified.

1102.4 Time Indicator

A mains driven synchronous type clock shall be suitable for front of panel mounting and resetting.

The display shall either be digital or analogue as specified and based on a 24 hour notation. The digital display shall be of white figures (not less than 55mm high), on a black background. The analogue display shall be dual scaled showing 0-12 hour black figures and 13-24 hour red figures on a white faced dial of not less than 220mm diameter.

The mains supply for the clock shall be via a suitable fused clock connector mounted in the panel, connected such that the clock is energized from the live side of the panel isolator.

1102.5 Capacitive Devices

Level monitoring shall be by means of a capacitance electrode suitable for the medium and environmental conditions specified such that the electrode capacitance varies in proportion to the immersed electrode length and be arranged to provide a 4-20mA output proportional to the specified level range on a scaled indicator giving a continuous read out.

Auxiliary switches shall be provided for high level alarm, low level alarm and control of external equipment. The position of all switches being adjustable over the level range.
Any fault in the electrode connection and in the electronic circuits shall provide an electrically isolated alarm signal for remote monitoring.

The electrode housing shall be a heavy duty pattern to IP 68 suitable for 2” flange mounting and incorporate a 20mm ET cable entry. The head shall be removable for cabling and servicing without disturbing the electrode mounting.

1102.6 Pressure Transducers

Pressure monitoring shall be by a transducer suitable for the medium and pressure/level range specified herein.

Each transducer shall be ranged to provide adequate sensitivity over the working range and be capable of sustaining a 400% overpressure without damage. They shall be of rugged and waterproof design, employing a pressure sensitive element within a stainless enclosure having an isolation diaphragm, suitable for either free wire suspension in the medium or fitted with a BSP thread for external connection to the relevant pipe tapping.

Suspended sensors shall be mounted in accordance with the manufacturer's instructions within a uPVC 'stilling tube' of sufficient nominal bore to enable easy withdrawal of the sensor.

Sensors shall be enclosed to IP 68, offer a long life and shall be supplied complete with a suitable signal cable to reach the approved point of termination transmitter-converter without intermediate joints.

The position of the equipment shall be such that withdrawal and installation can be achieved easily.

Cable entry shall be integral sealed assembly or by 20mm conduit entry into a sealed watertight terminal enclosure with provision for transducer venting.

A transmitter shall be provided either integral with the transducer or separately mounted as specified, suitable for operation from the mains or battery supply specified (not greater than 24V) and converting the signals received from the transducer to a 4 – 20 mA signal proportional to the ranged specified which shall be used as follows:

To drive an indicator/recorder to give a continuous readout;
To operate separate on/off pre-set adjustable points.
The transmitter shall have provision for range and zero adjustment.

For use in hazardous areas as specified, the units shall be certified intrinsically safe Ex (1).

1102.7 Ultrasonic Devices

Flow or level monitoring by non-contact ultrasonic measuring devices shall incorporate ambient temperature compensation and adjustable datum setting facilities. Where specified, the output shall be computed to give a flow reading for the given parameters and/or control of pumps.

Transducer

The sensor head shall be protected to IP68, mounted to provide an unhindered beam path, prevent unwanted reflections, within easy reach of maintenance personnel and, where possible, be clear of flood conditions. For sewer or foul pumping sumps, the units shall be certified intrinsically safe Ex (i) for use in hazardous areas.

Signal Converter

The converter shall be suitable for operation from the specified power supply and convert the signals received from the sensor head to a 4-20 mA signal proportional to the range specified, to be used as detailed in the Specific Requirements.

The converter shall comprise a base unit and a programming device, all in a polycarbonate enclosure to IP 65. Communication between the programmer and the signal converter shall be in such a manner that the IP rate is not prejudiced.

A minimum of 3½ digit liquid crystal display shall be used to indicate key programming features, settings and output conditions, including flow calculations to BS 3680 for flumes and weirs.

Accuracy of the signal converter shall be better than ±1% of reading and shall have the following programmable outputs:

- mA proportional to user definable engineering units.
- SPDT relay contact output closing upon failure of the signal converter,
- lost echo or multiple echoes.
- Off SPDT contact outputs with independently set trip points. These
- outputs shall be programmed to energise upon high/low levels, rate of change or to allow a number of pump sequencing operations. Contacts rated at 5A 240V ac, non-inductive.
- Serial ports RS 232 for down-loading data.

1102.8 Electro-Magnetic Flow Meters

Electromagnetic Flow meters shall be sized and installed in accordance with the manufacturer's recommendations as approved by the Engineer, BS 5792 and BS 6739.
Flow meters shall be supplied with a calibration certificate. Electromagnetic flow meters shall be selected and sized to give a maximum velocity of between 1 and 7m/sec. The minimum velocity achieving the stated accuracy shall be not more than 0.1 m/sec.

The flow meters shall be of electromagnetic inductive type having a DC pulsed field with automatic zero error averaging and low power consumption. They shall have no moving or protruding parts nor cause any restriction in the flow path and be capable of setting adjustments without the need to stop the flow.
Each metering system shall comply with BS 5792 a
nd comprise a flow sensor mounted in the pipework line and a signal converter, wither integrally mounted or remotely located preferably within the main control panel.

The system accuracy shall be a maximum at normal operating flow with an error not more than 1% of the reading. When operating in the lower 30% of the meter range, the accuracy shall be within ±3%.
Flow sensors - these shall comprise electrodes located in ammeter tube which shall be of watertight construction, suitable for operation without loss of accuracy when totally submerged to a depth of 3 metres.

The meter tubes shall be made from a non-magnetic material lined with an inert material suitable for the medium and fitted with flanges to suit the pipework system, the lining material being applied such that it extends from the bore of the tube to fully cover the raised face of the tube flanges.

The measuring electrodes shall be continuously cleaned by means which do not interrupt the process flow or the measurement. A sensing electrode shall also be provided to detect when the flow meter is not fully charged with liquid.

The flow meter body shall be effectively bonded by non-corrodible, tinned copper braid links at each end, to the adjacent pipework to ensure a good connection between the body and the metered liquid, an earthing flange being inserted where non-conducting pipework is employed.

<u>Signal Converter/Pulse Power Unit</u>
These units shall be suitable for operation from the flow sensor into output signals having the following features:
Single flow rate range adjuster suitable for the flow sensor.
Independent output signals shall be provided for each flow direction as follows:

- +5/0/-5 volts d.c. signal for telemetry purposes with magnitudes directly
- proportional to flow.
- 4-20 mA current signal, to be used for indication of flow, quantity, etc.
- 24V impulse for integration counter drive.
- Works presettable system response time.
- Output driven downscale to zero on receipt of a 'flow meter empty' signal from the liquid sensing electrode.

The transmitter shall have the following programmable outputs:

- mA, proportional to use definable engineering units.
- off multifunctional SPDT relays. Individually programmed to allow a number of sequencing operations, rate of change or high/low flow indication. Contacts rated at 5A 240V ac, non-inductive.
- Serial port RS 232 for down-loading data.

Flow Meter Cabling

Where remote mounted converters are specified, cables shall be provided, installed and terminated between the sensor and converter/pulse power unit for the following purposes.:

- flow signal;
- reference signal;
- coil supply;

Such cables and sealing glands shall be suitable for submersible operation of the sensor to the depth specified. The length of each cable shall be as specified.

Spool Piece: A flanged steel spool piece shall be provided of the same diameter and length as the respective flow meter and flanged for insertion in the pipe should it be necessary to remove the flow meter.

Isolating valves shall be provided on either side of the flow meter.

Differential Pressure Flow meters and Differential Pressure Switches

Flow meters of the differential pressure type shall be designed and installed in compliance with ISO 5167-1 or an Approved Standard. Primary devices shall be insertion probe type or carrier-ring type orifice assemblies with stainless steel orifice plate, or venture tubes shall include two sets of gaskets and fixing bolts for each primary device. Gasket materials shall be appropriate to the metered fluid and service conditions. Full details of orifice or venturi tube calculations shall be supplied.

Orifices shall be square-edged and concentric. The upstream edges of orifices shall be sufficiently sharp that the reflection of a beam of light from the edge cannot be seen without magnification. Drain holes shall be provided. The diameter ratio shall be between 0.20 and 0.70. Orifice assemblies shall have identification tags showing the direction of flow, orifice diameter and position of drain hole. The identification tag shall be welded to the plat before the orifice is machined.

Insertion probe type installations shall follow the equipment manufacturer's recommendations. The probe shall be mounted to a standard sired ferrule or flange plate and include appropriate 3-way value block.

Differential pressure transmitters and switches shall have over-range protection up to 1.5 times the maximum line pressure.
Location of these devices should be such that no turbulence shall interfere with the measurement of pressure either side of the device.

Signal Converter
The sensor shall be of the inductive type giving an output of 4 -20 mA proportional and the flow rate and a totaliser. The sensor shall be protected to IP 66 and having the following characteristics:

- Accuracy: <±0,25% of FSD between 25 and 100% of the flow measured.
- Stability: 6 months period: ±0,25% of FSD
- Voltage supply: 200 Vac
- Sensitivity:0,005%/V at 50% flow and more

Differential pressure switches shall have contacts with differing "cut-in" and "cut-out" values. The nominal values at which differential pressure switches operate shall be fully adjustable over the whole range of the instrument and the set value shall be clearly indicated by means of a scale and pointer. Contacts of differential pressure switches shall be hermetically sealed.

1102.9 Mechanical Flow Meters

Mechanical flow meter shall be volumetric, jet or in-line helical vane (Woltman) type to Standards ISO4064/BS 5728 EEC Specification with integral strainer. Meters shall be designed for minimum maintenance and shall incorporate best quality rotor bearings to ensure long working life.

Meter bodies shall be cast in spheroidal graphite iron to BS EN 1563. All internal parts shall be manufactured from non-corrodible materials.

Meters are for the measurement of potable water flow with a normal working temperature up to 30ºC and a maximum working pressure of 16 bar.

Meters shall be generally in accordance with the following Table:

Meter Size (mm)	Q_{max}: PEAK Instantaneous Flow (minutes only) (m^3/h)	Qn: MAXIMUM Continuous Flow At ±2% measuring Error (m^3/h)	Qmin: MINIMUM Flow at ±5% Measuring error (m^3/h)
15	3.0	1.5	0.036
20	5.0	2.5	0.050
25	7.0	3.5	0.082
32	10.0	4.5	0.127
40	20.0	6.5	0.182
50	80	40	0.55
80	200	120	0.70
100	250	180	1.20.
150	600	400	3.00
200	700	550	5.00
250	1200	750	10.00
300	1500	1000	12.00
400	3000	2000	25.00

Measurement mechanisms shall be removable from the meter body without the necessity to remove the meter from the main. Meters shall be equipped with a register indicating flow in metric units a sweep hand and six figure counter. Dummy cover plates to seal the meter after the mechanism removal shall be provided.

Tapers shall be provided, or non-standard bearings and propellers, if required, to obtain the specified degree of accuracy at the specified flow rates.

The meters shall be suitable for working pressures up to 16 bar unless otherwise stated.

An extension drive and extended head shall be fitted to meters as required. The drive shaft bearings and gears shall be designed for long life under continuous operation, and normal wear shall not significantly affect the accuracy of the meter.

Meters shall have a circular dial and rate of flow indicator registering flow in litres/sec. A flow totaliser having at least six digits shall be incorporated in the head. The totaliser shall have a capacity of at least one years flow at maximum flow rate. A multiplying factor in multiples of 10 may be used in conjunction with the totaliser if required, however, if this is the case, the factor shall be clearly marked alongside the register.

Meters shall be individually flow calibrated at the manufacturer's works and shall be guaranteed to within 2% of true flow within the rated range of the meter. Each meter shall be supplied with a calibration certificate.

The spare parts shall include as a minimum spare gearing and bearings for each size of flow meter used.

1103 Electrical Works

Functional Precepts

1103.1 Plant Operation

The plant will be unattended and all constituent units shall be arranged to be fully automatic and maintained ready for service at all times.

In order to simplify operation and maintenance, all control schemes shall, as far as possible, follow the same operating pattern, have similar control cubicle layouts, and employ similar items to minimize spares holdings.

Electrical system design shall reflect the hydraulic system design as far as possible and shall be directed to making each major item of plant capable of running substantially independent of others. Where common equipment is employed, then every effort shall be made to ensure that no single fault can affect the entire plant and particular care must be taken to protect the overall integrity of the system.

Provided that the principle of segregation is not infringed, solid state or microprocessor based equipment may be incorporated within the various control panels in lieu of electromagnetic relays, timers, etc., in order to perform the necessary control functions. In this event, full details of the proposal to achieve segregation shall be submitted for approval with the Tender. All costs for programming, setting-up, providing and training of purchasers staff in the operation and maintenance of such equipment shall be separately identified in the Bill of Quantities.

1103.2 Power Supplies

The Supply Authority will be requested by the Employer to provide a reliable, secure and adequate power supply to each site. This supply may not be made during the period of the Contract and the availability of electrical power supplied cannot be guaranteed. The Contractor shall provide all necessary temporary power supplies, by use of mobile generators or otherwise, for purpose of construction, connection, installation, testing and commissioning of the Works. The Contractor shall be responsible for assessing the requirements, availability and reliability of all power supplies at each site and shall be deemed to have included in his tender for the provision of all necessary temporary electrical power supplies.

The electricity supply is a nominal 415 V, 3 ph, 50 Hz. The voltage may vary ±15% and equipment shall be rated to withstand this variation.

Power will be brought to the site by the client either at 11 kV or 415 V. Where the supply is at 11 kV, a stepdown transformer will be installed by the client. The Contractor shall provide all cabling and wiring from the transformer or from the client cut outs at the metering location. Buried cables within the station compounds shall be in duct.

The Contractor is responsible for ascertaining the exact details of the supply, including the type of earthing, the earth fault loop impedance external to the installation, and the prospective short circuit current.

The Contractor shall provide a certificate of completion from the Government Electrical Inspectorate (GEI) prior to the client installing the meter and cut-outs, and making the final connections.

The Contractor shall size all cables in accordance with the IEE Regulations or NEC. The Contractor shall submit all calculations for comment and approval prior to the installation being carried out. The Contractor shall also provide a single line distribution diagram showing equipment and cable ratings, earth loop and prospective short circuit values.

1103.3 Pump Units

All pump units shall have means of isolation from their associated pipe work system.

In dry well installations, the suction valve will normally be left open, unless used for isolation when the pump is out of service.

The delivery side of the pump set shall include a non-return device to prevent back circulation when the set is not running. This shall be a fail-safe device such that in the event of pump failure or loss of external services, the device shall independently close. A gate valve will normally also be installed on the pump delivery side, downstream of the non-return device, for pump isolation.

1103.4 Pump Unit Control

The pump unit control panel shall include all control and indication elements for the pump motor, together with any associated valve actuators, lubricating systems and valves, cooling fans, flushing pumps and other ancillary control equipment required by a pump drive, all arranged to operate in a safe and proper sequence.

Where external services are fitted to open the delivery valve, the control system shall initiate the valve opening procedure as soon as the pump is up to a speed sufficient to overcome any existing delivery pressure.

Failure of the valve to open within the time allowed or closure occurring whilst running, shall initiate an alarm and shut down the pump set.

1103.5 Pump Duty Control (4 or more Pumps)

Each of the pump units shall be capable of operating in any combination of duty sequence. The Contractor should apply a clear and reliable method of pump duty allocation and duty rotation, to evenly distribute running times for each pump unit.

Any starting sequence, including those following restoration after a supply failure shall be time sequenced to prevent excessive load on the supply system. Each duty circuit shall include its own timer, arranged to be initiated in the selected duty sequence by the preceding duty, the delay periods between each restart being adjustable up to 20 seconds.

Where a microprocessor based pump control system is employed using common modules, two modules shall be provided, each capable of controlling at least 50% of the pumps available, the duty set points being interleaved between each module to limit the effect of failure of one module.

1103.6 Level Control

The water level shall be monitored by a system providing the necessary duty set points, each being adjustable over the full range of control specified.

To achieve performance stability under all environmental conditions and variations, all necessary signal compensation devices shall be included.

The monitoring system shall be damped to prevent spurious switching due to transient wave motion but shall respond sufficiently to allow adequate time for plant reaction to stabilize in order to prevent hunting.

The system shall include a duplicate back-up monitoring device or have a built-in self-monitoring circuitry with alarm facilities.

Any high settings which may be provided as part of a level control system may be linked with the independent high level alarm sensors specified.

1103.7 Alarms and Indicators

Separate indication of the following conditions shall be provided by means of annunciators grouped as indicated on the front of the panel. All indications shall have a lamp test facility.

Alarm annunciators shall be provided with accept ad rest facilities together with an audible alarm and an audible/mute selector switch.

Each of the alarm conditions specified shall initiate its individual annunciator with a flashing indication which shall become steady when "Accept" button is pressed and be extinguished by the "Reset" button once the alarm condition is removed.

In specified unattended locations, self-reset facilities shall be provided to enable the system to restore itself to normal operation after the fault has passed.

With audible/mute switch set to"Audible", the audible alarm shall sound when the indication is flashing and be silenced when "Accept" button is pressed. In the"Mute" position the audible alarm shall be muted and any alarm initiation shall give a steady lamp indication only.

To prevent false alarms occurring during mains failures or on restoration of mains supply, the common alarms specified shall be supported by a battery backed supply, either directly or via an inverter.

1103.8 Control Selector

A three position Hand/Off/Auto selector switch shall be mounted on the front of the panel to give the following control facilities; the switch shall be lockable in each position by means of a barrel locking device incorporated in the handle and the switch handle shall clearly indicate the switch setting.

In the "Hand" position operation shall be by means of the "Start" and "Stop" push buttons mounted on the front to the panel with all plant protective devices retained in circuit.

In the "Auto" position the plant shall be operated automatically under the control system specified together with the plant protective devices.

1103.9 Emergency Stops

Where means of stopping are required adjacent to a motor of the driven plant to prevent danger, emergency stop push buttons, trip switched, or interlocks shall be provided, arranged to immediately isolate the supply, as long as a greater risk is not thereby introduced.

Emergency stop buttons shall have a stay-put lock off feature, with "twist to release" manually operated reset facility. Such a button shall be located on the motor starter panel. A key operated reset facility shall be provided where specified.

Where plant is normally enclosed or has fixed guards to prevent accidental contact from moving parts, stop buttons are not normally required adjacent to such parts.

Stop buttons shall be hard wired direct t all motor control circuits and not by way if any semi-conductor logic control circuitry.

Means of equipment isolation for maintenance purposes shall be provided. This may either be by use of key operated emergency stop buttons or lockable isolators, which may be at the control panel or local to the plant.

1103.10 Mains/Standby Supply Changeover

If the site is supplied from two alternative mains supplies, the changeover section shall monitor the three phase voltages of each of the two incoming supplies and automatically close the contactor to the healthy supply. The two incoming supply contactors shall be mechanically and electrically interlocked to prevent paralleling two healthy supplies.

Where a bus section switch is provided for manual switching arrangements to allow both supplies to be utilized without paralleling, the contactors must be electrically interlocked between each other and the bus-section switch. Voltage monitoring settings shall be adjustable and nominally set to operate on a rising voltage of 90% nominal, with low/high voltage settings at ±15% nominal on each of the three phases.

1103.11 Automatic Operation

Mains/Supply – Closing the incoming isolator or restoring a healthy supply will initiate the closing of the Mains contactor via the monitoring relays, subject to the generator operating condition.

Momentary supply drop-outs up to 5 secs. shall allow the plant to resume without further action. Breaks of supply greater than 5 seconds shall initiate the generator supply. Delayed start timer setting to be adjustable 0-3 min.

After any changeover of supplies, automatic or manual, the pump motor loads may be restored automatically or manually (remotely or locally) as specified but with sequential 20 seconds re-start delay timers incorporated in each pump starter circuit to prevent co-incidental starting surges.

1103.12 Voltage Drop

The volt drop within the installation shall not exceed a value suitable for the safe functioning of any fixed current-using equipment.

1103.13 Equipment and Cable Ratings

All busbars, cable, switchgear, fuses, motor starter,, relay, instruments, panel wiring, etc. shall be sized and rated in accordance with normal operational requirements of the associated plant and equipment, taking into account maximum load currents, volt drop, frequency or motor starting, maximum ambient temperature etc.

Where specific voltage or current ratings have been included on the drawings and in the description of individual items of equipment in the Specification and/or Bill of Quantities the values stated shall be deemed to be minimum values. It shall however be the responsibility of the Contractor to ensure that all equipment supplied is properly insulated and adequately rated to handle operational loads and, in the case of fuse gear and circuit breakers, to deal with prospective fault currents.

a) Switchboard Components

1103.14 Panel Construction

Panels shall be constructed of sheet steel having a minimum thickness of 2.0mm (14 SWG) or other approved material, and similar equipment shall be of the same manufacture and units of the same type and rating are to be interchangeable. The use of toxic, hygroscopic or flammable materials shall be avoided.

LV Panels shall be damp and dust protected (IP52) for indoor situations and hoseproof (IP65) for outdoor or wet situations, or as otherwise specified under the specific requirements.

HV Panels shall have covers and partitions affording a degree of protection IP53 to BS 5447 or equivalent for drawout sections. Internal partitioning, instrument and control sections etc. shall be to IP52.

Switchboards shall incorporate a rigid steel frame and be suitable for ready extension at each end without further cutting or drilling. Composite switchboards shall be assembled by the principal electrical manufacturer and shall be sectionalized as necessary to facilitate handling.

Switchboards shall include barriers between each of their units to ensure safe maintenance on any circuit during normal operation with the remainder of the board live. When a functional unit is isolated and open, the degree of protection to any remaining live part shall be at least IP20. Barriers or covers to live components shall have warning labels attached.

If any compartments are provided within a section of outgoing units which are not fully equipped, they shall be arranged so that they can be fully equipped without de-energizing that section of the switchboard.

Cubicle type switchboards shall be totally enclosed, flush front and rear patter, arranged in a multi-tiered formation if practicable, with at least 300mm clearance between floor level and any operational item of fuse gear or control gear. Kicking strip protection shall be provided by a 100mm high plinth forming the base of the switchboard.

The overall height of control panels, including plinths, shall not exceed 2300mm. Isolator handles, control switches, push buttons indicator lamps and instruments shall be centred not more then 1900mm above finished floor level.

All components mounted on the front of the panel shall be of matching uniform appearance, orientation and colour, with all bezels and escutcheons finished black. The layout and grouping of components shall be as approved or specified.

Within each control cubicle a reduced size schematic diagram of the control circuit, printed on durable material, shall be permanently fixed.

1103.15 Doors and Covers

Each section or compartment shall be provided with full width access doors or covers, with individual doors or covers not exceeding 750mm width.

All doors and covers shall have returned edges for rigidity and incorporate dusts seals of flexible material secured in channel rebates. Covers exceeding $0.5m^2$ in area shall be provided with a supporting lip within the lower edge or have lift-off hinges. All doors shall be supported on strong hinges of non-corrodible material and shall be secured by adjustable quarter turn cams, operated by small TEE handles incorporating key operated barrel locking facilities or flush locks with drive key inserts. Covers shall be secured by similar fastenings or captive bolts.

All additional fittings such as handles, hinge brackets and locks shall be a black finish, polyamide moulding or epoxy coated metal.

Doors shall open at least 90º with the opening positively limited such that doors and their appurtenances are prevented from fouling adjacent panels when opened.

1103.16 Switchboard Rating and Busbars

Switchboard busbars, droppers, switchgear and its associated cable boxes shall be mechanically and electrically designed to withstand the fault level and duration specified herein and (except for LV switchboards rated less than 900A) shall be an ASTA certificated design rated at not less than 80kA RMS for 1 sec. or 50 kA for 3 sec. LV switchgear and motor control gear shall comply with BS 5486 Form 4 segregation of busbars, functional units and terminal chambers, unless otherwise specified.

Busbars and droppers shall each be air insulated and formed from solid drawn high conductivity copper bars, having a constant current rating with a uniform cross sectional area throughout their length. Each shall be clearly marked with the appropriate colours to indicate each phase, neutral and earth. Droppers shall be s short and as straight as possible. Busbar compartments shall be fully segregated and shrouded from all other sections of the switchboard.

All busbar connections shall have at least two bolt fixings, and due considerations shall be given to high stresses at bolted connections on high voltage equipment. Where flexible busbar connections are used these shall be secured by high tensile steel and nuts with anti-vibration locking devices.

1103.17 Earthing

All metal cases of meters, relays, instruments, starters, and control switches shall be connected to the switchgear frame earth terminal by means of green and yellow PVC insulated cable, not less than 2.5mm^2 cross section.

An earthing terminal or group of terminals shall be provided in the panel for termination of panel earthing connections and incoming cable earth or connection to a main earth bar.

A main earth bar of copper shall be provided to run the length of each board so that all cable sheaths and armouring may be bonded to it. Where the fault level at the switchgear is 33kA or less the minimum size shall be 31.5mm x 6.3mm x 6.3mm.

1103.18 Panel Preparation and Finishing

The whole preparation and paint system shall be suitable for the operating environment specified and a painting schedule giving details of preparatory treatments, types of paint, number of coats and method of application shall be submitted with the Tender. Proprietary items may be used in their standard finish subject to the approval of the Engineer.

The system proposed shall conform to the following minimum requirements.

- After all machining and forming has been completed all steelwork surfaces shall be thoroughly cleaned of rust, welding slag or spatter and other contaminations prior to any painting.

- Panels for indoor location shall, immediately after cleaning, have all surfaces protected by an approved zinc-based corrosion resistant primer, followed immediately by one intermediate and two finishing coats of pant to give a minimum total dry film thickness of 560 microns (0.002”).

- Panels for damp situations or outdoors shall have the surfaces grit blasted and zinc sprayed within 4 hours to BS 2569 Part 1 to a thickness of 125 microns (0.005") at the works. The final paint finish shall be one of two pack epoxy primer and two coats of epoxy paint to give a minimum total dry film thickness of 75 microns (0.003").

- Steel fixings and fastenings shall be treated to prevent corrosion by hot dip galvanizing to BS 729 or sheradized to BS 4921 Class 1 before painting. Chromed fittings shall not be used.

- Any damage occurring to any part of a painting scheme shall be made good to the same standard of corrosion protection and appearance as originally employed. Any finish coat applied on site shall be considered for decorative purposes only.

1103.19 Paint Colours

The colours of the primer, intermediate and finishing coats of a paint system shall be easily distinguishable from each other and the materials used shall be suitable for the application employed and preferably be supplied by one manufacturer who shall ensure that all coatings are compatible.

Electrical control panels shall be gloss finished in the following final colours:

DETAILS	COLOUR	BS 4800 Ref:	BS 381C Ref:
Panel Exterior	as advised by the Engineer		
Interior Equipment	White	10 B 15	-
Trays	White	10 B 15	-
Bushbar Shutters	Signal Red	04 E 53	537
Circuit Shutters	Lemon Yellow	10 E 53	309

1103.20 Labels

Each switchboard shall be provided with a title label and have circuit designation labels fixed to the front and rear cover of each circuit compartment. Rear covers for more than one sub-section shall have labels for each sub-section. In all cases, the label shall be positioned so as to leave no doubt as to which item it refers.

All indicators, instruments, relays, control switches, push-buttons, fuses and other ancillary apparatus shall be provided with labels clearly stating their function.

Character sizes for mains title and circuit designation labels shall be at least twice those for ancillary items.

All label inscriptions shall be to the front of the switchboards/control panels/starters shall be of transparent Perspex with radiussed or chamfered front edges, reverse engraved with white infill then sprayed on the rear to match the colour of the board. Other labels shall be sandwich type white/black/white, or yellow/black/yellow for Danger labels, or as approved by the Engineer.

All labels shall be fixed square to the equipment by means of screws or rivets of nylon or non-corrodible material. Labels affixed with adhesive will not be accepted.

1103.21 Cabling Facilities

Cable boxes and glands shall be accommodated within cubicles except where otherwise approved and all removable access, sealing and gland plates are to be provided with gaskets to form an adequate seal against the external atmosphere.

Adequate space within each compartment shall be allowed for external cable tails to be connected without stress on the terminations, bearing in mind the type and size of such conductors. Where multi-cores in excess of 95mm^2 or any single core cables are to be terminated, a minimum distance of 450 mm free space shall be allowed between the gland plate and the terminal connection point.

In multi-tier compartments, individual terminal covers and gland plates shall be provided for each circuit such that additional circuits may be terminated safely whilst the switchboard is energized.

For paper insulated cables, a suitable cable end sealing box shall be provided for each circuit as specified. Where the cable enters from beneath the panel, the bottom of the wiping gland shall be at least 150 mm above the panel floor level. Removable split ends sealing plates are to be provided for subsequent fitting around such cables.

Undrilled removable gland plates shall be provided for cables requiring compression glands entering from beneath the panel. The plate shall be located at least 300 mm above the panel floor level and shall form part of a compartment constructed within the panel to seal the interior of the panel. Access for glanding-off shall be provided by removable covers fitted to the available vertical sides which may extend the full width of the panel as necessary.

Where single core cables are to be accommodated, a non-magnetic or slotted gland plate shall be provided.

Terminals, studs or drilled holes shall be provided to accommodate all necessary cable terminal lugs and, prior to manufacture, The Contractor shall confirm cabling termination requirements with the Engineer.

1103.22 Panel Wiring

Panel wiring should be run neatly within the cubicle in suitable cable looms or panel trunking, and in the case of instrument, intrinsically safe or safety extra-low voltage circuits, run in separate groups accommodated within the cubicles. The looms or trunking shall be adequately secured without the use of adhesive material. Wiring carried across door hinges shall be neatly loomed and rolled in torision in the plane of the hinges to minimize flexing of the wiring, thus wiring shall enter and leave at different levels as widely spaced as practicable. Bushings or grommets shall be used where wiring passes through sheet metal or plastic.

All components and auxiliaries in repetitive units shall be wired in an identical pattern to match the arrangement of each component.

Wiring cables shall be adequately rated, tinned copper stranded conductors or not less than 1.0mm^2 (32/0.2) PVC insulated 600V grade, except wiring to PLC or other light current equipment which shall be not less than 0.5mm^2 (16/0.20).

Wring insulation shall be coloured as follows:

AC Circuits

Mains supply (LV) - Black

Uninterruptible power supply (LV) - White

ELV supplies (up to 50V AC) - Yellow

Intrinsically safe circuits - Blue

DC Circuits

Battery supply (ELV, not exceeding 120V DC) - Grey

Where various voltages exist within the above definitions, the colour coding shall be subject to agreement with the Engineer.

Each wire shall be terminated with suitable ring or spade crimps or bootlace ferrules and identified at both ends by means of white or resistor colour-coded ferrules imprinted to correspond with the diagram connections.

Wires linking common points in the circuit shall bear the same reference at each termination. Alternative identification methods require prior approval of the Engineer.

1103.23 Terminals

All terminal blocks for the connection of small wiring shall comprise shrouded anti-tracking mouldings or melamine phenolic or comparable material with provision for securing conductors either by high tensile screws and clamps or be solder tag connection.

Terminal blocks shall be arranged so that both terminals and wiring ends are readily accessible and have separate terminals provided for incoming and outgoing wire, together with insulated barriers between adjacent connections and transparent insulated covers. Blocks accommodated on common mounting rails shall have a foot designed to ensure s a secure fit to the rail. Foot springs shall be of stainless steel and have a locking device fitted to prevent accidental release of the block.

Each terminal shall be labeled to correspond with the diagram of connections and terminal identification labels shall be attached to the fixed portion of the terminal blocks only. Terminals for intrinsically safe circuits shall be clearly segregated and coloured blue.

Terminal which may be ‘live’ when the equipment is isolated from the main supply shall be adequately shielded from accidental contact and be clearly identified and inscribed accordingly.

1103.24 Current Transformers

Each current transformer shall bear a label showing the ratio, class, short time factor and accuracy limit factor. The inscription must be reasonable when the transformers are installed within the gear without the necessity of dismantling any equipment other than removing cover panels.

Bar type current transformers shall be supplied in preference to those with wound primaries. Short time current factors shall relate to the full fault level specified. For over-current protection, the product of VA rated burden and rated accuracy limit factor shall be 150 unless otherwise agreed with the Engineer.

One secondary terminal of each current transformer shall be earthed at the switchgear.

1103.25 Voltage Transformers

Voltage transformers shall be vacuum impregnated or encapsulated resin insulated type. Each transformer being fully isolatable and accessible for maintenance purposes and fitted with primary and secondary fuses.

1103.26 Indicating Instruments

All indicating instruments shall be of a similar flush vertical mounting, rectangular pattern, enclosed in black coloured, dust and damp-proof cases, one side being not less than 90mm (3.5”) long or as specified. Scaling shall be in approved metric units normally ranged from zero to 20% - 40% above the system designed operating value,

except where finite limits exist (e.g. p.f. indicators, synchroscopes) or where restricted ranges are specified. Instruments having a mechanical movement shall provide at least 90º scaled arc. 240º arc scales shall be employed on principal specified indicators.

Ammeters for motor circuits shall have an extended scale to cater for the starting current. These shall be adjustable red pointers or red markings on the scale to indicate the normal circuit current for the associated plant and shall be connected to each of the three phases of a three phase motor circuit.

1103.27 Indication Lights

Indication lights shall be flush panel-mounted types with bodies fastened and keyed to that the lamps shall be capable of replacement from the front of the apparatus without disturbance to the lamp-holder or panel wiring. Lens colours shall be specified in the Specific Requirements. Bezels shall be coloured black.

All light sources shall be operated at Extra Low Voltage. Single units shall be dotted with MES caps and be illuminated by LED clusters where colours permit otherwise filament lamps shall be used.

To extend lamp life, filament lamps shall be arranged to operate approximately 20% below their rated voltage and details of voltage and type of indication lamp shall be submitted for the Engineer’s approval. Particular consideration shall be given to circuits operated from a battery supply permanently floating across a charging circuit, where terminal voltage may be higher than the nominal voltage.

When annuciator style indicators are used they shall incorporate two lamps wired in parallel for each fascia which shall have a window area of not less than 48mm x 24mm. the engraved characters shall be not less than 3mm in height and shall be filled black on a translucent background coloured as specified.

Alternatively where specified (particular for unattended situations) self-contained LED annuciator display modules shall be used and configured for panel mounting. Legend plates shall be provided adjacent to each indicator. Where message display indicators are used, they shall have programmable legends and adjustable pulse rates.

1103.28 Push Buttons

Push buttons shall be heavy duty, double break pattern with fully shrouded moulded buttons having a spring return action through a flexible oil-tight seal. Each button shall be coloured in relation to its function accordance with Appendix 2 or as otherwise specified herein and bezels shall be coloured black.

Emergency stop buttons shall be arranged to de-energise without delay the drive motors for the whole of the associated plant whatever control mode of operation may be selected. They shall be of the 'stay put' type having a large red mushroom head with twist-to-release manual reset, suitably labeled and have at least two poles, 1 N/O and 1 N/C with contacts suitable for the circuit operation.

Where key reset heads are required, the key shall be common for all buttons.

1103.29 Control Relays

Control circuit relays for switching 5A/250V or less shall be of the multi-pin plug-in type having the following features:

- Neon or LED indication of relay energisation;
- mechanical ON/OFF indication;
- manual test button with provision for retention of the button in the operated condition for test purposes;
- legend plates on relays and base;
- relay retaining clip;
- be mounted on moulded bases having recessed screw terminals.

If sufficient contacts are not available in one relay, not more than two relays may be connected in parallel.

Any relay used to switch an external alarm circuit shall have a volt-free contact for the purpose.

1103.30 Protection Relays

Electro-mechanical protection relays and associated devices shall be provided as specified, suitable flush mounting in dust proof cases; withdrawable types being provided where they are fitted in fixed panels.

Where not mounted on a battery sourced alarm monitoring display, the relays shall have hand-reset flag indicators unless a self reset or electrically-reset facility is specifically called for. Hand-set indicators shall be capable of being reset without opening the relay case. Flag indicator relays shall be de-energised once the flag has fallen.

Where two or more elements are included in each case, separate indicators shall be provided for each element.

1103.31 Fuse Links and Holders

Suitable rated fuses shall be provided at all points necessary for circuit protection and isolation, separate fuses being provided for instruments, indication, alarm, heater and coil circuits. Fuse ratings shall be rationalized as far as possible to limit spares.

LV Fuses in circuits exceeding 50V shall, where practicable, be housed in all insulated carriers with fully shrouded bases of matching colour, which shall not be interchangeable with carrier and bases provided for removable solid links which shall be coloured white.

LV fuse links shall be HRC cartridge type to BS 88, Class Q1, having provision for screw fixings for attachment to the carrier.

Control and Instrument Fuses may be accommodated in moulded terminal blocks suitable for DIN rail mounting. Fuses rated up to 6.3A 250V shall be 20 x 5 mm (G type DIN 41660) having a hinged fuse carrier housing.

Fuses rated up to 13A 250V shall be 25 x 6.3 mm cartridge type to BS 1362, secured by a screw cap. The live connection being made to the lower terminal.

1103.32 Locks and Keys

Lockable selector switches or panel doors in a multi-unit installation shall employ a common interchangeable operating key but keys for each function may be non-interchangeable, subject to the approval of the Engineer.

For each key pattern employed, three keys shall be provided; each having a permanently attached brass identification label, embossed with the following:

- key number
- location of lock/item of equipment reference.

Lose padlocks and keys for security locking switchgear, isolators, shutters etc. shall not be included but will be provided by the Client to suit their master key suite to permit locking. Hasps shall not have less than 9mm diameter holes suitable for 6mm diameter shackles.

1103.33 Key Cabinets

Key cabinets shall be provided to accommodate, on suitably numbered/coloured, adjustable hook bars, one set of all the above keys and padlocks. The keys shall be fitted with corresponding number/colour coded tabs.

The cabinets shall be of stove enameled sheet material, suitable for surface wall mounting and be fitted with lockable hinged cover doors.

1103.34 Insulating Mats

Black rubber matting shall be supplied complying with BS 921 and shall be supplied for all indoor control or switch gear panel. It shall extend the complete length of the control panel and the minimum width shall be one metre.

b) HV Breakers and Disconnectors

1103.35 Circuit Breakers

For AC circuits, circuit breakers shall be triple pole of the vacuum interrupter, SF6 or air break type as specified, suitable for short circuit fault duty specified herein. Low voltage breakers shall incorporate a neutral link, unless in special cases a neutral pole is called for on the breaker under the specified requirements. Air or oil break circuit

breakers shall be 'trip free' and the whole of the operating mechanism shall be suitable for such conditions of operation.

The whole equipment shall be robust and capable of withstanding repeated closing and opening impacts satisfactorily.

Each breaker shall be provided with the following:

- Mechanical 'Flag' indicator giving reliable indication that it is either "Off" (open) or "On" (closed);
- Means of isolation so that the breaker may be maintained with busbars alive;
- An operating handle that can be concealed when not required, ensuring a flush fronted appearance;
- An adequate number of auxiliary switches with the addition of one normally open and one normally closed spare switches, all to be wired to a terminal board of approved design in the fixed portion of the switchgear and arranged in the same sequence on all equipment;
- Protection relays and tripping devices as specified;
- Facilities for connection of appropriate auxiliary circuits when the circuit breaker is in the isolated position to permit operation of the breaker for test and indication purposes;
- Key operated interlocks between breakers as specified.

1103.36 H V Disconnectors

HV disconnectors shall be triple pole, oil free switch-disconnectors rated for fault making/load breaking duty to IC 265, mounted on a non withdrawable chassis and enclosed in a metal clad enclosure in accordance with BS 5527 or equivalent.

The contact breaking mechanism shall incorporate expulsion quenching techniques to ensure positive arc extinction and high closing speeds to enable the switches to close onto existing short circuits without harming the equipment or the operator.

The switches shall be either manually or electrically closed and manually or electrically tripped as detailed in the Specification Requirements. All operations shall be effected with the panel door closed and include an ON/OFF indicator. Contact separation shall be clearly visible through a viewing window on the cover.

1103.37 Safety Shutters

Where withdrawable circuit breaker units are used, the housing shall be arranged to accurately locate the movable portion prior to engagement and accommodate automatic safety shutters.

Each group of busbar and circuit spout orifices shall be fitted with an individual automatically operated safety shutter, the appropriate shutters being positively opened or closed when the circuit breaker is racked in or out.

When closed, the shutters shall effectively prevent any contact with either the busbar or circuit connections and seal the spouts against the ingress of dust. The shutters shall be painted in bold characters 'CIRCUITS' as appropriate, the busbar shutter being coloured red and the circuit shutter being coloured yellow (see Appendix 8).

For testing and inspection, each shutter shall be separately hand operated from the front of the unit and latched in the open position. Any movement of the circuit breakers either in or out of the housing shall automatically restore the automatic feature.

Provision shall be made for each shutter to be locked only in the closed position.

Non-withdrawable HV switchgear shall have a three phase test access point incorporated in the design such that cable tests may be carried out on each circuit. The test access point shall be fitted with a lockable cover and interlocked to prevent access to live circuits.

1103.38 Provisions for Earthing

Provision shall be made for earthing the busbars and each circuit outlet through the circuit breaker, either integrally of by means of a portable device as specified; such an arrangement being suitable to withstand the full short circuit rating of the switchgear.

Where integral earthing facilities are included, selection of the locating mechanism shall prevent the breaker being engaged into any position other then that selected. Visual indication of such circuit breaker locations shall be clearly marked, e.g. “CIRCUIT EARTH’, “BUSBAR EARTH”, “SERVICE/ON” and “ISOLATED/OFF”.

Facilities shall be provided so that padlocks can be fitted to prevent the selection of either “EARTH” positions.

Facilities shall be provided for padlocking the circuit breaker while it is closed on to an earth circuit to prevent unauthorized tripping electrically or mechanically.

The circuit breaker truck (or carriage) and oil tank if applicable, shall be effectively earthed when in the “SERVICE/ON” position.

HV switched shall have facilities for earthing the circuit by means of a selector ad the ON, OFF and EARTH positions shall be visibly indicated, appropriately labeled and provided with locking facilities in each position. Inspection windows shall be provided so that the position and condition of the selector contacts and insulators can be observed.

1103.39 Interlocks

Each circuit breaker unit shall be provided with mechanical interlocks to prevent incorrect operation or accidental contact with live metal, and to protect the equipment and operator from the dangers of mal-operation and designed to prevent the following where relevant:

The circuit breaker being closed unless it is in the fully-engaged or fully-withdrawn position.

The circuit breaker being engaged and plugged into the busbar and circuit spouts unless the tank is bolted to the top-plate.

The circuit breaker being engaged or withdrawn unless the main contacts are open.

The circuit breaker unit being withdrawn from or pushed into the unit housing unless the breaker is in fully-withdrawn position.

The circuit breaker being positioned in the unit in any position other than that indicated on the locator.

Access to voltage transformers unless they are in the isolated position.

1103.40 Handling Track

For each switch boar and different type of breaker supplied, on purpose designed, manually operated lifting and handling track shall be provided to enable safe removal of a circuit breaker from its compartment.

1103.41 Switch Oil

The first change of switch oil shall be provided for each oil circuit breaker or switch. An oil level indicator shall be provided on each tank with maximum and minimum limits marked.

c) LV Distribution Switchgear

1103.42 Switches

Switches shall be of the air break patter, enclosed zinc sprayed heavy duty, cast metal or sheet steel cases providing enclosure protection to at least IP55 unless otherwise specified, suitable for industrial surface mounting or flush cubicle mounting as specified.

They shall berated in accordance with BS 5419 or equivalent and be fitted with solid or HRC fuse links as appropriate in each phase and a neutral ling, all contained within the switch case, with the terminals accessible from the front of the switch. Phase barriers and contact shrouds shall be provided with an interlock to prevent withdrawal or access when the fuse switch is in the 'ON' position.

Each switch shall have a free handle control mechanism to prevent inching and damage to contacts, be fitted with 'ON' and 'OFF' position indicators and have provision for locking in the 'OFF' position. When padlocked in the 'OFF' position, interlocks shall prevent the unit door being opened.

The moving contacts of fuse switches shall be readily withdrawable as a complete unit for maintenance when the remainder of the board is live.

1103.43 Distribution Fuseboards

Fuseboards shall be of the rust proofed, zinc sprayed, heavy gauge sheet steel, having a flush fronted door with concealed hinges and a resilient gasket, providing enclosure protection to al least IP 55 unless otherwise specified.

The interior shall be assembled from all-insulated shrouded fuse carriers and bases of the 380V patter, fitted with phase dividing barriers and all live parts being fully shrouded, all in accordance with BS 5486 or equivalent.

Circuit identification charts shall be fitted to the inside of all fuseboard doors.

All fuse carriers shall be fitted with fuse-links rated to suit the circuit duty. Spare ways shall have fuse links of the same current rating as the carrier, unless different current ratings are called for under the specific requirements. The Contractor shall however confirm fuse ratings with the Engineer before fitting fuses to the carriers. Fuse-links shall be of the HRC cartridge type to BS 88, Class Q1, having screw fittings to the carriers.

1103.44 Molded Case Circuit Breakers

Molded case circuit breakers shall be of the quick make, quick break, and trip-free type complying with BS 4752 and shall be complete with thermal/magnetic releases, except for those units serving as isolators only. Multiple

breakers shall have a common trip bar and trip elements on each pole to ensure that any abnormal condition on any one pole will cause all poles to open simultaneously.

Visual indication of open, close trip conditions shall be provided. Facilities for padlocking in the 'OFF' position shall also be provided.

1103.45 Miniature Circuit Breakers

Miniature circuit breakers shall be of the quick make, quick break, trip-free type complying with BS 3781 Part 1. Circuit breakers shall be complete with thermal/magnetic or magnetic/hydraulic releases. Multiple breakers shall have a

common trip bar and trip elements for each pole to ensure that any abnormal condition on any one pole will cause all poles to open simultaneously.

Visual indication of open, close trip conditions shall be provided. Facilities for padlocking in the 'OFF' position shall also be provided.

1103.46 MCB Distribution Boards

Miniature circuit breaker distribution boards shall be totally enclosed, metal clad, flush fronted units, with a hinged front door, all in accordance with BS 5486 Pt 12. The interior shall be assembled from all-insulated miniature circuit breakers with bolted connections and with switch dollies arranged for vertical operation. Phase dividing barriers shall be provided and all live parts shall be screened from the front. Circuit identification charts shall be fitted to the inside of all distribution boards.

1103.47 Terminals

All terminal boards and terminal blocks shall provided a positive mechanical clamp type connection. Pinch screw type terminals shall not be used. Terminals for the connection of all external cabling shall be situated at least 100mm from their respective gland plate or further if the cable size requires a greater distance for dressing.

All main phase terminals shall be suitably marked to ensure correct phase identification.

1103.48 Labels and Circuit Lists

All electrical equipment enclosures shall be clearly labeled to indicate the plant designation.

Individual items not subject to switchboard requirements shall have labels of non-corrodible, Traffolyte sandwich type white/black/white, or yellow/black/yellow for danger labels or as approved by the Engineer. They shall be fixed square to the equipment by means of screws or rivets of nylon or non-corrodible material. Labels affixed with adhesive will not be accepted.

Inscriptions on labels and circuit lists shall be in English and Arabic and be submitted for the approval of The Engineer. Abbreviation 'No.' shall not be used.

A list of circuits in approval form shall be supplied and fixed behind a "Perspex" sheet on the inside of the all distribution boards which are provided or rewired under this Contract.

1103.49 Residual Current Circuit Breakers

The circuit breaker shall be arranged to isolate each live conductor simultaneously within 30ms if the residual leakage current through the device exceeds 30mA.

It shall be housed separately or incorporated into other composite enclosures, include provision for testing the tripping operation under earth leakage conditions by means of a built-in resistor and push button, and require manual resetting.

d) Motor Starters

1103.50 General

Each starter shall contain all the necessary equipments to control the circuit load and isolate it from the supply in the event of a fault and shall be equipped to comply with the following general requirements unless otherwise specified under the relevant starter duties.

For starting LV Motors direct on line, the starter shall be rated for intermittent duty class 0.3 (up to 30 operating cycles/hour) and utilization category AC-3 in accordance with BS EN 60947, or as otherwise specified.

Unless otherwise specified for particular cases, pump starting shall be by autotransformer. Small motors may be direct-on-line or star-delta started as applicable.

The ratio of the starting intensity and the nominal intensity shall be inversely proportional to the power of the motor; the following values shall be used for determination of starting requirements:

For plant which is not supplied by a standby generator set:

$\frac{I_S}{I_N} = 6$ when the nominal current of the motor is between 15 an d40 A; and if the starting current lasts less than 1 second;

$\frac{I_S}{I_N} = 3$ when nominal current if the motor is between 40 and 125 A;

$\frac{I_S}{I_N} = 2.5$ when the nominal current of the motor exceed 125 A.

Where plant is supplied by a generating set, the above mentioned values are respectively the following: 4-2.5-2.

Unless stated otherwise, power factor correction shall be provided at all sites to give a power factor of not less than 0.9 lagging at duty point load. Except for smaller installations where the capacitors may be located within the starter sections(s), power factor correction capacitors shall be generally housed in their own separate section, complete with a switch fuse isolator. Panel sections that are fitted with capacitors shall have a prominent warning label in English and Arabic stating that the capacitors may remain charged.

Power factor correction circuitry shall be arranged such that the capacitors are not in circuit whenever the panel is being supplied from a standby generator.

1103.51 Isolation

Each unit shall be housed in a separate compartment or enclosure and be completely isolated by means of an isolating switch interlocked with the door or cover to allow access only when the switch is open. The isolating

switch shall be operated by means of an external handle and shall have provision for padlocking in the "OFF" position.

When in the "ON" position, interlocks shall prevent the unit door being opened. Any components still live after this switch has been opened shall be adequately shrouded and have warning labels attached thereto.

The switch shall be rated for making and breaking stalled motor current duty as specified in BS 5419. Off-load isolators shall be suitably interlocked to ensure that they do not make or break load currents and be provided with locking facilities in the "OFF" position.

Additional physical isolation by means of withdrawable units for ease of maintenance may be offered but is not a specific requirement. For such an arrangement the live poles shall be automatically shuttered when the unit is withdrawn and the shutters have provision for padlocking in the closed position.

1103.52 Contactors

All contactors shall be of the air-break electromagnetically held-on type. All contact pieces shall be readily replaceable and the necessary auxiliary contacts for control, indication and alarm shall be mounted in accessible positions and arranged in the same sequence on each contactor.

Vacuum interrupters shall be used for high voltage circuits. They shall be solenoid operated and designed to fail-safe, sot that in the event of failure of any part of the closing mechanism the contacts will open.

1103.53 Protection

Each starter shall be provided with an adjustable motor over-load and single phase protection device suitable for the motor load and have adjustable trip and rest delays provided, together with manual resetting facilities. Ambient temperature compensation shall be provided where relevant. Other protection features shall be as specified relevant to the particular drive.

Protection devices shall be arranged to trip the load and initiate the fault indications as specified and accept normal switching of load.

Where starters are fed directly from busbars or other systems having a high prospective fault level, suitably rated fuses or other means shall be provided within the started to limit the fault let through to a value within the rating of the starter components.

Protective overload devices shall be arranged to ensure that any such fault is cleared by such fuses and provide Type '2' co-ordinated protection to BS EN 60947.

1103.54 Control Circuit

All control circuits shall operate at not more than 110V and be derived from a double wound, screen earthed isolation transformer with one side of the secondary winding connected to neutral/earth. The primary supply shall normally be from one phase to neutral if available.

Individual transformers shall be provided for each starter but sequence groups of starters having a common isolator shall use a common control transformer.

Fuses shall be provided on each primary and secondary supply and be clearly labeled and segregated. A link shall be fitted in the neutral/earth connection.

The control circuit in the main supply must be isolated before opening the cubicle door but provision shall be made to re-energise the control circuit when the main supply to the cubicle is isolated, so that the operation of the control gear may be inspected without de-energizing the motor. The necessary control circuit Normal/Test switch shall be mounted within the cubicle and so arranged that it is not possible to close the door with this switch in the 'Test' position.

1103.55 Control and Monitoring

The method of control and operation shall be as called for under the specific requirements for the starter.

Control selector switches fitted to the front of starters shall have matching operating handles which are clearly shaped to show the selected position. Specified function switched shall have a key operated barrel locking device in the handle, or be key operated alone, with the key removable in each lockable position.

All fault conditions relevant to each mode of operation shall stop the drive and prevent it re-starting until the particular fault is cleared and individually reset; lock-out relays and a rest button being provided for any self-resetting devices such as excess torque switches etc.

Specified fault conditions shall be identified by separate indications on the starter. Volt-free contacts shall be provided and wired to terminals in each starter unit for remote signaling of all status indications specified. Minimum status indications shall be Auto Available/Un-available and Running/Fault.

Where the starter is to be remotely controlled by a remote terminal unit (RTU), interposing relays with 24 volt DC coils complete with back EMF suppression diodes shall be provided in each starter unit to facilitate remote control and watchdog capability (See Instrumentation and Control Specification).

"Hours-run" meters shall be of the non-resettable cyclometer type indicator having a flush fascia and driven by a synchronous motor controlled to show the hours (up to 99,999.9) run by the main motor. They shall incorporate visible indication of operation but need not necessarily be of the same bezel size as the instruments.

All starters of motors of 3 kW and above shall have ammeters, local' running' indicator lamps being provided for loads less than 3 kW.

1103.56 Heaters

Anti-condensation heater shall be fitted in each starter (and motor, where specified), fed from a separate fuse through the starter isolating switch and an auxiliary contact on the motor contactor, arranged so that the heaters are disconnected when the motor is running.

In multi-tiered starter panels, the heater shall be located at low level within each tier and fed from a clearly identified common distribution supply with local isolating links in each tier.

1103.57 Star/Delta Starters

Star/Delta starters shall be of the closed transition "Wauchope" type, having starting resistors, mechanically and electrically interlocked Star and Delta contactors plus a timing relay in addition to DOL starter requirements, all rated for up to 10 starts per hour.

1103.58 Protection

The thyristors shall be protected by high speed semi-conductor fuses and heat sink thermal cut-outs.

The device shall be shut down in the event of single phase loss or open circuited thyristors.

In the event of short circuited thyristors, the drive shall continue to run at full voltage by automatically transferring to an override condition.

1103.59 Indicators

Alarm indicators shall be provided for each of the above faults.

An auxiliary relay shall be used to control the function of the main contactor.

1103.60 Energy Saving Facility

For continuous running devices, an energy saving control shall be provided where the voltage applied to the motor is automatically matched to the actual power demand. The control shall be effective after run-up and a dwell time at full voltage has been allowed to enable the motor load to stabilize.

The device shall respond immediately to any sudden load changes to prevent a potential stall condition.

1103.61 Frequency Converters

The motor speed control shall be a frequency converter of an approved type and manufacture, providing a variable frequency of adequate capacity to drive the specified motor over the specified speed range and suitably matched to the starting torque and the speed torque characteristics of the driven plant. (Details to be determined by the Contractor from the driven plant/motor manufacturer during the Contract).

The converter unit with the associated control electronics shall be housed in a steel, free standing, drip protected (IP21) panel, mounted in the position specified. The unit shall be suitably air- cooled by means of an integral fan and all the components within the unit shall be readily accessible for easy servicing and removal without disturbing other components. Chassis units shall be suitable for rack mounting.

The incoming supply shall be via an isolator interlocked with the panel door and have suitable fuse protection.

The drive unit shall be capable of operating with the motor disconnected for test purposes. A current limiting circuit shall be incorporated to give short circuit and over-current protection in the output circuit, and under-voltage detection shall be incorporated

to protect the drive against fan failure. A thermostat shall be fitted for protection against fan failure and overheating.

1103.62 Harmonics

The unit shall be protected from any harmonic distortion or switching surges in the power supply system and incorporate contractors to automatically isolate the input and output and to protect the unit from component damage arising from a power supply interruption which shall, if necessary, include automatic shutdown. If the converter

will not perform correctly when running from a specified standby generator an interlock shall be provided to prevent such operation.

To prevent disruption of the supply system wave from (and dependent instrumentation), harmonic voltage and current distortion introduced into the mains supply by the drive unit shall be within the limits specified in Electricity Council Engineering Recommendation G5/3. The point of common coupling shall be regarded as the output connection of the first upstream transformer.

The supplier shall list with the offer the expected harmonics generated by the drive under running conditions (worst case).

Where an input filter is used to limit the harmonic currents, the design shall minimize the possibility of resonance with any power factor correction capacitors fitted.

The supplier shall include any shielding necessary in accordance with BS 800, to prevent any interference that may affect other surrounding instruments.

1103.63 Monitoring and Control

The control of each of the variable drive unit shall normally be from a PLC outstation which will provide a start/stop facility and a 4-2mA speed control signal. Where the distance between the drive unit and PLC exceeds 20m, special care shall be taken to ensure radio frequency interference and distortion is kept to a minimum.

The following signals will be required from the drive unit and wired to clearly marked terminals:

- Common fault (motor overload, emergency stop operated etc.)
- Control status indicating Hand/Off/Auto
- Control ’on’
- Motor available
- Motor running
- RS 232 Serial Interface (where required by the specification).

The following items shall be included along with other control devices and instrumentation:

- Control potentiometer for speed setting on hand control, (scaled with liner graduations over the range and arrows indicating clockwise rotation to ‘INCREASE SPEED’ and anti-clockwise rotation to ‘DECREASE SPEED’);
- Output ammeter;
- Frequency/speed meter;
- Test and fault diagnostic card for circuit checking, having a front panel display and facility for serial link remote indication.
- Isolated inputs for 0-20/4-20mA auto control, stop/start, external reset, etc.

- Adjustments for ramp up/down, duration, frequency range, base/maximum speed, current limiting facility and economy made.

The following items shall be monitored for fault conditions:

- Phase failure;
- Earth fault;
- Over current;
- Over voltage;
- High temperature/fan failure;
- DC link fuse failure.

e) Rotating Electrical Machines

1103.64 General

Machine type and starting or driving arrangements together with type of enclosure protection shall be as specified herein. Vertically mounted machines shall be fitted with a drip-proof top end cowl and those fitted with skirts shall have a skirt depth in excess of the shaft extension.

Each machine shall comply with the current BS 4999 and the relevant parts of BS 5000 and shall be designed to run at a high power factor and efficiency at the prescribed plant duty.

1103.65 Rating

The output of each machine shall be a continuous maximum rating (Duty type S1) determined by the Tenderer in relation to the power requirements and the normal environmental conditions for the plant offered in accordance with this Specification.

The maximum temperature rise of any machine winding shall not exceed 90ºC above a 40ºC ambient when operating at the above rating. Where the insulation is rated up to 120ºC only, the maximum plant loading shall not exceed 95% of the rated output of the machine.

1103.66 Generators

Alternators shall be star connected machines producing a 3 phase 4 wire 50Hz supply at the specified rated voltage within a standard waveform deviation, when being driven at the rated speed and connected to the plant load specified herein.

1103.67 Regulation

The generator automatic voltage regulation system for single set running shall be capable of maintaining the voltage for all loads between no load and rated load at rated power factor.

Due allowance shall be made for the current peaks associated with starting the motor loads connected to the alternator, and the regulation system shall be designed such that the transient voltage reduction following the load application does not exceed 15% of the rated voltage and shall be restored to within 97% of rated voltage in less than 1.5 seconds. The transient voltage rise when the rated load is thrown off shall not exceed 25%.

Where voltage regulation equipment is mounted on the alternators, the components shall be readily accessible and detachable for servicing, having terminations separate from the main terminals.

1103.68 Excitation

The alternator shall be the brushless self-excitation type with rotating armature and verifier assembly mounted on the alternator shaft, electrically interconnected with field winding. Radio noise suppression shall be in accordance with BS 800 and the exciter field shall be safely discharged when the alternator is tripped.

1103.69 Motors

Motors shall be suitable for operation from a 3 phase supply having the star point earthed and the phase sequence running R-Y-B anticlockwise. Motors rates less than 0.5kW may be arranged for single phase operation.

The torque available during starting of each motor shall be at least 10% in excess of the maximum required at any speed to satisfactorily start and accelerate the mechanical plant load under all service conditions.

1103.70 Overspeed and Reverse Rotation

Each motor shall be capable of satisfactory performance during a period of 2 minutes whilst it is run at 1.2 times its rated speed and subsequently at normal speed continuously.

Where specified (to cater for backflow consequent upon delivery valve failure), pump motors shall be capable of reverse rotation p to these speeds without damage.

1103.71 Electromagnetic Brakes

Where an electromagnetic brake is fitted to drive, the brake shall be continuously rated. It shall be suitable for direction connection across the associated motor terminals or for individual supply and interlinked control, depending on the method of operation and control specified herein.

The brake shall be arranged to fail-safe by holding on under spring return passage when the coil is de-energized and have provision for hand easing for maintenance purposes. All control circuits for brakes shall be arranged to fail-safe.

Coil and terminals shall be totally enclosed in a fully waterproof housing.

1103.72 Power Factor Correction

Where specified, a power factor correction capacitor complying with BS 1650 and suitable for operation over the temperature range -10ºC/+40ºC shall be supplied, connected, tested and commissioned to improve the overall power factor of each machine to not less than 0.9 when running at full load.

Each capacitor bank shall be fitted with HRC fuse protection enclosed within a sheet steel housing having a terminal box with separate bolted access over an external earthing terminal.

Means shall be provided for monitoring fuse failure visually. For HV applications, striker pin fuses shall be provided and arranged to operate a trip bar which shall initiate an alarm contact for remote indication.

Resistors shall be fitted to the capacitors and motor terminal boxes, inscribed as follows:

"WARNING - EQUIPMENT CONNECTED TO STORED ELECTRICAL CHARGE. ISOLATE AND EARTH ALL TERMINALS BEFORE HANDLING."

1103.73 Submersible Pump Motor

The pump and its associated motor shall form a compact integral pumping unit suitable for installation within the area specified. The motor shall be of squirrel-cage construction suitable for starting method as called for in the particular specification, and rated for continuous submerged operation in water having a maximum temperature of 22ºC. Where a sealed coolant motor is used, the coolant shall be distilled water.

The stator winding shall be insulated against heat and humidity to Class F and shall incorporate at least three thermal overload devices.

A length of butyl rubber insulated, CSP sheathed flexible cable shall be provided and connected to the motor. Unless otherwise specified, the cable length shall be at least 20 metres without joints. The cable cores shall be phase coloured and be suitable to carrying the motor full local current under the specified operating conditions. The cabling sealing gland shall be a water tight design and, where included within the pressurized pipework, shall be capable of withstanding a water pressure of 1.5 times the closed valve head generated by the pumping plant.

1103.74 Terminal Boxes and Connections

Terminal boxes shall be provided, suitable for PVC/SWA/PVC cables for all external cabling connections.

All boxes shall be bonded to the main frame earth and the frame of each machine shall be provided with means of connecting an earth protective conductor.

Each machine rated 10kW or above shall have at the six ends of the stator winding extended to the terminal block with the necessary linking effected there, adequate clearance being provided between phase terminations to permit the use of cable sockets.

For high voltage machines the terminal assembly shall be capable of satisfactorily withstanding the full fault capacity specified herein for one second.

1103.75 Heaters

Anti-condensation heaters shall be provided in all non-submersible machines as an integral part of the machines and wired with butyl rubber insulated tails to a terminal box adjacent to the main terminal box, the cover being clearly labeled 'Heater Supply – 220V'.

Heaters shall be of the embedded element type having a low surface temperature and be impervious to moisture. They shall be arranged to operate on a 220V supply from the associated control unit when the motor winding is de-energised.

1103.76 Maintenance Facilities

Machines rated over 50kW shall have lifting ears or eyes forming part of the main frame of the machine lifting and pulling facilities with a single tapped hole in accordance with the tables given in BS 4999 (Part 10). Depth of tapped hole shall be 1.5 times the diameter.

1103.77 Bearings

Bearings shall be of the heavy duty ball or roller type greased for life enclosed in a substantial housing designed so that lubricant cannot escape on to the windings and fitted with adequate seals to prevent contamination or escape of lubricant down the rotor shafts. Means of lubrication shall be made available from outside the machine carcase of enclosure. The shaft shall be suitably located to prevent the rotor from moving out of magnetic centre while starting or running.

The rotor of any vertical spindle machine shall be provided with a suitable thrust bearing to support the weight of the rotor and its half coupling only.

1103.78 Slip Rings

All machines which incorporate slip rings shall be so designed that the slip rings and associated slip ring mountings shall form a single unit which can be readily detached from the shaft for repairs and replacements. The slip rings shall be continuously rated and of the totally enclosed type.

f) Cabling and Wiring

1103.79 Electrical Installation

The electrical installation shall comply with the current edition of the Regulations for Electrical Installations published by the Institution of Electrical Engineers (IEE Wiring Regulations) and the requirements specified herein where these differ from the IEE Wiring Regulations.

The installation shall be arranged in a neat and orderly manner which may involve running out of direct lines in order to conform to building outlines etc. and to utilize any holes provided for a\cabling purposes in the structure. Unnecessary crossing of cables will not be accepted and due care should be given to this when selecting runs. Each cable shall be in one continuous length and no straight through joints will be permitted except as agreed with the Engineer.

It should be the entire responsibility of the Contractor to programme the whole of his work and co-operate with other contractors to ensure that the various parts of the electrical installation are execute at the proper stages of the construction, special care being taken \with concealed work.

Care should be taken that sleevings and sheathings of cables are not damaged during installation. Should any part be damaged, the damage shall be made good to the entire satisfaction of the Engineer. Cables shall only be installed when the ambient and cable temperature is above 0ºC and has been for the previous 24 hours.

Cables shall, wherever possible, be arranged to enter equipment form below, particularly equipment located externally or in damp situations. Cables entering cubicles provided with sealed covers of timber or sheet steel shall be accommodated by drilling or dividing the covers with clearance holes as necessary to allow the cable to pass through and be terminated at glands or gland plates provided within such cubicles, so that the cover when replaced, prevent entry of dust and vermin.

1103.80 Protection of Exposed Cables

Where cables emerge through steel platforms or concrete floors, the Contractor shall provide and position protective curbing or sleeves made from galvanized material extending 75mm above finished floor level.

Sleeves shall be finished flush with the underside of the floor. Final details shall be agreed with the Engineer on site in respect of all situations.

Cables rising into or against floor mounted equipment shall be secured to the equipment in a neat manner to ensure that the cables are properly supported and that no undue strain is put on the cable termination or the plant. Where vibration or expansion is a consideration, adequate precautions and vibration loops shall be made at the appropriate position.

Where cables emerge in an area exposed to vehicular traffic and no overhanging projection exists up to one metre above ground level, a galvanized steel pipe or protection cover fabricated from 3.00mm (10SWG) galvanized mild steel (or heavier as appropriate) shall be provided and fixed to the associated structure for a minimum height of 1.5 metres above the local finished ground level.

1103.81 Selection of Cable Runs

The routes and arrangement of all cables and the position of equipment and wiring points shall be marked out on site by the Contractor and agreed by the Engineer before any work is put in hand. Where cable routes have been agreed, the Contractor shall be entirely responsible for measuring the lengths of cable to be ordered and ensuring that the cables are supplied in the correct length.

1103.82 Cutting away and Making Good

The Contractor shall be responsible making out the agreed positions of all chases, holes and fixings required for the passage of cables and conduit, and shall arrange with the Main Contractor for making good with a week mix of concrete.

The Contractor shall carry out all the necessary drilling for fixing up to 25mm diameter in the building fabric for the support and fixings of all items supplied or specified herein. Such work shall be carried out in a neat and workmanlike manner without unduly defacing concrete or brick surfaces. The use of stud fixings employing cartridge guns will not normally be permitted.

Where indicated on the Specification drawings, holes have been incorporated in the structures for the passage of cables and any additional cutting away and making good necessary to such structures will be done by the Main Contractor with the agreement of the Engineer.

1103.83 Cable Materials

Cables shall be of approved design from a BASEC approved manufacturer having a certificate of Assessed Quality Management. They shall be manufactured within the 12 months prior to delivery and be delivered to site on cable drums or with protective wrappings.

The overall sheath of the cables shall be coloured as follows:

- High Voltage - Red
- Low Voltage - Black
- Earth continuity conductor - Green/Yellow
- Instrument - Grey
- Intrinsically safe - Blue

Cables shall be of the voltage grade, conductor size and type detailed in the specific requirements. General specification of the cable type to be used are detailed hereunder:

Paper insulated mains cables shall be stranded plain annealed copper conductors, insulated with helically would paper tape, mass impregnated with non-draining insulting compound.

Multi-core cables shall be laid upon in a belted construction having a lead sheathing applied overall, protected by a steel wire armouring and having an extruded PVC sheathing overall (PLSW/PVC type).

Single core cables shall have a lead allow sheath without armouring but with extruded PVC sheathing overall (PLY/PVC type).

Cross-linked polyethylene cables shall have stranded, copper conductors with cross-linked polyethylene insulation. Multi-core cables shall be laid up in an extruded bedding, steel wire armored and sheathed overall PVC, to BS 5467 (XLPE/SWAP/PVC type).

Single core cables shall have aluminum wire amour. Cables rated over 6350V shall incorporate graded semi-conducting tapes and core screens in accordance with IEC 502.

Low smoke and fume emission cables shall be as above except that the bedding and sheathing shall be of low smoke and fume emission material, all in accordance with BS 6724 (XLPE/SWA/LSF type).

PVC armored cables shall have stranded copper conductors with extruded PVC installation, PVC sheathed, steel wire armoured and sheathed overall with PVC (PVC/SWAP/PVC type). Cables shall be in accordance with BS 6346. Conductors of 1.5mm^2 and 2.5mm^2 shall have stranded conductors (7/050 and 7/0.67 respectively).

PVC insulated wiring cables shall be 450/750 volt grade single core stranded copper conductors PVC insulated to BS 6004 (PVC wiring type).

Mineral insulated cables conductors and sheaths shall be solid annealed high conductivity copper separated by highly compressed mineral insulating powder. The cable shall be sheathed overall with PVC.

Light duty rated up to 600V, heavy duty up to 1000V, all as BS 6207 (MICS/PVC type).

Telephone cables shall be thermoplastic insulated multipair cables having twisted pairs of copper conductors (telephone type).

Instrumentation cables shall be polyethylene insulated copper conductors with twisted individual pairs screened, polyethylene bedded, steel wire armoured and PVC sheathed overall, all in accordance with BS 5308 Part 1 Type 2. Conductors shall be 0.5mm^2 stranded 16/0.2mm (PE/IS/SWA/PVC type).

Earth and bonding cables shall have stranded copper conductors PVC insulated and sheathed (PVC/PVC type).

Flexible cables shall have stranded, tinned, copper, flexible conductors, EP rubber insulated and CSP sheathed all in accordance with BS 6007 (flexible type).

Flame retardant cables shall be EP rubber insulated, tinned copper conductors in a CSP sheath, braided with galvanized steel wire (single cores having phosphorous bronze wire) and protected with a CSP sheath overall, generally in accordance with BS 6883.

The sheathing shall have heat and oil resisting characteristics to BS 6899 with an oxygen index value not less than 35 (HOFR type).

1103.84 Compression Glands for Cables

All the glands shall be supplied by the Contractor and shall be of the brass compression pattern, so designed that any strain on the cable is taken by the steel wire armouring. The glands shall incorporate watertight seals on both inner and outer sheaths and have a separate armour clamping ring to ensure a good mechanical connection for the earth continuity path. The glands shall be secured with heavy duty locknuts and the whole assembly is to be protected by an overall plastic sleeve, suitably sealed to prevent atmospheric attack.

Glands fitted to unthreaded gland or adaptor plates, non-metallic equipment, or where specified for circuits likely to pass high fault currents, shall include brass earthing tag and connections arranged to effectively bond the gland body via a protective conductor to an effective earth point. Where instrument cable screen terminations need to be isolated, insulated gland adaptors or non-metallic plates shall be used.

Glands and earthing tags shall be compatible with the gland plate and cable armouring materials to prevent electrolyte corrosion, e.g. brass for steel wire armouiring described above, but shall be classified EX (d) in accordance with BS 5501 Pt 5 and be suitable for use with Apparatus Groups IIA and IIB.

Where cables to BS 6346, BS 6116 or BS 5467 having extruded or taped bedding are used for direct entry into such apparatus Groups, a sealing stopper box or compound sealed barrier gland shall be used in accordance with BS 5345 Part 3.

1103.85 Termination of Glanded Cables

All cable compression glands shall be fitted by the Contractor, with the insulated conductors and sheathing being carried through the gland. The sheathing shall be preserved where required within the equipment and the insulated conductors properly connected to the terminals of the equipment concerned.

The armouring shall not be cut off short of the gland but shall be properly laid up and secured under the clamping ring provided. The gland shall be fitted finally with an overall PVC sealing sleeve.

All cable tails shall be of sufficient length to connect up to the equipment terminal boards, and in addition to making off the gland the Contractor shall strip, insulate, ring through and identify the individual cores, fit suitable termination lugs, ring or spade crimps or bootlace ferrules as appropriate, and fit numbered reference ferrules, lace the tails in a workmanlike manner and finally connect up.

All spare conductors within multi-core cables shall be terminated as shown on the connection diagram or be folded back with sufficient surplus to allow them to be connected if required in the future.

1103.86 Wiring Ferrules

These shall be of durable materials suitable for permanently affixing to the cable cores and be of the interlocking slide-on type, such that the interpretation of the reference is unambiguous.

All control circuits consisting of more than two wires shall be identified by means of wiring ferrules attached to the individual cores at each end of the conductor where it is connected to any apparatus or junction box.

Unless otherwise specified, it shall be the responsibility of the cabling contractor to obtain interconnection terminal data and references from the equipment manufacturer to enable proper connections to be made.

1103.87 Cable Cleats

Cleats for fixing cables to walls, structures, etc. shall be of the non-corrodible hook and clamp type made of high impact plastic or cast aluminum comprising two halves fixed by means of galvanized rawlbolts or on to galvanized backstraps where the number of cleats makes this more economic.

All assemblies to be complete with necessary galvanized bolt, nut and washers. The spacings of supports or cleats for cables shall in any case be not greater than shown in the following table but, where circumstances merit, closer spacing arrangements may be required by the Engineer.

The vertical spacings shall be applied to runs sloping up to 30º from the vertical. For greater deviations, the spacing for horizontal runs shall apply.

For outdoor and damp situations, fixing bolts or studs for cleats shall not be less than 13mm overall diameter unless otherwise agreed by the Engineer.

1103.88 Cable Support Spacing (mm)

Cable Type	XLPE/SWA/PVC OR PVC/SWA/PVC with stranded copper conductors	
Overall dia (mm)	Horizontal	Vertical
Up to 15	350	450
15 – 20	400	550
21 – 40	450	600
41 60	700	90
Over 60	110	1300

1103.89 Segregation of Duties and Services

Cable of different circuit categories shall be segregated as defined in the IEE Regulations. Instrument control cabling shall as far as possible be routed separate from electrical power cables and long parallel runs to thes or pipework should be avoided. Where parallel routes and crossovers are necessary, a minimum separation of 250mm shall be maintained. Power cables shall not occupy the same ducts as instrument cables.

Similarly, separation between the three categories of instrument cables shall also be maintained as scheduled below:

Categories to BS 6739	**Cat 1**	**Cat 2**	**Cat 3**
CATEGORY 1	-------	200 mm	300 mm
Instrument power & Control			
(over 50V, under 10A, AC or DC			
CATEGORY 2			
High level signals	200 mm -------	300 mm	
(5V to 50V DC)			
CATEGORY 3			
Low level signals	300 mm 300mm	-------	
(Less than 5V DC			

Only conductors carrying signals of the same category shall be contained within any one multicore cable. Similarly, conductors forming part of intrinsically safe circuits shall be contained within multicore cables reserved solely for such circuits.

All screens for instrument cables shall be earthed at one point only, preferably at the main control centre.

1103.90 Cables in Concrete Trenches

Where cables are run in concrete troughs or trenches, they shall be run on the floor of trenches less than 300 mm deep. In trenches deeper than 300 mm, cables shall be supported along the side of the trench on galvanized mild steel hangers, racking, cleats or on a suitable tray run supported from the side of the trench, whichever is specified. The spacing cleats or hangers shall be as specified under ‘Cable Cleats’.

Where use is made of existing trenches with existing cables installed, it may be necessary to reposition certain existing cables so that the new cables can be laid in a proper manned and the whole of the cables (new and old) left in an arrangement which is tidy and fulfils engineering requirements. Such repositioning work shall be carried out to the directions of the Engineer.

1103.91 Galvanizing Fastenings

Where manufactured or purpose-made steelwork, ladder, racking tray supports and all fixings nuts, bolts and washers are specified as galvanized, this shall mean hot dipped galvanized finish to BS 729 as far as practicable. Bolts and nuts shall be in matched condition.

Fixings screws for boxes, saddles, clips and other accessories shall be of brass or other non-corrodible type e.g. cadmium plated steel.

1103.92 Racking

Cable racks shall be robustly constructed of mild steel, not less than 2.5 mm (12 SWG) in thickness and galvanized after manufacture. Where cleats are not used, the rack shall be provided with a toe at the outer end. Racks of proprietary construction may be used subject to approval.

Main rack supports, where fixed to brickwork of concrete, shall be secured with bolts of not less than 13mm diameter. The fixing bolts shall be of the self-securing type with expanding sockets and shall not require grout to hold them in position.

Where fixed to walls in places subject to dampness and in cable subways, the racks shall be set off from the walls by 35mm x 18mmm thick galvanized packers placed at the bolt fixing positions.

In cable basements, the lower tier of any row of racks etc. shall be not less than 100mm above finished floor level.

1103.93 Cable Ladders

Cable ladder shall be heavy duty type, fabricated from mild steel not less than 2mm thick and galvanized after manufacture. The side rails shall be at least 120mm deep with rungs set towards one edge, spaced at regular intervals of approximately 300mm and having elongated slots to accommodate the cable fixings.

Lengths of ladder shall be coupled and changes in direction, level and width shall be achieved by means of standard accessories designed for the system, such as radiussed risers and gusseted intersections. Cable tray shall be accommodated on the ladder system for cables less than 15mm overall diameter.

1103.94 Cable Channels

Cables requiring mechanical support across voids may be accompanied in not less than 40mm square galvanized channel sections fitted with plastic closure strips and suitable end caps in preference to tray, and subject to the Engineer's approval.

1103.95 Cable Tray

Cable tray shall be heavy duty pattern formed from galvanized sheet steel, perorated with elongated holes for cable fastenings. The tray shall have side flanges not less than 25mm deep with returned edges and be galvanized after fabrication. Material gauge shall be 1.5mm (16 SWG) minimum, except that for tray widths less than 400mm the gauge may be reduced subject to the flange depth and the approval of the Engineer. Factory made tee sections and bends shall be used where possible.

The cutting trays shall be kept to a minimum but where unavoidable, all cut edges shall be rounded or folded over and protected with zinc rich cold galvanizing paint, holes for cable shall be bushed with nylon/PVC strip edging

material. Mushroom headed bolts and nuts shall be used to join sections of tray and accessories and arranged not to present any obstruction on the tray. Capacity amounting to 25% usable tray area shall be left spare.

Where specified herein for damp or corrosive conditions, the trays shall be of un-plasticized PVC with non-corrodible nuts and bolts.

1103.96 Cables on Tray of Ladder

Cables shall be laid flat and straight, properly dressed into position and fastened by cable ties or straps of metal reinforced PVCC strip material, secured at intervals not greater than 1m for horizontal and vertical runs. Where the runs is horizontal but arranged in the vertical plane, support spacing shall be as specified under 'Cable Cleats'. Care shall be taken to space the cables to allow adequate cooling. Not more than seven cables shall be embraced by one group tioe and not more than two layers of cables shall be run on one try.

1103.97 Cables in Ducts

Before drawing any cables in ducts, the Contractor shall ensure that they are clean and free from obstructions.

Adequately spaced temporary supports and cable rollers shall be provided for the drawing in of cables such that abnormal strains and damage to the cable is prevented; approved lubricants shall be used as necessary. Cable stockings shall be used for general drawing work, core pulling eyes being specially fitted for heavy hauls.

Stresses shall not exceed 10MN/m2 (1500 lb/sq in) on the lead sheath and 70MN/m2 (10,000 lb/sq in) on the core.

Maximum pulling tension shall not exceed 20 kN (4500 lb).

1103.98 Duct Seals and Cable Transits

After the cables are drawing, the Contractor shall seal the ends of all ducts, pipes or trenches leading into buildings, passing through walls or floors within buildings or underground chambers containing equipment for cabling associated with this Contract, whether occupied or not.

All cables, conduits or pipes shall be sealed into the ducts by means of a secure and effective water, gas, vermin and fore-proof material which will accommodate settlement and vibration. This may be a self-supporting non-settling mastic packed into the annuls to a depth at least equal to the sleeve diameter, or approved multicable tandit units with appropriate fillers and insert blocks. All steelwork on such transit assemblies and frames shall be hot dip galvanized.

Where shown in the Specification drawings, transit frames will be incorporated in the construction by the Civil works contractor.

1103.99 Cable Laid in Ground

Where cables are laid direct in the ground, they shall be well bedded in fine soil or sand and shall be covered with protective tiles. A minimum of 60mm thickness of fine soil or sand shall be supplied around the cables. All cables running along any one portion of route shall be laid at the same time and no extra payment will be made do re-excavation should any cable be overlooked at the time of laying. The Contractor shall be responsible for all excavation, for the supply of fine soil or sand for bedding, and for the backfilling and reinstatement of cable trenches along previously agreed runs. Trenches shall not be backfilled until the installed cables have been inspected by the Engineer.

1103.100 Clearance and Coverage for Buried Services

Trenches shall be excavated or ducts laid at such depth that where cables are laid in the ground the minimum coverage to the top of the duct of the cable shall comply with the following:

Minimum Coverage

Type of Service	Vehicular Roadways	Open Ground Footpaths
HV	1000mm	750mm
Others	750mm	500mm

Where possible, electric cables and their ducts shall be routed so that subsequent excavation to expose another service will not disturb cables and electrical ducts. Where separated routes are not practicable then the following clearance shall be ensured:

Minimum Clearances

Type of Cable	To HC Cable	To LV Cable	To Other Cable	To Gas/Water etc. Pipes
HV	150mm	300mm	300mm	300mm
LV	300mm	150mm	240mm	300mm
Others	300mm	250mm	150mm	300mm

The spacing of cables installed at the same time shall be generally in accordance with the above table, but where circumstances permit a more economical arrangement may be specified by the Engineer.

As far as possible electric cables shall avoid the same route as other services except where otherwise directed. Where such segregation is not possible then 50mm thick concrete slabs may be used as separators with the Engineer's approval. Adequate slack shall be left at each bend for cables laid direct.

1103.101 Protective Cover Tiles

These shall be of the concrete apex pattern engraved 'Danger – Electricity' or similar, of dimensions appropriate to protect the number of cables along a particular route.

Following the installation and compaction of the bedding soil or sand over the cable, covers shall be laid by the Contractor so that they overlap at approximately 30mm each side of the cable run. Where cables are displaced by no more than 300mm vertically, covers shall be installed only over the upper cable run.

1103.102 Backfilling and Reinstatement

Reinstatement of soil following laying of cable shall be effected by backfilling in 100mm layers. Hand ramming shall be employed for the first two layers and power ramming for subsequent layers.

After hand ramming to a depth of 200mm, a yellow coloured plastic tape approximately 150mm wide with the words 'CAUTON CABLE BELOW' shall be provided and run over the centre of the route of each cable run by the Contractor.

Top soil is to be placed and the level of the finished reinstatement shall not protrude more than 50mm above normal ground level.

All surplus spoil is to be removed from the site and areas surrounding the excavation shall be restored to their original condition.

Where tarmac surfaces have been excavate, the final 200mm backfilling after allowing the settlement shall consist of 120mm of compacted, graded hardcore, followed by a 60mm concrete screed and a 20mm top dressing of tarmacadam.

1103.103 Route Markers

These shall be of reinforced concrete with the words 'ELECTRIC CABLES' cast in one face. They shall either be of the flush block type approximately 300mm x 150mm or the pillar type approximately 600mm high erected with 300mm projecting above the ground, as directed by the Engineer.

As soon as site conditions allow, the location of each group of buried cables ad every joint shall be accurately marked. Concrete marker posts or blocks shall be set at the origin, changes of direction, joints and otherwise at intervals of 20 metres or as directed by the Engineer.

1103.104 Cable Identification

Identification labels of durable material shall be provided suitable for permanently affixing to the cable sheath by means of buckle type straps and shall carry the cable reference in PVC channel strip. The reference character sizes shall be not less than 4mm (5/32") high (Crtitchley Unilabel or similar).

Cable identification labels shall be fitted to each cable end below its respective gland, also where the cable passes through ducts or trenches and at each entry and exit to a room or building.

1103.105 Trunking Materials

All trunking, bends, cover plates, tees, flanges, supports, fixings, etc. shall comprise an approved complete system capable of adaption and erection without size modification and with compatible manufactured bends and accessories being used as far as practicable. The trunking access covers shall comprise easily removable convenient sized lengths retained over the entire length by clip-on features or suitable fastenings which shall not obstruct cable entries. Overlapping covers and internal flanges or coupling sleeves shall be provided at all trunking junctions. All cable supports, edges, sharp internal angles etc. shall be protected with PVC or formed to present a smooth edge.

Metal trunkings and fittings shall be zinc coated or galvanized mild steel not

less than 1.2mm thick (18 SWG). Copper earth bonding straps shall be fitted at the junction of adjacent lengths of trunking and fittings.

PVC trunkings and fittings shall be of high impact heavy duty rigid PVC.

1103.106 Trunking Installation

As far as possible, trunking shall be installed clear of other services and positioned so that future access is not restricted. Drawings detailing supports, terminations, sizes and centre lines of trunking shall be submitted to the Engineer for approval prior to commencement of the installation. Provision for expansion of the trunking materials shall be made in accordance with the manufacturer's instructions. Trunking shall include fire barriers of fiberglass wadding fitted at each point where the run passes through fire walls and floor levels. All cable and conduit exits shall be fitted with bushes without decreasing the effective cross-sectional area of the trunking.

When connecting adjacent sections of trunking or when fixing trunking to a wall or supports, round or mushroom headed bolts or screws shall be used such that no sharp edges project into the inside surface. When installed in damp situations the trunking shall be spaced from the wall by means of short tube collars.

All trunking shall be protected against damp and corrosion and where entries, joints and/or bends have been installed, cut and/or sawn edges exist, all damaged galvanizing shall be made good by a minimum of two coats of aluminum paint of an approved quality. For extensively damaged galvanized coatings the items shall be re-galvanised or replaced with acceptable components.

Conduit shall be connected to the trunking by means of couplings and male bushes to obtain a good earth connection.

To assist identification within trunking, final circuit wiring shall be formed into groups held by buckle clips or PVC straps. Each group shall be labeled where wiring enters or leaves the trunking and at intervals of approximately 600mm centres to be used as cable supports.

Separate conductors comprising the same circuit shall be run enclosed together throughout their length.

1103.107 Cables in Conduit

For wiring installations carried out with PVC insulated cables in conduit, the wiring throughout is to be on the "looping in" system and no "Tee" or other intermediate joint between fittings will be permitted, and in no case must the cable be drawn into the conduits until all such conduits, bends, boxes, or other fittings have been fixed permanently in position and approved by the Engineer.

Any water which may accumulate in the conduit during erection shall be removed before any cables are drawn in. Sufficient slack shall be allowed at each point to ensure that all conductors are under no physical strain or tightness.

Separate conductors of the same circuit shall always be drawn into one conduit, but cables forming final circuits shall always be drawn into one conduit, but cables forming final circuits connected to different distribution boards shall not be drawn into the same conduit or box.

The cables shall be coloured RED or BLACK as required to distinguish opposite poles, a BLACK conductor shall be used throughout for neutrals and connected to the neutral pole of the supply system.

No reduction of the strands forming the conductors will be allowed at switch or other terminals; all the strands shall be efficiently secured by screws, nuts and washers or other approved means and all conductors shall be so proportioned that the drop of potential does not exceed that indicated by the IEE Wiring Regulations.

After the Contract award a Table (in duplicate) showing the proposed arrangement of wiring circuits and the size of cables to be used shall be submitted to the Engineer for his approval before any work is put in hand.

1103.108 Conduit Materials

i) Metal All conduits and fittings shall be Class 4, galvanized steel, heavy gauge welded and welded and screwed smooth bore tube employing threaded couplings and complying with BS 31 and BS 4568. As an exception, lengths of conduit completely encased in structural concrete may be finished with black enamel.

Conduit boxes shall be of malleable cast iron. For surface work the lid shall be of cast iron machined or ground to make good contact with the boxes. Adaptable boxes for surface work shall be of malleable iron.

ii) PVC All conduits and fittings shall be heavy duty gauge PVC in accordance with BS 4607.

iii) Flexible Flexible conduits shall be water proof metallic type PVC sheathed and adaptors to rigid conduit shall be of the internally rifled split brass type.

Flexible conduit shall only be used for bridging expansion joints in a building or for final connections from the rigid conduit system to the terminal boxes of equipment subject to vibration or adjustment. All such conduit shall have an earth continuity conductor connected through the flexible adaptor at each end. Individual lengths of flexible conduit should not exceed 400mm.

1103.109 Conduit Installations

The conduit system shall be continuous throughout so that the cables are fully protected. No conduit smaller than 20mm shall be used. Provision shall be made for draining condensed moisture where directed by the Engineer.

The conduit throughout shall be of adequate capacity in accordance with IEE Wiring Regulations, and shall be arranged with draw-in boxes to allow for easy draw in or out of any one or all the cables in the conduit. For multiple parallel conduit runs, draw boxes may be combined by an appropriately sized adaptable box provided segregation of services is maintained.

Wherever possible conduits shall be installed either horizontally or vertically and changes in direction shall be effected by easy or well formed sets without altering the section or opening joints; solid or inspection tees shall not be installed.

The inside surfaces of the conduit ends and all fittings shall be smooth and free from burrs and all other defects.

For surface work the conduits shall be fixed by means of spacer and saddles or substantial distance saddles. Where conduits pass directly through concrete or similar floors and where washing down is likely to occur, the conduits shall be sleeved. The sleeve shall be grouted flush with the underside of the floor and extend 75mm above the top surface of the floor. Where conduits are run on steel work, they shall be fixed by means of purpose-made clips. If the Contractor requires to drill any steel work, permission in writing must be obtained from the Engineer.

If exterior situations, all joint box lids etc. shall be made waterproof with compound or gaskets as appropriate.

Metal conduit installations shall be electrically continuous throughout, and at all terminations conduits shall either be screwed into approved spigot boxes or coupled by means of screwed couplings and smooth bore hexagon bushes. In no cases shall the length of the thread into which the conduit is screwed be less than the outside diameter of the conduit. Where tapped entries are provided and where internal space permits, a ring bush shall be used as a lock nut.

All exposed threads and damaged galvanizing shall be cleaned and thoroughly coated with zinc rich paint. If black enamel conduit has been approved for use, then where the black enamel is damaged the conduit shall be satisfactorily repainted to the approval of the Engineer.

Contact between conduit and gas pipes shall be prevented wherever possible by adequate spacing, or by means of insulating distance pieces. Where the conduit is or may be in contact with any other pipes or metal work and efficient metallic connection shall be made between the conduit and the pipes or metal work and the incoming gas, water and electricity services shall also be bonded together, all as required by the IEE Wiring Regulations.

PVC conduit installations shall have couplers and spouted fittings joined with a permanent solvent adhesive, and provision shall be made in surface conduit installations for expansion by using semi-permanent mastic jointing seal in expansion couplings as necessary.

Conduits shall be fixed by means of spacer bar saddles spaced as defined in the IEE Wiring Regulations.

These figures apply to surface runs at normal room temperature. Where high ambient temperature or rapid fluctuations are likely these spacings shall be reduced as agreed with the Engineer. Conduit shall also be secured 150mm either side of a bend.

The bending radius of PVC conduit shall be not less than 4 times the diameter of the conduit and bending shall be achieved by the use of the correct size bending spring.

If bending is to be carried out in temperatures below normal room temperature, frictional heat shall be applied to the conduit before bending commences.

Potentially Explosive Area conduit installation shall employ metal conduit andcomply with the relevant Parts of BS 5345 for the specified zone classification; Ex(d) projection for Zone 1 and Ex(n) protection for Zoone2 Applications.

All screwed joints whether entering into switchgear, junction boxes or couplings, must be secured by a standard lockout to ensure a tight and vibration-proof joint which will not be slacken during the life of the installation and thus impair continuity and flameproofness. The length of thread in the conduit must be the same as the fitting plus sufficient for the locknut. Due to the exposed threads, the use of running joints is not permitted and specially designed flameproof unions shall be used for securing conduit to an internally screwed entry. All unwanted outlets shall be plugged with approved blanking plugs.

When a conduit passes from a hazardous to a safe area, the flame-proof section must be terminated by a stopper box or sealing device mounted in the safe area.

All conduits entering directly into a flame-proof enclosure where exposed terminals are fitted shall be sealed at the point of entry by means of stopper boxes which must be entirely filled with a non-oxidising compound. Conduit boxes or indirect entry compartments not containing exposed terminals do not require sealing.

Conduit stopper boxes of certified design must be used, having splayed, plugged filling spouts in the cover to facilitate the entire filling of the interior with compound.

1103.110 Intrinsically Safe Conduits

Circuits complying with the requirements of BS 5345 for intrinsically safe circuits shall be arranged such that all cables are identified and segregated as detailed in BS 6739. Conductors forming part of an intrinsically safe circuit shall only be contained within multicore cables reserved for such circuits and must be terminated separately.

Intrinsically safe circuits shall be connected to a separate earthing system as detailed in BS 6739 and any shunt diode barriers shall be installed in accordance with the certification requirements.

1103.111 Mineral Insulated Cables

Cables shall be installed saddled to trays, run on the surface or as otherwise specified. The spacing saddles shall be in accordance with the IEE Regulations. Cable termination accessories and saddles shall be brass or copper and shall be supplied by a particular cable manufacturer. All cables shall have a temporary mastic seal applied during installation. Once cut to length, each cable shall be permanently terminated without delay by using an approved seal. Termination seals shall be anchored in approved glands and locked into screwed conduit entries or gland plates forming part of accessories or equipment.

Wherever possible, glands shall be locked in position with locknuts. Shrouds shall be fitted over glands except where they are encased in the structure of the building.

In cables where dampness may be present or where dissimilar metals are present, corrosion inhibiting paste shall be interposed in all voids between surfaces in contact.

Where MICS cable serves an inductive circuit liable to voltage surges or circuits subject to lightning surges, appropriate surge diverters shall be connected across the inductive sources (coil etc.) or between lines and earth at the point of entry in the case of lightning protection.

1103.112 Sealing Boxes for Lead Sheathed Cables

For terminations at plant items, these will be provided by others except as specified herein and will be of cast iron, compound filling type, provided with filing plugs in the appropriate position for filling with compound when mounted on the associated equipment. Each will be complete with wiping cone armour clamp. For through joints or tee joints, the Contractor shall provide suitable boxes as detailed herein.

All necessary jointing materials, filling compounds and earthing requirements shall be included for all joints to be made under this Specification.

1103.113 Lead Sheath Cable Terminations

The Contractor shall submit to the Engineer for approval the proposed method for terminating lead sheathed cables. Terminations must ensure that moisture cannot creep along the cores of the cable nor in between cores.

Where cable tails are to be brought out, cores shall be cut back below the level of the sealing compound and connected to the tails using a brass ferrule sweated to provide a solid damp and oil migration barrier between tail and core.

Paper insulated tails shall be double half lapped with an approved non-hygroscopic insulating tape. Alternatively for LV cables, instead of an approved tape, a length of temperature sensitive, PVC sleeving may be heat shrunk over the tail, joint and cores.

The continuity of armoured cables shall be maintained by an efficient bond between the cable armour and, the gland and the metalwork of the equipment at which the cable terminates, in order that a reliable path is provided for fault currents.

When the lead sheath has been wiped on to the cable gland, the steel armouring shall be brought over the wiped joint and clamped to the top of the gland to provide additional earth continuity and mechanical strength to the

plumbed joint. The armour clamp shall sandwich a copper braid between the clamp and the armouring to ensure a bedded connection.

Compression gland shall be to an approved pattern provide adequate bonding and armour clamping facilities.

Cable cores shall be fitted with suitable termination lugs and be phase coloured as appropriate and marked with an approved label to correspond with the diagram of connections.

Glands exposed to weathering shall be totally wrapped in impregnated tape to exclude all moisture from the gland connection and have an outer wrapping of PVC tape.

1103.114 Jointing

Personnel employed for jointing power cables including all types of terminations for aluminum conductors shall have received specialised training. Joints on all buried or stranded cables shall be sweated, but compression joints will be permitted for stranded copper or solid aluminum conductors at terminations only.

Joints shall be completed without pause of unnecessary delay. Reduction in the number of strand is not approved but limited reduction in the cross sectional area of solid conductors by an approved method is permitted. Cable cores shall be cut with due regard to fanned out terminations, leaving a neatly arranged minimum of slack core between cable and terminal. As far as practicable all HV joints shall be made to avoid crossed or twisted cores, final phasing out being arranged it he cable box termination.

Where crossed joint is approved, a sleeve at least 30% longer than standard shall be used to minimize the distortion of cores. The engineer shall witness the final termination in order that the Contractor may prove the phasing before the last joint in a cable run is made.

Cables shall be jointed colour to colour or number to number. Where numbered cores are to be jointed to existing coloured cores etc. the Engineer will direct the system to be used.

A reliable continuity path shall be provided for fault currents flowing via the lead sheath and/or armouring by means of an efficient earth bond between the cable armouring and sheath on each side of the joint.

Any semi-conducting screens incorporated in HV cables (e.g. XLPE rated at 6350/11,000V) are to be thoroughly removed before application of any stress control components supplied with the necessary cable jointing kits.

1103.115 Sealing Compounds

The outer protection boxes for joints or termination shall be filled with compound of the hot or cold pouring variety of a type compatible with the cable materials to be agreed by the Engineer.

Compound which require heating shall be evenly heated, well stirred and the temperature maintained within the recommended pouring ranges. Cable accessories shall be thoroughly dried before filling and pre-warmed where possible.

Where cable sealing boxes are fitted beneath oil-filled compartments or where inverted cable sealing boxes are used due to cables entering from overhead, the compound shall be of the oil resisting type to prevent any risk of softening due to contamination from the insulating oil.

Cold pouring resin encapsulation materials shall be carefully mixed to avoid entrapped or uncured filler materials.

1103.116 Single Core Cables

Circuits utilizing single core cables shall be installed under IEE 'Defined Conditions' but to minimize mutually induced voltages, three phase circuits shall be run for as long as possible throughout the route in close trefoil formation. Where a circuit employs more than one cable per phase, each trefoil group shall contain one cable of each phase, allowing at least 50mm clearance between adjacent groups. Cleat spacing shall not exceed 1.2 metres.

Ferrous screens or armour shall not be used on such cables and associated termination or enclosure must avoid the use of magnetic material which would provide a flux path in service.

To control induced voltages, single core cables shall have their metallic sheathing and/or aluminum armouring bonded together at both ends of the run, the bonding being connected directly to the system earth bar or other approved points. Cables having no insulating oversheath shall have their metallic sheaths or armouring bonded together by the use of normally spaced, well fitting, non-magnetic metallic trefoil cleats.

In all cases the bond shall be sized to carry the prospective fault current and have a conductivity not less than that of the cable sheath and/or armouring. Bonds for cables laid in a flat formation shall also allow for the unequal sheath currents.

To prevent circulating currents, bonding and earthing at the supply end only of short runs of single core cables will be permitted where it can be shown to the satisfaction of the Engineer that the induced voltages are safe under fault conditions.

1103.117 Busducts

Connections between major electrical items shall (where specified) employ a fully integrated, totally enclosed, busduct system to BS 5486 (IEC 439-2), comprising HDHC copper conductors embedded in a non-flammable, self-extinguishing, case epoxy resin insulation.

The complete assembly including junctions shall be completely free of condensation and watertight to IP68. Fire resistance shall be Class M1 (F) and Class B1 (D) to IEC 332.

All parts of the system shall be from the same manufacturer and comprise factory made lengths, bends, tees and terminating pieces to suit the physical application and layout of the installation.

The voltage and prospective fault ratings of the system shall be suitable for the application and the current rating shall be based on the most onerous method of installation for the circuit. The cross sectional area of the conductors shall not be reduced throughout a given circuit.

The installation shall allow foe any necessary expansion, be properly supported and connected in accordance wit the manufacturer's instructions. Fire and damp-proof barriers shall be provided when passing through walls, floors/ceilings etc.

Conductors shall be jointed by means of double junction plates, one on each side to ensure low joint resistance. The junction shall be compressed by means of high tensile steel nuts and bolts. After assembly, all junctions shall be overcast with the same materials mixed under vacuum, as used for the busduct elements, thus maintaining a homogenous and weatherproof enclosure throughout.

Provision for conductor shifting, transfers and paralleling, shall be made within the terminal elements.

1103.118 Earthing and Bonding

All non-current-carrying metal parts of the electrical installation and other services shall be properly bonded together and connected by means of a protective conductor to an efficient earth in accordance with IEE Wiring Regulations.

All connections shall be by means of an approved mechanical joint or adjustable clamp which shall be accessible and made secure with brass nuts and bolts. On no account shall plain or spring washers of ferrous metal be used.

Protective conductors shall provide earth continuity either through the conduit, armouring, lead sheathing, steel trunking or by independent earth tapes or PVC sheathed wires, according to the system of wiring employed.

Where PVC conduits or trunking systems are employed the protective conductor shall be routed within the conduit or trunking.

Wherever cable armouring is used as a protective conductor, care must be taken to ensure an adequate earth bond and additional bonds to the metalwork shall be provided as required.

1103.119 Main Earth Connections

Where a main earth bar is to be installed it shall be connected in a ring with the earth bar provided on the switchgear and any existing main earth ring in the building. The glands and wire armour of cables shall be connected to the switchgear earth bar or directly to the earth ring.

The main earth bar shall be formed from high conductivity, hard drawn copper bar Grade C101 to BS 1433 of not less than 31.5mm x 6.3mm cross-section. Any joints in the earth bar are to be brazed together using brazing alloy type CP1 to BS 1845 or pan head riveted and sweated. The bar overlap/thickness ratio shall be not less than 5.

The earth bar shall be secured to an inside wall in an accessible position. Connections to the metal work of electrical plant shall be made in soft drawn copper tape or equivalent sized cables. Where plant is subject to vibration, connections shall be made sing flexible conductors. All earthing conductors and equipotential bonding cables shall

have a green and yellow PVC sheath, and earth bars shall have a green/yellow marker tape or sheathing applied.

Reinforced concrete or sheet steel piling shall be connected to the earthing system as directed by the Engineer. Structures of steel framed buildings shall be bonded to the main earth bars.

Earth rods are to be 16mm (5/8”) diameter driven by an automatic hammer to a depth of approximately 4 metres. Spacing between rods is not to be less that the depth of the rod. Inspection pits shall be provided for each electrode to allow subsequent access for testing.

Where copper earth tape is buried below ground level it is to be served with PVC or double half lap wrapped with an approved grease-impregnated tape for a distance of at least 300mm above and below ground level.

The routing, dimensioning and arrangement of all main earth bars and connections shall be detailed on the schedules and drawings forming part of this Specification as called for in the specific requirements. Disconnecting links for testing purposes shall be provided as shown therein.

g) Civil Works for Cable Installations

1103.120 General

The works involved are associated with the cable installation and comprise trenching, excavation, supply, laying and jointing if cable ducts; building of jointing and draw-in pits; application of bedding sand and soil; temporary reinstatement of ground. The installation of cables, supply and laying of cable covers and preparation of route record drawings will be carried our by the Contractor appointed to undertake the cable installation. Excavation, duct and cable laying and backfilling shall proceed in accordance with an agreed programme ensuring that all cables and ducts are satisfactorily covered immediately following laying and after approval from the Engineer.

1103.121 Trenching Measurements

The depths and widths of individual trenches for cables or ducts and the clearances from other services shall be determined by reference to the clauses in this part. For contracts let with scheduled rates it will be assumed upon re-measuring that excavations have been in accordance with this specification unless the engineer has been sent an advice to the contrary.

1103.122 Coverage for Buried Cables or Ducts

Trenches shall be excavated or ducts laid at such a depth that the minimum coverage to the top of the duct of the cable shall comply with the following:

Type of Services	Vehicular Roadways	Open Ground or Foothpaths
HV	1000mm	750mm
Others	750mm	500mm

1103.123 Clearance between other Services

Where possible electric cables and their ducts shall be routed such that subsequent excavation to expose another service will not disturb cables and electrical ducts.

Where separate routes are not practicable then the following clearances shall be ensured:

Type of Cable	To HV Cable	To LV Cable	To Other Cable	To Gas/Water etc. Pipes
HV	150mm	300mm	300mm 300mm	
LV	300mm	150mm	250mm	300mm
Others	300mm	250mm	150mm	300mm

Where such spacings are not possible then 50mm thick concrete or stone slabs may be used as separators with the Engineer's approval. Each cable shall be at least 50mm clear of the side of the trench excavation.

1103.124 Excavations and Precautions

Turf and topsoil shall be carefully removed and positioned where indicated on the drawings or as directed by the Engineer for subsequent reinstatement in their original position.

Broken land drains and damage to other services shall be reported to the Engineer and marked on site.

Excavations shall be kept free of water and properly shored up. Other services uncovered shall be adequately supported by slings or other means and protected.

1103.125 Bedding for Cables

Prior to laying the bedding for the cable, the bottom of the trench shall be cleared of loose and projecting rubble etc. and evenly graded.

A sand bedding shall be applied below and around the cables and shall be thoroughly compacted. Thickness of bedding around the cable shall be 60mm except where soil contains coke, ash or other corrosive matter where the thickness shall be 200mm. Bedding shall be well graded sand, free of clay with minimum particle size of approximately 0.08mm (BS sieve No. 200) and maximum particle size of approximately 2 mm (BS sieve No.7). 60% of the material shall pass through BS sieve No. 72. Where the engineer directs, local soil may be used for bedding after passing through a 10mm mesh sieve provided the material is evenly graded.

1103.126 Ducts and Couplings

Buried cable ducting shall be smooth bore uPVC pipe to BS 4660 (or medium density polyethylene, where greater flexibility is required) jointed by spigotted ends or couplings of compatible, non-deteriorating material. These couplings shall be a self-aligning, push fit and incorporate seals to prevent the ingress of water and other fluids as far as possible and the joint so formed shall be equal in internal diameter to the duct itself.

Ducts entering below ground level into a building or structure shall emerge inside the building either directly into and accessible trench or void, or the duct shall have an upturned bend to emerge adjacent to an inside wall face, or as otherwise specified. All exposed upturned duct ends shall project at least 75mm clear of the finished floor or ground level to prevent unwanted collection of water or debris and protect the cable exit.

1103.127 Bedding of Ducts

Prior to laying ducts in trenches, the trench bottom shall be evenly graded, cleaned of loose rubble etc. and compacted to form a solid foundation. In rocky soil a layer of loose, rock free earth shall be used for this foundation.

Where ducts are laid beneath vehicular access roads, the ducts shall be haunched in C20 concrete for the full width of the road and extend each side beyond the curbside by at least 300mm.

1103.128 Duct Alignment and Cleaning

Ducts shall be laid in a straight line as far as possible with minimum deviation. Where bends are required, these may be manufactured, pre-formed bends with a radius of not less than 10 times the bore diameter. No continuous duct run shall incorporate more than two bends nor turn through a total of more than 135º in any plane. No single bend shall exceed 90º.

Where greater changes of direction are necessary, cable draw pits shall be incorporated in the run as required or defined by the Engineer.

A non-corrodible draw wire or rope shall be left in each duct and plugs shall be inserted at the ends of each section of duct to prevent entry of soil or stones. On completion of the ducts and prior to drawing in cables, a circular wire brush 6mm greater in diameter than the duct shall be pulled through each duct.

1103.129 Cable Draw Pits

Cable draw pits shall be of brick enclosed construction fitted with suitable removable access covers and have bellmouthed duct entries into the pit interior. The interior dimensions shall be determined by the Engineer but shall be not less than 750 x 600mm in plan and the depth shall be determined by the invert of the lowest duct with a minimum of 50mm clearance to the base of the pit.

Where specified, a pulling eye for the use of 2000kg pulley block shall be provided opposite each group of ducts in the wall of the pits, and positioned to facilitate as straight

a pull as possible in the cables with the use of a pulley block. The base of the pit shall be formed with a fall towards a sump, suitably placed for pumping dry.

1103.130 Backfilling and Reinstatement

Reinstatement of soil following laying of cable shall be effected by backfilling in 100mm layers. Hand ramming shall be employed fir the first two layers and power ramming for subsequent layers. Backfilling shall only proceed in the presence of the Contractor responsible for laying cables.

After hand ramming to a depth of 200mm, a yellow coloured plastic tape approximately 150mm wide with the words 'CAUTION ELECTRIC CABLE BELOW' shall be provided and run over the centre of the route of each cable run.

Top soil is to be replaced and the level of the finished reinstatement shall not protrude more than 500mm above ground level. All surplus spoil is to be removed from the site, and areas surrounding the excavation shall be restored to their original condition. Where tarmac surfaces have been excavated, the final 200 mm backfilling after allowing the settlement shall consist of 120mm of compacted graded hardcore, followed by 60mm concrete screed and a20mm top dressing of tarmacam.

1103.131 Cable Trenches

Trenches cast in floors of ground shall be of specified internal dimensions to suit the specific installation. They shall have smooth vertical sides and bottom with provision for cover plates to finish flush with the finished floor surface.

Inside bends shall be either radiussed (150mm min) or chamfered at least 100mm back, equally angled from each direction. Such radiussing or chamfers shall extend the full height of the trench, however the top 100mm may be corbelled out to simplify the cover plate arrangement.

Trench covers shall be of aluminum or galvanized mild steel chequer plate (min 8mm thick) supported to prevent undue flexing and having suitable holes to allow removal be standard lifting keys. Support shall be by means of steel curbing rebates cast into the trench top edges, providing a landing width of at least 300mm.

Additional or alternative support for switchboards etc. shall be from at least a 75 x 35 mm channel section cross bearers and transverse trimmers, fixed or cast into the floor and located to suit equipment fixings, access requirements and floor cover spans.

To prevent differential deflection, butt straps shall be fitted to the underside of floor plates which have no other support.

Edging curbs suitable for mild steel chequer plate shall be painted in red oxide primer, the curbing may be tapped to accept cover securing screws. Where aluminum plates are used in contact with any mild steel supports, a bitumen coating on the points of contact shall be used.

1103.132 Cable Troughs

Pre-cast concrete trough sections shall be laid either flush or upon the finished ground level as specified.

The sections shall be sized and provided with rebated covers to suit the span and any imposed load conditions specified, e.g. at road crossings. Provision shall be allowed for handling/removal of such covers. Pre-formed junctions and turn-outs shall be provided with suitable chamfers inside bends.

1103.133 Transformer Bays

The dimensions and weight of the transformers are specified herein in order that access clearances and loadings may be determined. The transformer bases shall be located at ground level, accessible form a made up road or hard standing to the bays.

Each transformer bay shall be separately enclosed to prevent unauthorized access and be portioned by plain brick blast walls up to a height of 2.2m, with one side being fitted with full width, lockable open-mesh gats or louvred doors for access and ventilation. Where roof covering is necessary, it shall be of non-flammable construction and allow 800mm clearance at least for natural ventilation of the transformer.

The bay shall be sized at least 1.5m greater than the transformer width (across terminal boxes) and at least 1.0m greater than the transformer depth. A level concrete mounting ramp shall be located within the bay area suitable for rolling the transformer into position, and a pulling eye shall be fitted centrally in the rear wall at the ground level.

Provision shall be made for the oil to be conducted to underground drainage tanks having access for pumping out, separate tanks being provided for each transformer.

Cable ducts shall be arranged to suit the cable routes and have up-turned spouts projecting clear of the designed oil/pebble level for the bund.

Alternatively, the area surrounding the plinth within the bay, and enclosed after the transformer installation by a low bund wall if required, shall be excavated sufficient to accommodate 10% in excess of the transformer oil capacity when filled with fire quenching 50mm graded pebbles having 30% voids. Provision shall be made for drainage if accumulated rainwater.

For silicon cooled transformers of sealed construction, quenching pebbles will not be required, but an oil catchment area shall be provid3d where specified.

1103.134 Earthing Connections

Two earthing connection tab shall be welded to the concrete reinforcing bars in the positions shown on the specification drawings and be incorporated in the concrete encased, reinforcing steel network of the building foundations. The network shall be not less than 30m in length, buried at least 1m below ground level. The total length may comprise more than one bar, welded together to form the required minimum length.

Each earthing tab shall be of hot dip galvanized flat bar steel 50mm wide x 6mm thick, attached by welding to at least two parallel reinforcing bars (9mm diameter minimum) and of sufficient length to project beyond the finished concrete surface by at least 100mm in an accessible position.

The welding shall be of good mechanical strength over the full 50mm tab width and shall be located within an area of the rebar not required to provide structural strength, such as a trimmer or surplus length of the bar.

The reinforcing steel of existing buildings may be used to provide the electrode for a new installation or to replace a damaged or deficient conventional earthing system. A substantial rebar of a main beam or column shall be exposed by chipping away its concrete cover. The earthing terminal plate shall be welded to the rebar and the removed concrete replaced by mortar.

h) Electric Actuators

1103.135 General

Electric actuators shall be suitable for outside installation and all components shall be housed in waterproof enclosures to IP67 or better, which shall incorporate an anti-condensation heater.

The whole actuator shall be of easily maintained, robust construction and shall be sized to guarantee the penstock or valve opening or closing at the maximum differential pressure specified herein. The operating speed shall be approximately 300mm/minute unless otherwise specified.

All actuator component items shall be coupled via flanged mating faces secured by stainless steel bolts, except valve mounting fixings subject to thrust forces which shall be by means of suitably sized, high tensile steel bolts.

The gearbox shall be of the wormgear totally enclosed, oil bath lubricated type, having a cast iron enclosure suitable for operating at any angle and provided with the appropriate filling and drain plugs. The actuator drive bushing shall be easily detachable for machining to suit the valve stem or gearbox input shaft and the length of the drive nut shall be less than 1.25 x the spindle diameter.

The drive shall incorporate a lost motion feature to provide the additional torgue required to unseat he valve from the ‘Open’ or ‘Closed’ position in the event of the valve being in either position for an extended period. This movement shall give a hammer blow of sufficient force to free the valve.

The output shaft shall be hollow to accept a rising spindle where appropriate, and incorporate thrust bearings of the ball or roller type. The design shall preferably permit the gear case to be opened for inspection without releasing the spindle thrust or taking the penstock/valve out of service.

1103.136 Motors

All motors fitted to actuators shall be specially designed for the application and of the squirrel cage induction type for operation from the supply system specified.

The rated output of the motors shall be determined by the tenderer in relation to the requirement of the mechanical plant described elsewhere in this specification, and starting torgue shall be at least 10% in excess of maximum service requirements.

The motors shall preferably be 4 pole 1440 revs/minute machines designed with adequate thermal capacity to ensure that the actuator and starter can adequately perform, without overheating, the number of successive opening and closing operations called for in the specific requirements, and in no case shall this number be less than three.

Each motor shall be fitted with a thermostat or thermistor arranged to stop the motor in the event of dangerously high temperature in the motor windings due to overcurrent or an abnormally high number of starts per hour.

1103.137 Manual Operation Interlock

The actuator shall have a handwheel for manual operation which will be at standstill during motor operation. A lever shall be provided for engaging the handwheel drive, and this shall be interlocked so that when starting the motor the handwheel is automatically uncoupled without danger to the operator. Provision shall be made for the lever to be padlocked in either position to prevent hand or motor operation as required.

1103.138 Position Monitoring

A mechanical position indicator, showing the open, closed or intermediate positions of the valve on a visible dial, shall be incorporated in the actuator housing. Alternatively, where specified, a continuous position indicator shall be provided.

Remote position indicators, where specified, shall be controlled from a suitable potentiometric drive arranged to provide a continuous proportional signal from ‘Open’ to ‘Closed’ positions.

1103.139 Position Control

Where specified for control purposes, a current position transmitter shall be provided to give a positive 4-20mA signal proportional to the valve position, and shall incorporate zero and span adjustments to suit the actual valve travel.

1103.140 Torque and Limit Switches

All switches shall be accommodated within the actuator housing and all contacts and mechanism shall be of sealed, rustproof and robust construction and have a self-cleaning wiping action.

Adjustable torque limiting devices and switches shall be provided to trip the starter in the event of mechanism overload due to obstructions or jamming etc. They shall be mechanically latched to prevent torque tripping during unseating.

Limit switches shall be arranged to trip the starters when the ‘fully open’ or ‘fully closed’ positions are reached. Should the manufacturer consider it desirable (to ensure proper seating) the travel may be stopped in the ‘fully closed’ position by the torque limit switches, but in this case the ‘fully closed’ limit switches shall still be provided, although they will be adjusted to be inoperative.

1103.141 Auxiliary Switches

Auxiliary changeover switches shall be provided to operate at each end of the travel, in order that they may be used for remote controls or indications monitoring the 'Open' and 'Closed' positions.

1103.142 Terminal Facilities

All electrical components shall be wired out to terminal blocks in a common terminal chamber incorporated in the actuator housing but separated form all actuator components by means of a watertight seal.

Each terminal shall be labeled to correspond with the diagram of connections and shall be capable of accommodating not less than 2.5mm^2 copper conductors. AC and DC terminals shall be clearly segregated.

Terminal blocks shall comprise shrouded anti-tracking mouldings of melamine phenolic or comparable material with provision for securing conductors by screw clamp connectors or other vibration-proof devices.

The terminal chamber shall be provided with three tapped conduit entries, 1 x 32mm and 2 x 25mm ET or as otherwise specified. These holes shall be plugged with suitable plugs during transit and storage to prevent ingress of moisture or foreign matter.

Any conduit entries not used after cabling is completed shall be plugged with threaded aluminum blanks and the threaded joints made watertight by using suitable tape or jointing compound.

1103.143 Starters and Control Gear

The actuator motor shall be controlled through integrally mounted electrically and mechanically interlocked contactors, rated for switching the motor direct on-line, adequate for the duty requirements and complete with all necessary auxiliary contacts for the functions specified herein.

The control circuit shall operate at 24V DC derived from a suitably rated transformer/rectifier with one side of the secondary winding connected to earth or as otherwise specified. Primary and secondary windings shall be protected by cartridge type fuses.

The method of control and operation shall be as called for under the specific requirements and the actuator shall be provided with any facilities called for therein to suit the method of control, whether this be automatic or by hand. Local controls integrally mounted on the actuator shall consist of push buttons for 'Open', 'Close' and "Stop' functions, together with a Remote/Off/Local selector, lockable in all positions. The "Stop" button shall be effective in both local and remote settings and operate directly on the contactor control circuit.

Facilities by means of volt-free contacts shall be provided for remotely monitoring:

- motor running
- actuator is available for remote operation
- actuator is opened and actuator closed.

1103.144 Paint Finish

The finish colour shall be gloss, Crimson, Colour No 540 to BS 381C (or 04 D 45 to BS 4800).

1103.145 Actuator Isolators

The switch shall have a slow make and break mechanism of the two position rotary pattern arranged to isolate the 3 phase supply and all other control circuit supplies to the actuator. The ratings and number of poles required for each duty shall be as detailed in the specific requirements, the isolator rating being based on the actuator average load current being switched normally off-load, but emergency on-load.

Each switch shall be incorporated in a heavy duty, hoseproof, cast aluminum enclosure to IP65, having external fixing lugs and adequate seals and drip shields on the operating shaft and cover. Austinlite rotary type EXO 190 or equal.

Switch positions shall be 90 apart, clearly and permanently inscribed or embossed as 'OFF' and 'ON' on the cover, and the switch handle shall incorporate provision for the switch to be padlocked in both the 'OFF' and 'ON' position. The 'OFF position to be to the left of centre or vertical, the 'ON' position to the right or horizontal.

It shall be possible to remove the switch cover for access to the terminal without disturbing the switch or its mounting base. The enclosure shall be suitable for mounting on, or adjacent to, the penstock pedestal. If mounted on the penstock pedestal, cabling between the isolator and the actuator above may be arranged through conduit connections, suitable for disconnection should it be necessary to remove the actuator assembly complete.

(This item preferably to be provided by the contractor who is responsible for the cabling).

i) Miscellaneous Equipment

1103.146 Warning Signs

'Automatic Plant' warning signs shall be provided and erected by the Contractor in the building or on the plant in a prominent position to be agreed.

The 500mm x 300mm x 0.7mm (22SWG) signs shall be located approximately 1.6m above the adjacent floor level to the sign centre.

The sign shall be off 22swg, vitreous enameled aluminum sheet or plastic, having black letters on a yellow background, (see Appendix 5) inscribed as follows:

CAUTION

PLANT UNDER AUTOMATIC CONTROL

AND LAIBLE TO START WITHOUT WARNING

ISOLATE AT SOURCE BEFORE ATTEMPTING ANY

MAINTENANCE OF MECHANICAL AND ELECTRICAL PLANT

1103.147 Equipment for Potentially Explosive Atmospheres

Equipment for use in potentially explosive atmospheres shall be selected and installed in accordance with BS 5345, subject to the temperature classification of the specified gas, vapour or liquid. Ex(d) and Ex(i) classified equipment shall be certified for Apparatus Groups IIA and IIB.

In such areas, aluminum and other light metal alloys shall only be used for enclosure of electrical apparatus and fittings where such enclosures conform to the material requirements of BS 5501 Part 1.

Aluminum and light metal alloy fans on motors may be used if adequately protected, or if plastic fans or cowls are used they shall be of anti-static material.

Where no British Standard is applicable, equipment to an equivalent European standard may be submitted, subject to the approval of the Engineer.

1103.148 Field Mounted Equipment

Individual starters, fuse-switches, distribution boards and other equipment shall be housed in robust, heavy gauge, rustproofed, metal-clad enclosures having external fixing lugs except where otherwise specified.

Components, fittings and housings shall be as specified elsewhere in this specification.

Equipment housings shall be mounted such that the terminal and covers are readily and safely accessible and are not obstructed or affected by the adjustment or mounting arrangement.

Push button stations shall be single or composite units suitable for accommodating the required buttons in the above enclosures. Each button top shall be fitted with a durable protective flexible boot.

Junction boxes shall be equipped with rail-mounted, deed-through terminals adequately sized to accommodate the cables to be terminated. An earth connection facility shall be provided for each box.

Auxiliary switches shall be mechanically and electrically suitable for the duty and circuit operations specified herein and intended by the switch manufacturer. Roller-lever operated switched shall be of the snap action type.

Where employed for crane or gantry duty, spring failure within a limit switch shall not render it inoperative.

Handgear interlocks shall be fitted to any driven equipment which has provision for manual operation to ensure that it is not possible for drives to start with the handgear in position.

1103.149 Heavy Duty Electrodes

Each electrode shall comprise a single element mounted in an insulating high impact phenolic moulding, impervious to corrosion and having separate fixings for the flange mounting base and for the cover.

The base shall have a 20mm screwed conduit entry and be suitable for accommodating the electrode length by means of a substantial clamping collar which shall also have a provision for terminating the cable conductor.

A sealing gasket shall be fitted between the base and cap and the whole head shall be sealed to prevent ingress of water after installation is completed.

The electrodes shall be formed of ¾” BSP galvanized steel tubes (approximately 27mm diameter) sealed at one end and cut to suit the specified length, cut ends being dipped or coated with galvanizing paint or similar. Where

intermediate steady brackets are required or when otherwise specified, the electrodes shall be sheathed with an insulating material to within 150mm of the electrode tip.

Spacing between electrodes and to the adjacent wall shall be not less than 150mm.

1103.150 Light Duty Electrodes

Each electrode shall be mounted in an insulating moulded body having a 20mm screwed conduit entry and a screwed cover such that the whole head may be sealed to prevent the ingress of water after installation is completed.

The electrodes shall be formed from not less than 6mm diameter stainless steel rod and should not exceed 1.5m in length for light duty applications. Spacing between electrodes and to the adjacent walls shall be not less than 100mm.

1103.151 Electrode Circuits

All electrode circuits and components shall comply with BS 5345 and the BAASEEFA requirements for intrinsically safe system for Apparatus Groups IIA and IIB.

The system shall operate by the circulation of an AC current when the circuit is completed by the liquid coming into contact with the electrode, this current operating a

relay to initiate the events specified herein. The relay operation shall incorporate a five second time delay 'On' and 'Off' to allow for spurious initiation.

Intrinsically safe electrode circuits shall be completed by a separate return electrode for each circuit.

1103.152 Electrode Mounting

The electrode heads shall be mounted on a suitable support bracket at a height well above the expected maximum water level as shown on the specification drawings.

Intermediate steady brackets shall be provided and fitted for every 2m of electrode length, insulated lengths of electrode being fitted where these are used.

Support Brackets and steady brackets shall be hot dipped galvanized to BS 729 or otherwise protected to prevent corrosion.

1103.153 Emergency Lighting

Emergency lighting shall be provided to maintain sufficient illumination in accordance with BS 5266 for escape routes within the building during mains supply failures.

The luminaries shall comprise at lest a single 8w fluorescent tube with a solid state changeover circuit and high efficiency, high frequency, inverter all contained within a die-cast aluminum bulkhead body, having a corrosion resistant, stove enamel finish. The diffuser shall be f unbreakable, opal polycarbonate material, secured by an oil and water proof sealing gasket to result in a laminate rated to IP65.

The luminaries shall be self-contained and shall incorporate a maintenance free, nickel cadium battery, capable of preserving the light output for a period of at lest 3 hours without mains supply, together with an automatic

recharging circuit to restore the charge within 24 hours of total discharge. Each luminaire shall incorporate an indicator to show that the charger circuit is healthy and have a hinged gear tray and fused terminal blocks.

The luminaries shall be either of the following forms, as detailed in the Specific Requirements:

- maintained from, normally lit from the mains and automatically switched from
- mains to battery during mains failure;
- non-maintained form, energized automatically from the battery supply only when
- the mains fails and the associated local lighting circuit is switched on;
- sustained form, having tow lamps, one of which is mains fed only, the other
- operating form the battery supply during mains failure.

1103.154 LV Outlet Transformer

Isolating transformers shall be of air cooled, double wound construction in accordance with BS 3535, fitted with an earthed metallic screen between primary and secondary windings and suitable for operation form a 220V 50HZ single phase supply.

The secondary winding shall have a rated output of 100VA continuous (1500VA intermittent tool rating) at 110V and have a centre tapping connected to earth.

The transformer shall be enclosed in a wall mounted sheet steel or moulded casing with external fixings lugs and separate cabling connections. The secondary output shall be via fuses incorporated in the enclosures.

1103.155 Water Heater

Single point water heaters shall be thermostatically controlled free outlet 'single point' heater suitable for wall mounting. The water inlet shall be 0.5" BSP fitted with a control tap and the outlet swivel spout shall have a reach of approximately 300mm. The heater shall have a capacity of approximately 1.5 gallons (7.0 litres) and an electrical loading of approximately 3kW.

1103.156 Space Heater

Wall mounted single tier tubular heaters rated at 250 watts/metre and suitable for 220V operation shall be provided.

The heaters shall be mounted approximately 300mm above floor level in the positions indicated on the drawings. They shall be directly connected to heater circuits controlled by the room thermostat, the final connection to the heaters being made by means of flexible conduit and a protective conductor. The flexible conduit shall enter from below the heater.

1103.157 Space Heater Thermostat

The thermostat shall be a surface mounting 14 Amp bi-metallic strip type, adjustable over the range 0-30ºC and lockable to prevent unauthorized adjustment of the setting.

The room thermostat shall be mounted approximately 2.0m above floor level in the position indicated.

1103.158 Electric Trace Heating

Heating cables shall comprise a self-regulating, conductive polymer core or double heating elements within a waterproof outer PVC sheath having sealed ends with a cold lead at one end. The cable shall have a flat section to provide efficient heat transfer.

The cable shall be straight laced along the underside of pipes and secured with cable ties at 300mm spacing or be spiraled around the pipe and secured at each end.

All heating cable must be in intimate contact with the pipe and must not be overlapped on itself, additional ties being positioned on either side and close to all flange joints. To avoid mechanical or leakage damage, the cable shall be run over the sides of flanges at 90º to the invert on horizontal pipe runs.

After any thermal insulation has been fitted, wiring labels shall be fitted in prominent positions in the pipework to indicate the presence of trace heating.

1103.159 Trace Heating Thermostat

A wall mounting, air sensing thermostat set at 5ºC shall be provided and arranged to switch on the heater for frost protection. If non-self-regulating heating tapes are used and where lagging is applied, or on PVC pipework, a thermostat shall be located on the pipework and arranged to switch off the heater if the temperature exceeds 60ºC.

Liquid filled sensing bulbs and capillary tube connections to the thermostat shall be of stainless steel with a stainless steel flexible sleeve fitted over the capillary tube for mechanical protection.

The air measuring thermostat shall be mounted on the outside wall, 600mm above ground level and adjacent to but not above the protected pipework.

Enclosure and terminal arrangements to be as specified for field mounted equipment.

1103.160 Lightning Protection

The building shall be protected against lightning strikes by a system consisting of an air termination network, down conductors and a ground termination network. Ground Termination shall be achieved by installation of electrode rods (in pits) connected via tape tails to the bottom of the down-conductor.

The installation shall be complete with a binding connection taken from a down-conductor position to the building main earth terminal bar.

The protection system shall be designed and installed in accordance with BS 6551 by a specialist contractor; with horizontal conductors on the outside walls of the structure.

All metalwork on or around the structure shall be bonded to the lightning protection system. Where connection between dissimilar metals are made, precautions shall be taken to prevent corrosion.

The horizontal and down conductors shall be of 25mm x 3mm copper strip, fixed with leaded gunmetal clamps, secured by phosphor bronze screws or bolts. Each down conductor shall take the most direct route from the air termination network to the earth termination and be provided with a bolted test joint in a position accessible from the ground level.

Earth electrodes of 16mm2 copper bonded, steel cored rods shall be driven into the ground as close as practicable to the structure at the end of each down conductor. The rods shall be installed in sections connected by screwed

couplers and driven to a depth sufficient to achieve a resistance to earth such that the whole of the lightning protection system shall have a combined resistance to earth not greater than 3 Ω ohms. The screwed couplers shall be long length aluminum bronze material, counterbored to protect the threaded ends form damage and corrosion.

1104.1 Pump Duty

Pumps shall be of the type specified and arranged as indicated in the Specification Drawings and shown on schedule of pumps. They shall be designed to give specified output against all losses including those relating to the pump.

The Contractor shall match his pump characteristics to the pipe system network to achieve high pump efficiency and reliability.

Each set must be capable of running satisfactorily in parallel with other sets in the system without throttling and by itself, without cavitation or overload under all operating conditions within the system characteristics given.

The pump section and arrangement shall be such as to ensure that the head available exceeds the N.P.S.H. requirements of the pump under all operating condition.

Where the system and pump characteristics are such as to give rise to the possibility of surge in the pipeline with consequential damage, a surge investigation shall be undertaken if the results of the investigation show that there is a problem. Measures shall be proposed by the Contractor to alleviate the problem. These measures shall be agreed with the Engineer.

Centrifugal pumps shall be capable of withstanding without detriment, reverse rotation to a speed that would occur if the pump were to stop when the differential head was at a maximum and the delivery and/or non-return valve failed to close.

For submersible pumps the ability to operate with the maximum reliability is of prime importance, with efficiency being a paramount consideration. The pump shall therefore operate without clogging, being designed to pass a sphere of 125 mm diameter where the size of the delivery mains permits. Whilst the pumps shall be designed to meet a specific duty they shall also be capable of operating over the duty range specified for prolonged period and for standing idle for long periods without attention as in the case of storm pumping.

1104.2 Centrifugal Pump Casings

Pump casings shall be of the volute type and shall be capable of withstanding all pressures which may be produced due to operating pressure surges.

Particular attention shall be paid to the wear characteristics of the pumps. In the case of submersible pumps, due to the presence of grit in the water, could be appreciable.

The pump design shall ensure that alignment is maintained between the various assemblies by recesses, spigots and dowels and shall be such that all components liable to wear can be replaced.

Components shall be permanently marked with the manufacturer's number and where dowels are not used, permanently marked for correct assembly. The pump casing and the pump impeller should normally have detachable wear rings.

The casings of the pumps shall be of a suitable grade of close-grained grey cast iron or nickel iron and have flanges to match the specified pipework.

The waterways through the pumps shall be smooth in finish and free from recesses and obstructions.

Sewage pump casings shall be of substantial construction to give long life under abrasive conditions and suitably stiffened to withstand shock due to solids in suspension. Inspection holes shall be provided in any section bend and in the pump casing above the impeller for access to facilitate the clearance of obstructions. The inspection hole covers shall be shaped to conform to the interior profile of the waterway when in place and shall be fitted with starting screws where necessary.

1104.3 Impellers

Impellers shall be securely fitted to pump shafts in such a manner to prevent them becoming loose or detached when the pump is in operation, or when rotating in the reverse direction, either by liquid flow or motor rotation.

The impellers and guide vanes (if any) shall be manufactured from a suitable material, accurately machined and smoothly finished to minimize hydraulic losses.

The rotating elements shall be statistically and dynamically balanced before final assembly. The impeller shall be readily withdrawable from the pump casing without the need to disconnect pipework.

For submersible pumps, the impeller shall be of the open type with the inlet ends of the vanes being of bulbous design and the impeller passages being as large as possible consistent with good performance.

The inlet ends and surfaces of the vanes shall be dressed to give a smooth finish to prevent fouling by rages and fibrous matter within the pumps.

Impellers for both submersible and storm water pumps shall be of the non-shrouded type, constructed normally of close-grained grey cast/nickel-iron, and designed to exclude gritty matter from the shaft and gland.

Clearance at the eye rings and wear plates shall be kept to a minimum, and where it is found necessary to cut back the impeller this it be done on the vanes only.

1104.4 Pump Shaft

The pump shaft shall be of high tensile or stainless steel adequately sized, with good fatigue, shock load and corrosion resistance. The duty speed range shall be well below the first critical speed of the shaft. Where a change in diameter of the shaft occurs the shoulder shall be radiussed or undercut to the appropriate BS to reduce stress concentration.

The shaft shall be complete with easily renewable steel protecting sleeves at glands and bearings.

1104.5 Shaft Seals

Pump shaft sealing arrangements shall be suitable for the water pressures and shaft speeds involved.

Pumps fitted with soft re-packable or packed gland type, seals shall have stuffing boxes designed to facilitate adjustment of the packing materials.

Pumps shall be fitted with a split type mechanical shaft seal arranged such that replacement of wearing components can be carried out without the need to dismantle the pump.

Special care in the selection of materials shall be taken in order to avoid binding and electrolytic action between the shaft sleeve and he mechanical seal components, particularly where long periods of idleness are inherent in the duty cycle as in the case of standby and storm pumping.

1104.6 Bearings

All pumps shall incorporate bearing arrangements which prevent the escape of lubricant into the liquid being pumped. The bearings shall be located in dust/moist-proof housings.

All bearings shall be liberally rated to ensure cool running and meet the load factors specified.

For vertically mounted pumps, the top bearing shall be s a combined thrust and journal type, designed to prevent any thrust loads being transmitted to the drive motor. The pump bottom bearing shall be lubricated by an enclosed water lubricated sleeve bearing for potable water applications by grease or other approved means for sewage use. Storm pump bearings shall also be suitable for standing idle for periods of up to 2 months without attention or movement.

Where grease points are necessary they shall be fitted with removable screwed plugs which shall be accessible without removing guards. All bearings having automatic lubrication shall also have provision for hand lubrication.

1104.7 Baseplates and Stools

For vertical pump units, heavy cast iron or fabricated steel floor plates and motor stools shall be provided for direct mounting in concrete floors or supporting steelwork. Suitable journal and thrust bearings shall be provided in the baseplates to carry out the vertical drive shaft.

Where necessary the motor stools shall be designed to accommodate flywheels and bearing housings.

Floor plates shall be recessed and so arranged that the tops and fixing bolts are level with the finished floor.

The pump units shall be accurately aligned and located on baseplates by set screws and parallel dowels

1104.8 Lubrication/Cooling Monitoring

A lubrication system shall be arranged for the lubrication of all grease points on the pumps and shafting from motor room level. Individual bearings within the support tunnel tubes and on the pump sets themselves shall receive separate supplies of grease fed by pressure tubes laid from each bearing to battery plates readily accessible from motor floor level for grease gun operation.

Pressure tubes shall be grouped together where possible and securely attached by brackets, straps, etc. to tunnel tubes, with connectors located near to the motor support plate for easy removal of shafting in the event of maintenance work. In exposed positions pressure tubes are protected from damage. Motor grease points will not be included in this lubrication system but shall receive individual attention.

The battery plates shall have sufficient greasing points for all bearings to be located on or adjacent to each pump motor stool.

A notice is to be supplied and fixed on the wall in a prominent position detailing the manufacturer's recommended greasing schedule. The notice shall include a warning of the dangers to bearings from 'over greasing'.

A grease gun shall be supplied for all greasing purposes.

Bearings which require a continuous supply of lubricant shall incorporate a means of monitoring such a supply, either by flow or temperature rise as appropriate for the type of bearing employed; separate monitors being fitted for each bearing feed or housing.

Such monitors shall include all necessary ancillary power of pulse counting devices to enable the operation of any monitor to initiate a volt free contact rated at 240V 0.5 A AC.

1104.9 Pump Tundish

Where specified, each pump shall be equipped with a cast aluminum or fabricated steel tundish to accommodate the drain lines from mechanical seals, casing vent and other minor drainage points on the pump. A single drain pipe shall be run from the tundish to the common drainage system.

1104.10 Air Release Cock

The higher point on the pump casing shall be fitted with a manual air release cock have a removable handle or an automatic air release valve with a lockable isolation valve as specified. Air release pipework on sewage pumps shall be not less than 30mm bore and shall discharge back into the wet well at high level and have facilities for rodding. The drain from each air release cock shall discharge via pipework as specified.

1104.11 Couplings

All couplings shall be of an approved type and the Contractor shall arranged for the provision and fitting of both coupling halves to each respective shaft and shall include for all necessary modifications to any existing shafts to be coupled.

Where specified, the Contractor shall include any equipment required to prevent damage to any part of the drive in the event of reverse rotation of the pumps..

1104.12 Lubrication

The gear unit shall be grease or oil lubricated, arranged to provide an adequate supply of lubricant for the duty.

Where oil lubrication is employed, the casing shall include an oil breather, level indicator and drain plug.

Units having a rated output greater than 500kW shall have inspection covers and include a forced lubrication system comprising an oil circulating pump, reservoir tank and full flow 'Duplex' type oil filters having re-useable elements together with associated pipework; the oil being circulated by either (a) an internal mechanically driven gear pump and an external electrically driven pump arranged to prime the gears as pre-set timings as recommended by the unit manufacturer, or (b) duplicate external electrically driven pumps, each of which may be selected to prime pre-set intervals and run when the gear unit runs.

Such a lubrication system shall include dial gauges and alarm switches to monitor high oil temperature and low oil pressure.

1104.13Submersible Pumps

Pumps impellers shall be closed or semi open type made from zinc free bronze or such other materials required for use with particular water to be pumped. Pump bodies shall be of zinc free bronze or such other material as required for the water to be pumped, treated against corrosion, and equipped with detachable wear rings. The bowls shall be joined by flanges or by tie rods.

The shaft main guide bearings located in the suction and delivery end housings of the pump shall utilize a leaded-bronze material, and shall be provided with protection guards to prevent ingress of sand and grit. Pump bowl guide bearings shall utilize either leaded bronze or other approved abrasion resistant material.

All pump bearings shall be lubricated by the water to be pumped. The pump delivery end housing shall incorporate a thrust washer of suitable material at the shaft end housing to absorb upthrusts that occurs during pump starting. The pump shall incorporate a mushroom type delivery check valve to prevent reverse rotation of the shaft from back flow of water through the pump. The pumps shall be provided with a flanged discharge connection suitable for operating against the pump closed valve head or 16 bar whichever is greater. The shaft coupling connecting the pump and driving motor shall be of the stainless steel material accurately machined and keyed to ensure a precise shaft engagement and alignment. A strainer of suitable corrosion and abrasion resistant material, designed to guard against entry of foreign matter but permitting unrestricted flow of water into the pump, shall be provided on the pump suction housing.

Protections against the effect of sand shall be provided by renewable wear rings (made from a hard smooth flexible material such as polymethane) mounted at the seating of the impellers and the passages of the shaft.

The pump shall be designed to pump water having a sand content of up to $80g/m^3$.

A centralizer shall be fitted to every pump to ensure central alignment of the pumping and motor in the borehole casing.

Electro-submersible motors shall be 'wet' squirrel cage rotor induction type designed to operate continuously under submerged conditions and shall, where appropriate, comply with the requirements of IEC publication 34. They shall have operating speeds not in excess of 3000 rpm.

The motors shall be continuously rated at least 20% above the maximum power absorbed by he pump within the specified operating range. Motors shall be designed to allow three consecutive starts from cold and three starts in any on hour when hot.

The motor housing shall be constructed from close grained cast iron, cast steel or fabricated steel as appropriate, and shall be designed for easy dismantling and re-assembly to facilitate replacement of motor guide and thrust bearings.

The motor windings shall be insulated with an approved heat resistant material of high insulation resistance and impervious to water. All connections on the motor winding shall be made watertight. The temperature rise of motor windings shall be limited to 45ºC above ambient temperature.

The motor shall be equipped, in factory with several PTC or Pt100 thermoprobes, 2 minimum, connected to a multifunction protection relay and a pre-selection digital thermometer which cuts off the operation current of the starter when the threshold temperature is reached. The temperature setting of this device shall depend upon the type of the probe determined by the manufacturer according to the insulation class of the motor.

The motor shaft shall be machined from high tensile stainless steel of sufficient diameter to prevent distortion from the dynamic and electro-magnetic stresses imposed on it. Critical shaft speed shall be well above the maximum running speed.

The motor shall be provided with a heavy duty multipad thrust bearing at the base of the motor to absorb the shaft down thrust developed by the pump. The bearing design shall incorporate tilting thrust pads with replaceable segments arranged to self adjust according to the thrust load. The thrust disc shall be of a suitable segment carbon based or similar approved material.

The thrust bearing design shall also be suitable for reverse rotation of the shaft in the event of backflow of water through the pump.

Motor guide bearings shall utilize either leaded bronze, copper impregnated carbon or similar approved material. Rubber, nylon, Tufnell and similar materials will not be accepted for the motor guide bearings.

Motor guide and thrust bearings shall be lubricated by the motor coolant water which shall be effectively isolated from the water to be pumped. A compensating device shall be incorporated in the motor design to allow for expansion of the coolant on rising temperature.

1104.14Submersible Pumps Headworks

A fabricated steel discharge head piece shall be provided at the top of the tank to support the complete rising column and electro-submersible pumpset assembly, and shall be complete with lifting eye bolts. The discharge head piece shall comprise a heavy duty sealing plate arranged for bolting to the borehole outer casing flange, and a 90º discharge bend arranged for flanged connection to both rising column and horizontal surface pipework. Lifting eyes shall be provided in the sealing plate. A flange shall be provided and welded by the Contractor to the top of the borehole outer casing. The flange shall be suitably drilled to accommodate the discharge head piece sealing plate bolts. Holes shall be provided in the sealing plate to accommodate an air vent pipe, motor and control cables, water level dip tubing, etc. and shall include adequate sealing arrangements to protect against borehole contamination. A 255mm diameter screwed removable plug shall be provided over the dip tubing for water level measurement with electrical contact tape. A stainless steel air vent pipe shall be fitted to the discharge head sealing plate, terminating in an insect proof screen and arranged to prevent entry of rain or surface water.

Tank power and signal cabling shall be brought to separate robust watertight junction boxes in the top of the well head chamber, with separate cabling from the junction boxes to the Motor Control Centre (MCC).

1104.15Surge Suppression Equipment

Surge vessels and associated equipment for suppression of surge in pumping systems shall include the following:

Surge pressure vessel designed and constructed to BS 5500, constructed

category 1, 2 or 3, post weld heat treated and with a corrosion allowance of 1mm. The vessel shall be cylindrical, carbon steel, fusion welded with domed ends and mounted either vertically or horizontally on steel supports. The vessel shall be provided complete with including the following fittings:

- McNeil type access manhole with opening not less than 450 mm x 410 mm;
- Water inlet/outlet branch flanged to BS 4504 Table 16 or 25 as necessary;
- 100 mm diameter drain branch with gunmetal valve and handwheel with drain pipework discharging to drainage channel;
- Spring loaded gunmetal safety valve;
- 150 mm diameter pressure gauge complete with isolating cock;

- Water level sight glass with isolating and blowout prevention valves;
- Air inlet fitting incorporating an air release valve and isolating and non-return valves;
- Three stainless steel water level control electrodes of appropriate length, complete with electrode holders, spacers and brackets;
- Access ladder;
- Lifting lugs;
- Nameplate giving vessel details.
- One or more air compressors with standby facilities. Each compressor shall be capable of charging the pressure vessel from full water in approximately 30 minutes. The compressors shall be air cooled, electrically driven and complete with baseplates.

The compressors are required to deliver completely oil-free air but may be of the air lubricated type with two stage carbon air delivery filters providing complete removal moisture and oil vapour. Each compressor shall be provided with the following fittings:

- Outlet pressure gauge;
- Pressure relief valve;
- Suction filter and silencer;
- Automatic unloading valve for a no-load start under all conditions;
- Non-return valve;
- Protective guard between motor and compressor.

Control equipment to provide fully automatic control of the selected duty compressor from the water level electrodes in the surge vessel. A time delay shall be incorporated to prevent operation of the compressor during water level changes under surge conditions and a push button feature shall be provided for manual test of the system. The control equipment shall be housed in a wall mounted panel fabricated from mild steel to form a rigid box construction of neat appearance providing an enclosure to IP54. The enclosure door shall be hinged with a rotating handle and positive closing action. The equipment shall include:

- A three pole isolating switch, with operating handle interlocked with the enclosure door;
- A water level control module;
- A 0 to 30 minutes adjustable timer;
- A non-latching motor test push-button.

Ductile iron flanged inlet/outlet pipework between a flanged tee on the pumping station or wellhead delivery pipework and the surge vessel. The pipeworks shall include an isolating valve with gearing and handwheel and all necessary bends and fittings.

Small diameter GMS pipework between the air compressors and the surge vessel. The pipework shall be suitably coated and wrapped.

For small installations a vessel with a flexible membrane and hand air pump may be used.

j) Valves

1104.16 Types and Operating Conditions

Valves shall be designed to meet the operational and environmental conditions specified for the types indicated in the specific valve schedule.

The closure rates of all valves shall be designed to prevent the effects of surge. Where necessary, valves with a varying closure rate shall be used.

Valve flanges or couplings shall be as specified in the valve schedule and match those specified for the pipework installation.

1104.17 Identification

Each valve shall be identified by a unique reference as approved which shall identify the medium/plant controlled and be numbered in a logical sequence.

The reference shall ither be engraved on a 3mm thick laminated white/black/white traffolyte disc or stamped on a1.0mm (19g) thick brass disc. The disc shall be at least 35mm diameter with reference letters and numerals not less than 4mm and 8mm high respectively.

The discs shall be mounted on the hub of the handwheel or where this is impractical, they shall be attached to the valve stem by means of suitable brass 'S' hooks and/or jack chain through a hole at the top of the disc.

1104.18 Access

All valves, spindles and handwheels shall be position to give good access for operational personnel. It shall be possible either to remove and replace or to recondition seats, gates or gland packings which shall be accessible without removal of the valve from the pipework or, in the case of power operated valves, without removal of the actuator from the valve.

Extension spindles shall be supplied wherever necessary to achieve the specified operating requirements.

1104.19 Hand Operation

All handwheel shall be arranged to turn in a clockwise direction to close the valve or penstock, the direction of rotation for opening and closing being indicated on the handwheels.

The handwheels shall be coated with black plastic and incorporate facilities for padlocking in either the open or closed position.

The operating gear of all valves and penstocks shall be such that they can be opened and closed by one man against an unbalanced head 15% in excess of the maximum

specified service value and any gearing shall be such as to permit manual operation on a reasonable time and not exceed a required rim pull of 200kg.

Power operated valves shall include equipment for manual operation by means of a handwheel or other suitable device which shall be interlocked with, and fixed to, the power unit.

Headstocks and valves of 50mm nominal bore and above shall be fitted with mechanical position indicators to show the amount which the valve is open or closed in relation to its full travel, i.e. 0.25, 0.50, 0.75, 1 etc.

1104.20 Valve Materials

Valve bodies and other components shall be of corrosion resistant materials, compatible with the medium and of robust industrial design.

For water applications and where specified, valve bodies, discs and wedges shall be of cast iron, with facing rings, wedge nut and other trim of carrions resistant bronze or gun metal.

The valve stem, thrust washers, screws, nuts and other components exposed to the water shall be of a corrosion resistant grade of bronze or stainless steel.

For water works applications, wedge gate, metal seated valve materials shall be in accordance with BS 5163 Table 6A, fitted with a stuffing box and gland seal on the stem. Oil or grease shall not be used on any bearing or seal that may be in contact with the water being controlled.

1104.21 Non-Return Valves

All non-return valves shall be of a type that will operate without stock.

Valve bodies shall be of cast iron and shall be fitted with renewable type seatings.

In the case of swing gate type valves the hinge pin shall be of stainless steel, mounted in zinc free bronze bushes and extended and fitted with external levers and counter balance weights, all protected by a screen guard.

Other types of valves will be considered. In every case the non-return valve shall be selected with full consideration of the system characteristics, and shall avoid valve slam, and have low maintenance requirements.

Where specified, limit switches shall be provided to operate from the external lever. The screen guard being slotted to allow the guard to be removed without disturbing the switch cabling.

1104.22 Butterfly Valves

Butterfly valves shall conform to BS EN 593.

Butterfly valves shall have a high grade cast iron body to BS EN 1561 designed to the specified working and test pressures. The pressure rating valve shall be cast in the valve body.

The disc shall be of high grade cast iron to BS EN 1561 or nodular cast iron to BS 2789 to the defined working and test pressures. It shall have a convex shape designed to achieve low head loss characteristics. The valve shafts shall be of stainless steel operating in self lubricating bushes in the body.

The valve seat shall be of gunmetal to BS 1400. The sealing ring shall be a renewable Ethylene Propylene Diene Monomer (EPDM) rubber attached to the disc edge by a sectional bronze retaining ring to form a resilient and durable seal.

The valves shall be fitted with hand wheel actuators not exceeding 500mm diameter incorporating gearing to allow opening and closing by manual operation at the pressure stated using an effort no greater than 36kg on the hand wheel supplied.

In all cases the gearing shall be designed to close the valve, from fully open to fully closed in a period of not less than ten minutes with this effort. Actuators shall be designed so as to close the valves when the hand wheel is turned in a clockwise direction; the direction of closing shall be clearly cast on the hand wheel. Position indicators shall be fitted to all actuators.

Where required valves shall be electrically actuated with a manual override. Remote actuation shall be provided with a visual indication of valve open, valve closed and percentage opening together with fault indication.

A performance curve, relating percentage valve travel, open area and discharge coefficient shall be submitted to the Engineer. The head loss coefficient with valve fully open shall be defined.

All valves shall be tested in accordance with BS EN 593 and pressure and material test certificates shall be submitted to the Engineer for approval.

1104.23 Plug Valves

Plug valves shall be of the wedge gate type, with cast bodies. The plug surface shall be coated or lubricated to endure low torque operation with bubble tight shut-off and 'non-sticking' materials.

1104.24 Isolating Cocks

For isolation of small bore pipework tappings for instrumentation equipment etc. and for individual component isolation, the cocks shall be stainless steel, quarter-turn, ball or plug valves with the operating handle arranged to indicate the open and closed positions. Where specified, means shall be provided for securing the valve body to a front panel or rear surface.

Where corporation cocks are specified, these shall be similar to the above isolating cocks but shall have a detachable key handle for fitting onto a squared operating shaft, the shaft end being marked to indicate the open and closed valve positions.

1104.25 Air Valves

Air valves shall be either:

- Single (small) orifice valves (SAV), for the discharge of air during the normal operation of the pipeline.
- Double orifice valves (DAV), consisting of a large orifice and a small orifice. These shall permit the bulk discharge of air from the main during filling and air inflow when emptying in addition to the discharge of small quantities of air during normal operating conditions.

Air valves shall be supplied with an independent isolating butterfly valve (DAV) or cock (SAV) which permits the complete removal of the air valve from the main, without affecting the flow of water in the main.

Each air valve assembly shall be suitable for connection to a flange on the pipeline.

At the connection between the air valve and its isolating valve a BSP tapping shall be made suitable for fitting of a pressure gauge. All tappings shall be sealed by a brass plug and copper compression ring gasket.

Air valves shall operate automatically and be constructed so that the operating mechanism will not jam in either the open or closed positions.

1104.26Systems Design

All pipe systems shall be arranged, installed, supported and provided with all necessary means of venting, draining and expansion subject to the approval to the Engineer before erection commences.

The pipework layout shall be designed so that items of equipment and sections of pipework can be removed from the pipelines without major disturbance to the adjacent pipework. Particular care shall be taken to ensure that pipework thrusts are not transmitted to machinery or associated apparatus. The Contractor shall indicate on his detailed drawings the thrust blocks required to anchor his pipework.

Dead legs shall be avoided, but where this is not possible provision shall be made for flushing the pipework. Changes in pipe bore sizes shall be by the use of proprietary fittings or fabricated sections to avoid sudden changes.

Where relevant, formed bends and offsets shall be used and be cold formed in a standard pipe bending machine. They shall have an inside radius of not less than 4 times the outside diameter of the pipe.

Hydraulic pipework. Pipework for pressurized hydraulic fluid shall be sized to maintain fluid velocities below those which specified and provide a safety factor of 4:1 on the design pressure, which shall be taken as 120% working pressure;

Compressed air pipework. Air pipework shall be seamless heavy duty Black Mild Steel class C, sized such that the air flow velocity does not exceed 8m/sec. the complete pipework will receive 2 coats of chlorinated rubber paint, with a final 3rd coat, the final finish color to match existing and as approved by the Engineer. All joints will be flanged; no threaded joint will be approved for the entire compressed air pipework assembly. To provide adequate condensate drainage, the pipework system shall be run with a horizontal fall of not less than 1 in 50 in the direction of air flow and incorporate drainage points at distances of not less than 30m. Drainage points shall be formed by the use of equal tees with a down-pointing leg fitted preferably where changes of direction of flow occur.

Any branch take-off shall be from the top of the main and the bottom of any falling pipe shall be drained.

1104.27Flanges

Unless otherwise specified flanges shall be faced and drilled to conform to the dimensions specified in BS 4504. Flanges shall be compatible with the pressure rating of the adjacent pipework but not less than 15 bar. Bolts, nuts and washers (two washers per bolt) shall be to BS BS EN 1092-3;2003. No bolt shall project more than two full threads beyond its nut after tightening. In no circumstances shall the shortening of excessively long bolts by cutting be allowed.

Gaskets shall comply with replaced by BS EN 1514 (1997) and replaced by BS EN 681-2 (200) and BS 681-1 (1996) Type W.

Flanges shall be painted with two coats of chlorinated rubber paint.

1104.28 Mechanical Couplings

Unless otherwise specified or shown in the Drawings pipes and fittings shall be supplied with flexible joints.

Mechanical couplings shall be of the Dresser, Viking Johnson type without a centre register.

Joints rings used shall be of the ethylene propylene rubber (EPDM) or other material approved by the Engineer.

All mechanical couplings and flange adapters including nuts, bolts and washers shall be supplied with 'Rilsan' nylon thermoplastic polyamide applied by fluidized bed dipping.

1104.29 Materials for the Assembly of Flexible Joints

Lubricant shall be of a kind not conducive to the growth of bacteria and shall have no deleterious effects on either the joint rings or pipes. Lubricants for water supply shall not impart to water, taste, colour, or any effect known to be injurious to health.

1104.30 Materials

Pipework materials, sizes, pressure rating, fittings, coupling arrangements and median carried shall be as detailed in the Particular Specification, pipework being in standard metric sizes where possible.

General purpose steel pipework with screwed fitting shall be of galvanized mild steel to BS 1387 heavy grade with fittings of galvanized malleable iron to BS 143/1256, having tapered internal and external threads to BS 21.

Flange joints shall be as specified below for the application and all necessary bolts, nuts and washers shall be cadium plated. Welded joints in carbon steel pipe shall be to Class II quality to BS 2640 or BS 2971. Welding shall only be carried out by welders who are approved in accordance with the relevant BS.

Water pressurized system shall use pipe-work of carbon steel in accordance with BS 3601 with pipe sizes to BS 3600. Sizes greater than 80mm shall be selected from the preferred sizes 100, 150, 200, 300, 450, 600 and 800mm.

Flange sizes shall be according to BS 4505 rated NP16 unless otherwise specified.

All flanged joints shall be made with 3mm thick rubber canvas reinforced insertion rings complying with BS 4865 Part 1 table 16A.

Low pressure large bore systems shall use steel pipes and fittings to BS 4622 unless ductile iron pipes and fittings to BS 4772 are specified. Screwed or cast flanges shall have a minimum NP16 rating and be fitted with 3mm thick rubber canvas-reinforced insertion rings.

Hydraulic pipework shall be of stainless steel high pressure tubing grade CFS 316 to BS 3605 or mild steel grade CDS 23/S to BS 3602 as specified.

Flexible hoses shall be of the twin wire braid reinforced type complying with BS 3832.

Pipe fittings not normally visible or accessible after installation shall be of the welded socket type with break joints at suitable positions for maintenance.

All other fittings shall be of the compression type in mild steel with an electroplated corrosion resistant finish.

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1104.31Joint and Pipe Fastenings

All nuts, bolts, washers, flanges, gaskets, flanged tied adaptors, drain valves, special connection pieces, supporting hangers, brackets or clips and temporary supports for the pipework, together with all terminal point connection material shall be supplied and installed under this Contract.

All flanged joints shall be fitted with suitable insertion ring gaskets which shall be carefully adjusted concentric to the bore of the pipe so that no undue strain is placed on any of the bolts or flanges of the pipe when bolting up.

Joints on flanges that exist or have been installed under other contracts shall be made with the same material and suitable for the flange faces.

Flushing and drain connections on pipework below 150mm shall be made using proprietary welded fittings with G series internal parallel threads to BS 2779 which shall be immediately sealed with steel hexagon headed shouldered plugs and seals. Holes thus made in the pipe shall have any burrs removed and be finally pulled through to remove loose particles.

1104.32Template Pipes

Template or closure pipes shall be provided where necessary to facilitate erection. The design and construction of the template pipes shall be to the approval of the Engineer, and the Contractor will be responsible for establishing the dimensions of the template pipes such that there will be no strain on the connected items after installation.

1104.33By-passes

Where pipeline flow meters are used, particularly electromagnetic meters, by-pass pipework and valves shall be installed to allow removal of the meter without interrupting the process flow. Draining shall either be via backflow or drain valves.

1104.34Flanged Adaptors

Flanged adaptors shall be provided as indicated in the Specification drawings. Each adaptors shall be complete with all associated fittings and shall be installed in accordance with the manufacturer's instructions.

1104.35Branch Pipe and Bosses

Whenever any small bore pipework makes a connection into the pipeline system, a boss of branch pipe shall be provided which shall be at least twice the diameter in width and one diameter in thickness of the tapped hole which it contains.

Bosses shall be located at the main pipe horizontal centre line and those provided for water sample cocks shall be tapped 38mm (1.5") BSP and have reasonable access for sampling. Bosses provided for instrumentation equipment shall be tapped 1" BSP with a reducer fitted to suit the small bore pipework and isolating cock. Unused bosses shall be fitted with blank plugs having a central squared projection for tightening or removal.

1104.36Small Bore Pipework

Small bore pipework up to 15mm OD shall be manufactured from stainless steel tubing with suitable compression type fittings. All smart bore pipework and capillary tubes shall be adequately and securely clipped or clamped. Compression fittings bends shall be kept to a minimum, as pipeline bends of generous radii are preferred. Compression couplings shall be heavy series to BS 4386 Part 1.

Any gauges, transducers or switches etc. fed via small bore pipework shall have an individual isolating cock adjacent to each component with adequate space being allowed for component removal for servicing.

1104.37 Duct Seals

After the pipework is installed, the Contractor shall seal the ends of all ducts, pipes or trenches leading into buildings, whether occupied or not, for pipework associated with this Contract.

The seals shall be approved water, gas and fire sealing transit units with appropriate fillers, and insert blocks shall be fitted to duct trench entries. All steelwork on such transit assemblies and frames shall be hot dip galvanised. Where shown on the Engineer's drawings, transit frames will be incorporated in the construction by the Civil works contractor.

1104.38 Reference Marking

Prior to dispatch from the manufacturer's works each pipe section shall be marked with an appropriate reference number for future identification.

1104.39 Protection of Pipework

Immediately after the completion of fabrication at the works or on site and during transport and storage, pipe ends shall be protected from external damage and sealed against ingress of dirt by suitable caps, plugs or other similar means. After cleaning and inspection, machined surfaces of all steel and ironwork shall be covered with preserving fluids of approved type otherwise protected and all flanges shall be fitted with blank discs bolted to each face.

1105 CONTROL PANEL PARTICULAR SPECIFICATIONS

1105.1 Location

The works will be located in Machakos.

1105.2 Scope of Works

The contractor shall supply and install the complete Electrical Services installation systems comprising but not limited to the following:

- Pump Control Panels

1105.3 4.2.1 Control Panel

The contractor shall supply, install, test and commission. Control panels to monitor and control all the electromechanical installations.

The Panel's controllers shall be capable of control and monitoring all the speed controlled pumps. The control panels shall also comprise of external frequency converters for each pump. The starting method for all the pumps shall be done electronically via variable speed drives for each of the pumps.

It shall also allow for fitting of a transducer to provide low water pump shut down protection to the pump set, with alarm signal. The control panel will also incorporate run and fault indicator lights for each pump and as well as speed indication lights.

The Panel shall incorporate the following features:

- LCD panel with backlit dynamic buttons to enable the user to interrogate the panel.
- Automatic fans to cool down the cabinet if required according to EN60439-1
- Lockable mains breaker
- Individually breakers for each pump

Control panels functionality

The control panels shall operate the pumps to keep a required pressure at the discharge manifold. The system shall automatically start the required number of pumps to keep the required Pressure.

The system must ensure a minimum of pressure surges when starting and stopping pumps by ramping the pumps in according to a defined ramp.

On the control unit it must be possible to read out:

Speed of individual pumps.

State of individual pumps.

Power consumption

Energy consumption

A measured or estimated flow rate.

Process value and set point.

The Controller must incorporate a log that graphically shows the trend of:

- The Estimated/measured flow
- Speed of the pumps
- Set point
- Process value

It must be possible to retrieve the data and open it in a spreadsheet.

The control shall store at least the last twenty fault conditions experienced by the pump set, for subsequent display when the panel is interrogated.

The alarms must be presented in plain text indicating the source of the alarm.

The control system shall incorporate password protection and shall fully segregate access to interrogate the pump operating history from the access level at which pump operating settings can be changed.

The control system shall incorporate automatic test run of each pump every 24 hours. The system must automatically ensure equal running hours of the pumps. It must be able to, once a day, evaluate the running hours of the pumps and alternate between them if an idle pump has less running hours than a running pump.

Standby pump

- It shall be possible from the controller to define a number of standby pumps.

- Where a pump is designated as standby it shall still be included in the duty change cycle.

1105.4 4.2.2 High Pressure protection

It shall be possible to program a “high-pressure” safety cut-out, set 1.5 bar above the duty pressure. The pumps set shall automatically shut down in the event of the above pressure being identified. Following a shut-down the controller shall (a) re-start the pump set automatically once the high condition has disappeared, or (b) will remain shut down until manually re-started by an authorised person. (The preferred option shall be agreed with the end user prior to hand over and the controller programmed accordingly).

1105.5 4.2.3 Low Pressure/pipe burst protection

It shall be possible to program a "Low-pressure" safety cut-out, set 1 bar below the duty pressure. The pumps set shall automatically shut down in the event of the above pressure being identified. Following a shut-down the controller shall (a) re-start the pump set automatically once the high condition has disappeared, or (b) will remain shut down until manually re-started by an authorised person. (The preferred option shall be agreed with the end user prior to hand over and the controller programmed accordingly).

1105.6 4.2.4 Soft pressure build up.

The panel shall incorporate a slow-speed/one-pump-only start up, following a power outage or maintenance shutdown to gradually fill up the pipeline and reduce risk of airlocks and water hammer.

1105.7 4.2.5 Redundant sensor

The controller shall have a feature that gives an alarm if there is incoherency between the two discharge sensor signals.

1105.8 4.2.6 Testing and Commissioning:

Once installed on site, with all necessary permanent water services, power supplies, control and alarm systems completed and tested. The panel manufacturer shall be invited to site to commission, test and demonstrate the operation of the panel to the full satisfaction of the Engineer and End User.

1105.9 Working Drawings /Fabrication Drawings

Upon award of the subcontract the subcontractor shall produce three sets of the working drawings to Engineer prior to commencement of the work. The Engineer has to approve the drawings for the subcontractor to proceed with the works. The drawings shall be in A2 hard copies.

Fabrication drawings of the pumps control panel shall be submitted to the engineers for approval before fabrication commences.

1105.10 As Built Drawings

The subcontractor shall prepare the as installed drawings at the completion for the subcontract. The drawings shall be in AUTOCAD and 3No. Sets of A3 hard copies.

ABBREVIATIONS

The following abbreviations are used in these documents:

FIDIC	Federation International des Ingenieurs – Conseils
BS	British Standards
CP	Code of Practice
GRP	Glass Reinforced Plastic
AC	Asbestos Cement
DI	Ductile Iron
Ch	Chainage
PVC	Polyvinyl Chloride

kPa	kilo Pascal
g	acceleration due to gravity - (9.807m/s^2)
gpm	gallons per minute
mgd	million gallons per day
mm	millimeters
m	metres
mhd	metres head
m^3	cubic metres
m^3/day	cubic metes per day
m/s^2	metres per second head
1/head/day	litres per head per day
kW	kilowatts
kVa	kilovolt-ampere
kWh	kilowatt hour
ISO	International Standards Organisation
CFM	cubic feet per minute
AOD	Above ordnance datum
SWL	Static water level
PWL	Pumping water level
GL	Ground level
EOH	End of hole

Section X. DRAWINGS

[Attach drawings]

Supplementary Information

Section XI. Bills of Quantites

LIMURU WATER AND SEWERAGE COMPANY

NAIROBI - NAKURU – MAU SUMMIT PPP ROAD PROJECT

RELOCATION OF WATER AND SEWERAGE INFRASTRURE ALONG THE PROJECT ROAD SECTION III: RIRONI - MAGUMU FLYOVER AND RIRONI – MTARAKWA

CONTRACT NO: LIWASCO/001/KENHA/2020/21

GRAND SUMMARY

Bill No	Description	Amount (KShs)
1	PRELIMINARY & GENERAL	
2	TRANSMISSION LINES	-
3	BOREHOLE	
4	DAYWORKS	-
BILL TOTAL		
Contingencies	10%	
Bills Total inclusive of Contingencies		
Value Added Tax (VAT)	16%	
TOTAL CARRIED TO FORM OF BID		

SIGNATURE OF BIDDER: ……..……..

NAME OF AUTHORIZED REPRESENTATIVE: ……...……

COMPANY STAMP: ……...……..

DATE: …….……..

BILL 1 - PRELIMINARY AND GENERAL ITEMS

ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT (KShs)
	CLASS A: GENERAL ITEMS				
	Contractual Requirements				
	Allow for Provision of:				
	Setting Out & Survey Work				
1A268.1	Allow for Establishment of Level Datum and Setting Out of the Works in all the Project Areas in accordance with the Specifications. This shalll include staking out of the Pipeline Routes. Include for preparation and submission of Setting Out Survey Report to the Engineer for approval.	Item	L.S		
1A268.2	Allow for review of Contractors working drawings by experts	Item	L.S		
1A269.3	Test Running of the Works: Contractor to Test-run the newly installed water pipeline and borehole for a period of 24 hours upon completion of the Works as per the Specifications. Test Running to be carried out in close liaison with the Water Services Provider's Staff. The Contractor to allow for 'on job' training of Operation and Maintenance Staff, Tools, etc, and ensure that the operations are carried out full time on a 24 hour basis.	Item	L.S		
	PAGE TOTAL CARRIED TO TO BILL 1 COLLECTION				

BILL 1 - PRELIMINARY AND GENERAL ITEMS

ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT (KShs)
	Sign Boards				
1A279	Allow for Provision, erection and maintainance of Project Sign Boards at sites to be indicated by the Engineer within the Project Area and removal upon completion of the Contract. Details of the Sign Board are shown on Drawing.	Nr	5		-
	Method Related Charges				
	- Dayworks (A411)				
A411	Provisional sum for undertaking works under the Dayworks Bill as instructed by the Engineer.	PS		-	
	Other Provisional Sums				
1A429.7	Allow a Provisional sum of Kshs 20,000,000 for the Engineer's miscellaneous account to be spent in whole or part as instructed by the Engineer and to be reimbursed against receipts.	Sum			-
	PAGE TOTAL CARRIED TO TO BILL 1 COLLECTION				**-**

BILL 1 - PRELIMINARY AND GENERAL ITEMS

ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT (KShs)
1A7	**Specific Conditions**				
1A7.1	Allow for all specific works related to working along active pipelines and maintaining continuity of water supply and sewer operation including protection of supports etc. of existing pipelines during construction activity.	Sum			
1A7.2	Allow for excavation for and identification of extent/limits of existing pipelines including excavation, alignment, levels and other as-built details at interconnection points. Include for backfilling of excavated areas and production of ACAD drawings showing details of pipelines. These Works to be carried out prior to commencement of pipeline works.	Sum			
1A7.3	Allow for any costs associated with compliance with Environmental, Health and Safety Requirements as specified in the Specifications and as required by Government Agencies and Prevailing Legislation.	Months	3		
1A7.4	The Contractor shall include in the programme to be submitted for the execution of the Works under an alleviation programme for Site staff and labour and their families in respect of Sexually Transmitted Infections (STI) and Sexually Transmitted Diseases (STD) including HIV/AIDS.	Month	3		
1A7.6	P.C. Sum for Payments demanded by the Authorities for re-location or crossing of existing services, Road and Railway crossings, etc . Liaison with the relevant Authorities including KWS, KFS, KPL, KRC, KURRA, KERRA etc shall be the responsibility of the Contractor for the timely execution of the Works.	Item			
1A7.7	P.C. Sum of Kshs 500,000 for Inspection and Witness Testing of Pipes, Fittings and Equipment at manufacturer's premises by the Employer, Engineer and their representatives	Item			
1A7.9	Contractors overhead and profit items 1A7.4-1A7.8	%	0	10%	
	PAGE TOTAL CARRIED TO TO BILL 1 COLLECTION				

BILL 1 - PRELIMINARY AND GENERAL ITEMS

ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT (KShs)
	BILL 1 Collection Page Total Page 1 Total Page 2 Total Page 3				
	BILL 1 COLLECTION CARRIED TO GRAND SUMMARY				

BILL No. 2 WATER TRANSMISSION LINES -					
ITEM	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (KShs)**	**AMOUNT (KShs)**
	CLASS A: GENERAL ITEMS **Specified Requirements** *Testing of works* Carry out pressure testing, cleansing and sterilising of the pipeline in accordance with the specification.				
A260.1	Pipe bore n.e 50-315mm	m	11,000		
	CLASS D:DEMOLITION AND SITE CLEARANCE clearance shall include demolition and removal of natural and artificial articles, objects and obstructions which are above the original surface. Items for demolition and site clearance shall be deemed to include disposal of materials arising. Items for general clearance include removal of hedges and removal of hedges stumps of any diameter and disposal of materials arising of. Items for removal of trees shall include removal of stumps where required. The girth shall be measured 1m above the ground level. (provisional) -				
D210	General clearance for pipeline route of all shrubs. Clearance width not exceeding 2m.	ha	2.75		
D210	Trees of girth 500mm - 1m	nr	10		
	CLASS I: PIPEWORK - PIPES Supply and Transport to site. Transport from site store, lay and joint pipes in trench, include for excavation, preparation of surfaces, disposal of excavated material, shoring sides of excavation and backfilling. Note:- Trench width and minimum cover to pipes is as per the Specifications. The cost shall include for strutting, shuttering, stabilizing the earth faces of trenches and keeping the trenches free of water from whatever source by pumping or other means and cost of use of selected soil from the excavated material for compaction in bed and surround to backfilling of trenches, all as specified.				
	PAGE TOTAL CARRIED TO COLECTION PAGE				

BILL No. 2 WATER TRANSMISSION LINES

ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT (KShs)
I7	*Approved High Density Polyethylene Pipes (HDPE)*				
I73	*Nominal Bore DN 315 , PN 16 in Trenches*				
I732	Depth n.e 1.5 m	m	200		
I733	Depth 1.5-2 m	m	50		
I734	Depth 2-2.5 m	m	50		
I73.1	*Nominal Bore DN 250, PN 16 in Trenches*				
I732.1	Depth n.e 1.5 m	m	100		
I733.1	Depth 1.5-2 m	m	50		
I734.1	Depth 2-2.5 m	m	50		
I72	*Nominal Bore DN 200, PN 16 in Trenches*				
I722	Depth n.e 1.5 m	m	80		
I723	Depth 1.5-2 m	m	40		
I724	Depth 2-2.5 m	m	40		
I72.1	*Nominal Bore DN 160, PN 20 in Trenches*				
I722.1	Depth n.e 1.5 m	m	2,600		
I723.1	Depth 1.5-2 m	m	1,000		
I724.1	Depth 2-2.5 m	m	200		
I72.2	*Nominal Bore DN 110, PN 20 in Trenches*				
I722.2	Depth n.e 1.5 m	m	100		
I723.2	Depth 1.5-2 m	m	30		
I724.2	Depth 2-2.5 m	m	20		
I72.3	*Nominal Bore DN 90, PN 16 in Trenches*				
I722.3	Depth n.e 1.5 m	m	2,000		
I723.3	Depth 1.5-2 m	m	500		
I724.3	Depth 2-2.5 m	m	500		
	PAGE TOTAL CARRIED TO COLECTION PAGE				

BILL No. 2 WATER TRANSMISSION LINES

ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT (KShs)
I72.3	*Nominal Bore DN 50, PN 16 in Trenches*				
I722.3	Depth n.e 1.5 m	m	1,000		-
I723.3	Depth 1.5-2 m	m	300		-
I724.3	Depth 2-2.5 m	m	100		-
I72.3	*Nominal Bore DN 25, PN 16 in Trenches*				
I722.3	Depth n.e 1.5 m	m	2,000		-
	CLASS J: PIPEWORK - FITTINGS AND VALVES				
	All Fittings to PN 16. Butt fusion fittings for DN 110 and above while Compression fittings for DN90 and below. Rate to include for all uPVC-HDPE connection fittings where applicable.				
	Supply, handle, deliver to site, fix in place inclusive of all jointing fittings/accessories and test Sluice valve and gate valve to Tees				
J811.4	DN 315 flanged Sluice Valves to Peglar UK PN16 or approved equivalent	No	2		-
J811.5	Ditto for DN 250 ,PN 16	No	1		-
J811.6	Ditto for DN 200 ,PN 16	No	2		-
J811.7	Ditto for DN 160 ,PN 16	No	2		-
J811.8	Ditto for DN 110 ,PN 16	No	5		-
J811.9	Ditto for DN 90 ,PN 16	No	7		-
	Double collars				
	Flexible coupling (VJ Type)				
6J341	DN 110	nr	28		
6J342	DN 90	nr	30		
6J343	DN 50	nr	14		
6J344	DN 25	nr	20		
	Air Valves, Fire Hydrants and Washouts				
	Supply, handle, deliver to site, fix in place and test inclusive of all fittings, including flanged tees,saddle clamp, nipples and steel fittings,steel pipes inclusive (rate to exclude construction of chambers).				
J861.1	DN100mm Vent-O-Matt RBX series or similar approved flanged double orifice air release and vacuum break valve	No	10		-
	PAGE TOTAL CARRIED TO COLECTION PAGE				

BILL No. 2 WATER TRANSMISSION LINES

ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT (KShs)
	BENDS				
	Supply, handle, deliver to site, fix in place and test inclusive of all fittings bends as directed by the Engineer. For:				
	Bends 90^0				
J612.1	DN 200 mm	No	8		
J613.3	DN 160 mm	No	8		
J613.4	DN 110 mm	No	20		
J612.2	DN 90 mm	No	28		
	REDUCERS				
J681.1	Supply, handling, fixing in place and testing inclusive of all fittings For reducers				
J681.2	DN 315 x 250	No	2		
J681.3	DN 250 x 200	No	4		
J681.4	DN 250 x 160	No	4		
J681.5	DN 200 x 160	No	3		
J681.6	DN 160 x 110	No	6		
J681.7	DN 110 x 90	No	9		
J681.8	DN 90 x 63	No	10		
	CLASS K: PIPEWORK - MANHOLES AND PIPEWORK ANCILLARIES				
	Chambers				
	Supply and deliver materials on site, excavate for a construct complete chambers including precast concrete cover slabs where necessary as shown on the drawing				
	Provide all materials and construct **CONTROL VALVE** chambers internal dimensions 1000mm x 1000mm. Include for supply and fixing of lockable cover and step irons, as detailed in drawing				
K232	Depth: not exceeding 3 m	No	19		
	PAGE TOTAL CARRIED TO COLECTION PAGE				

BILL No. 2 WATER TRANSMISSION LINES

ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT (KShs)
	Micro-tunnelling below bituminous road				
	Rates quoted shall be deemed to include for costs incurred on traffic control, signage and safety measures during execution of the works.Including all costs of protection				
K692	Micro-tunnelling below the bituminous road. Nominal bores n.e 50-400 mm	m	1,100		
K693	Micro-tunnelling below the railway. Nominal bores n.e 50-400 mm	m	80		
K694	Extra over microtunnelling in rock	m^3	35		
	Other Pipework Ancillaries Pipe markers shall be made from reinforced precast concrete to detail. This item shall be deemed to include supply and fixing the pipe markers and painting as directed by the engineer.				
K820.1	Pipeline marker post	nr	31		
K820.4	Sluice Valve marker post	nr	19		
	CLASS L: PIPEWORK – SUPPORTS AND PROTECTION, ANCILLARIES TO LAYING AND EXCAVATION				
L111	Excavation in trench for rock (Provisional) Concrete stools and thrust blocks	m^3	130		
L78	Provide and place mass concrete (1:3:6) for anchor blocks in bends etc Rate to include excavation and necessary formwork (provisional)	m^3	12		
L7	***Concrete thrust blocks*** *Mass concrete Class 15* *Thrust blocks - RC, Volume 0.5 - 1.0m^3*				
5L74	For All junctions and branches	nr	8		
	Anchor blocks for Road Crossing- RC, Volume n.e 0.1 m^3				
5L71	Anchor blocks including metal strap and holddown bolts	nr	8		
	PAGE TOTAL CARRIED TO COLECTION PAGE				

BILL No. 2 WATER TRANSMISSION LINES

ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT (KShs)
	BILL COLLECTION				
	From page 1				
	From page 2				
	From page 3				
	From page 4				
	From page 5				
	BILL 4.1 COLLECTION CARRIED TO GRAND SUMMARY				

BILL NO. 3: DRILLING AND EQUIPPING OF A BOREHOLE					
ITEM NO.	DESCRIPTION	UNIT	QTY	RATE (KSHS)	AMOUNT (KSHS)
	GENERAL ITEMS				
1.1	Conducting a hydro-geological survey and preparation of Hydro-geological survey report	sum	1.00		-
1.20	Follow-up and acquisition of drilling permit from the Water Resources Management Authority and other relevant authorities	sum	1.00		
1.30	Mobilization / Demobilization of all Drilling Equipment, rig, as well as personnel to the site	LS	1.00		
	DRILLING WORKS				
201.00	Drilling of 254mm (10") diameter borehole from 0 - n.e 100m below surface	m	250.00		-
202	Ditto but 100 - n.e 200m depth	m	100		-
203	Ditto but 200 - n.e 300m depth	m	100		-
203A	Ditto exceeding 300 but n.e 360m	m	1		
204	Supply and installation of n.i.d 203.2mm (8") diameter plain steel casing heavy duty 4.85mm/152 and 5mm/203 to KS 06-259 and BS 1387.	m	250		-
205	Supply and installation of n.i.d 203.2mm (8") diameter steel casing (M/s Plasma cut well screens provision) heavy duty 4.85mm/152 and 5mm/203 to KS 06-259 and BS 1387.	m	144		-
205	Supply and installation of filter gravel pack (2-4mm)	Ton	25		-
207	Development of the boreholes	Hr	12		-
208	Test pumping and recovery measurements to ascertain borehole yield. (Test pumping for 24hr and recovery measurements for 12hr for the borehole)	Hr	36		-
209	Construction of borehole head-works around well head by constructing a concrete plinth and a chamber measuring 1mx1mx1m with class 20/20 mass concrete floor slab and walls. Chamber to have painted Gauge16 steel plate lockable access cover 1mx1m with anti-theft and weather resistant padlock.	No.	1		-
Total for Drilling 1No. Borehole					**-**

BILL NO. 3: DRILLING AND EQUIPPING OF A BOREHOLE					
ITEM NO.	**DESCRIPTION**	**UNIT**	**QTY**	**RATE (KSHS)**	**AMOUNT (KSHS)**
210	Supply and fix 6" borehole steel cap.	No.	1		-
211	Supply and fix 8" surface casing	M	10		-
212	Place a bentonite sanitary seal 3m deep.	LS	1		-
213	Clay Disaggregate calgonTM injection as sodium hexametaphosphate to acceleare removal of clay matter / improve on water turbidity : includes cost of injection.	kg	30		-
214	Allow costs for providing water for all requirements of the contract, field camp, drilling works e.t.c.	Sum	1		-
215	Collect water samples and carry out water quality analysis (chemical and bacteriological analysis) in a reputable laboratory acceptable to the Project Manager and submit water quality test report.	No.	2		-
216	Allow costs for collecting formation samples and prepare Geological logging charts.	No.	1		-
217	Complete the prescribed WRMA Borehole drilling completion report and submit to WRMA	No.	1		-
301	Provide, install and commission a submersible pump set (complete with motor) capable of delivering 60m3/hr against a head of 350m	Nr	1		-
Total Carried Forward to the Next Page					**-**

BILL NO. 3: DRILLING AND EQUIPPING OF A BOREHOLE					
ITEM NO.	DESCRIPTION	UNIT	QTY	RATE (KSHS)	AMOUNT (KSHS)
302	Provide, install and commission a 3 phase, 415Vac, DOL control panel for the above pump comprising of the following:- Provisional a) Appropriate rating contactor b) Appropriate rating thermal overload relay c) Over/under voltage phase failure protection relay d) Voltmeter e) Voltmeter selection switch f) Water level relay g) Appropriate Ammeter h) Appropriate MCCB for the mains i) Appropriate MCCB for the control circuit j) Start, Stop/reset push button (Green marked "START", and Black/Red Marked "STOP/RESET") k) Pilot indicator lights (green marked "PUMP RUN", red marked "OVER LOAD TRIPPED", yellow marked "BOREHOLE LOW, white marked "TANK HIGH" etc l) Hours run counter range 0 - 99999 hours m) Cable looping box of appropriate rating	LS	1		-
303	Enhanced MP204 Blackbox unit to integral circuit NB: A schematic and control wiring diagram MUST be supplied with the starter.	No	1		
304	3" class B G.I rising main pipe c/w pipe locking clamp including connecting to the existing tank and connecting to existing pipeline	m	440		
305	Supply of 3" crane sockets to the rising main	No.	42		
306	Provide and install one 3" bulk flow meter class B (type and make to be approved by the Project Manager) c/w Non Return Valve at the well head. Rate to include all pipe and fittings at the well head.	No.	1		
307	Electrode cable(pair)	m	440		
308	Electrode pencils (pair)	No.	1		
309	25mm Dipper tube complete	m	240		
310	1.5mm2 Flat cable for float switch	m	100		
311	2"*6" borehole cover c/w sundries	No.	1		
Total Carried Forward to the Next Page					

BILL NO. 3: DRILLING AND EQUIPPING OF A BOREHOLE					
ITEM NO.	DESCRIPTION	UNIT	QTY	RATE (KSHS)	AMOUNT (KSHS)
312	1.5mm² 2-CORE underground armoured cable – Electrodes	m	100		-
313	63A switch fuse "MEM" or equivalent	No.	1		-
314	Allow a P.C. Sum for electricity supply and connection to the borehole sites. Contractor is responsible for the application of electricity connection; follow up and for prompt supply and connection of electricity by KPLC. Electricity account to be held in the name of the Employer .	PC	pc		
315	Add a percentage of items 315 for contractor's overheads and profit.	%	10%		-
316	Allow a sum for testing and commissioning of the borehole equipping works.	LS	1		-
319	Provide for float switch to exisiting storage tank and connect to the control panel and pump	sum	1		-
320	4 FT Copper earth rod complete with clamp	Set	1		-
321	Lead cable 10.0m2 single core (for earthing)	m	10		-
322	Submersible cable rubber sheathed 25mm2 3 core submersible armored cable	m	240		-
323	Underground armored cable 25mm2 3 core	m	95		-
324	Construction of a well ventillated pump house 3mx2m internal dimension and 2.2m clear height with conrete roof slab reinforced with Y12 at 150 c/c both directions. Rate to include provision of steel door of gauge 16 (1.5mm thick) metal plates complete with two anti-theft and weather resistant padlocks all to the approval of the project manager. the walss shall be constructed with 225*225mm stone masonry fine dressed. Place hoop iron 3/4" on every coarse.	LS	1		-
325	Construction of borehole area perimeter fence approximately 100m long using 2.1m high chainlink G14 and 65 x 65 x 5mm thick steel angle lines at 2m centre to centre embedded in mass concrete 0.6m deep and diameter strutted at all corners of straight lines	m	100		-
326	Provide 6No. Strands of wire G12 and secure the chainlink using blinding wire G16	m	100		-
Total Carried Forward to the Next Page					

BILL NO. 3: DRILLING AND EQUIPPING OF A BOREHOLE					
ITEM NO.	DESCRIPTION	UNIT	QTY	RATE (KSHS)	AMOUNT (KSHS)
327	Provide and fix hinged and lockable steel grilled gate 2m wide with frame of 75mm class B pipes embedded in concrete as shall be directed.	Nr	1		-
Total Carried Forward to the Next Page					-

BILL NO. 3: DRILLING AND EQUIPPING OF A BOREHOLE					
ITEM NO.	DESCRIPTION	UNIT	QTY	RATE (KSHS)	AMOUNT (KSHS)
	Total from Page 1 Total from Page 2 Total from Page 3 Total from page 4				
BILL TOTAL FOR DRILLING AND EQUIPPING 1NO. BOREHOLE CARRIED TO SUMMARY SHEET					

DAYWORKS BILL

ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT (KShs)
1.1	**LABOUR** The rates inserted hereafter should include all such costs as insurance, travel time, overtime expenses, accomodation, use and maintenance of small tools of trade, Contractors overheads and profit. Only time engaged upon work instructed by the Engineer under this Bill will be paid for.				
1.1.1	Unskilled labour	hr	200		-
1.1.2	Foreman	hr	23		-
1.1.3	Driver	hr	38		-
1.1.4	Mason	hr	38		-
1.1.5	Carpenter	hr	25		-
1.1.6	Plumber	hr	13		-
1.1.7	Electrician	hr	25		-
1.1.8	Plant Operator	hr	50		-
1.1.9	Supervisor	hr	25		-
1.1.10	Pipelayer	hr	50		-
1.1.11	Painter	hr	25		-
1.1.12	Concretor	hr	50		-
1.1.13	Technician	hr	25		-
1.1.14	Watchman	hr	75		-
	TOTAL FOR LABOUR CARRIED TO DAYWORKS BILL SUMMARY				-

DAYWORKS BILL

ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT (KShs)
1.2	**MATERIALS** Materials shall comply with the relevant Technical Specifications and shall be subject to the approval of the Resident Engineer. The rate to include for delivery, storage, handling, Contractor's overheads, etc.				
1.2.1	Building sand	ton	50		-
1.2.2	Ordinary portland cement in 50 kg bags	No.	250		-
1.2.3	Fine aggregate	ton	50		-
1.2.4	Coarse aggregate	ton	50		-
1.2.5	150mm Blockwork	m^2	50		-
1.2.6	200mm Blockwork	m^2	50		-
1.2.7	Reinforcement fabric mesh.	m^2	125		-
1.2.8	Reinforcement steel.	ton	5		-
1.2.9	Concrete Class 25	m3	25		-
1.2.10	Imported Fill	m3	200		-
1.2.11	Hardcore	m3	25		-
1.2.12	Formwork	m^2	125		-
1.2.13	Petrol	L	250		-
1.2.14	Diesel	L	250		-
1.2.15	Lubricants	L	100		-
1.2.16	Epoxy Paint	L	100		-
1.2.17	Emulsion Paint	L	100		-
1.2.18	Gloss Paint	L	50		-
1.2.19	Wrought Finish Formwork	m^2	250		-
1.2.20	Smooth Finish Formwork	m^2	250		-
1.2.21	DN400 Gate Valve	No.	1		-
1.2.22	DN500 Gate Valve	No.	1		-
TOTAL FOR MATERIALS CARRIED TO DAYWORKS BILL SUMMARY					**-**

DAYWORKS BILL

ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT (KShs)
1.3	**EQUIPMENT**				
	Rates to include for all operation and maintenance of equipment, cost of fueling and lubrication, etc.				
1.3.1	Excavator	hr	25.00		-
1.3.2	Dozer 70Kw	hr	25		-
1.3.3	Grader Tractor	hr	50		-
1.3.4	Mobile generator 15 kVA	hr	100		-
1.3.5	4 WD Pickup 1 tonne	hr	100		-
1.3.6	Concrete mixer type 5/3.5	hr	25		-
1.3.7	Concrete dumper 0.5 cu.m.	hr	25		-
1.3.8	Concrete vibrator poker type N.D. 50 mm	hr	25		-
1.3.9	Dewatering pump 50mm dia suction end	hr	60		-
1.3.10	Air Compressor (5,000 l/min)	hr	250		-
1.3.11	Tipper Truck 7 tonne	hr	25		-
1.3.12	Tipper Truck 15 tonne	hr	25		-
1.3.13	Oxy-acetylene cutting and welding set including oxygen and acetylene gases.	hr	25		-
1.3.14	Electrical welding set including electrodes	hr	25		-
TOTAL FOR EQUIPMENT CARRIED TO DAYWORKS BILL SUMMARY					-

DAYWORKS BILL

ITEM	DESCRIPTION	UNIT	QTY	RATE (KShs)	AMOUNT (KShs)
	SUMMARY SHEET				
	-				
	Page 1: Labour				-
	Page 2: Materials				-
	Page 3: Equipment				-
	SUMMARY PAGE TOTAL FOR CARRIED TO BILL No. 1				-