REPUBLIC OF KENYA

COUNTY GOVERNMENT OF MERU

TENDER NAME:

PROJECT : CONSTRUCTION OF INTAKE AND PIPELINE RUGENE WATER PROJECT

NEGOTIATION NO. 697999/2018-2019

NOVEMBER, 2018

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SECTION I: INVITATION FOR BIDS

Invitation for Bids (IFB)

Date: 26th NOVEMBER 2018

CONSTRUCTION OF INTAKE AND PIPELINE RUGENE WATER PROJECT

Contract Identification No: **NEGOTIATION NO. 697999/2018-2019**

1. The **county government of meru** intends to undertake

2. the county government of meru invites bidders qualified as NCA 6 and above for tender for the above works

The **county government of meru** invites sealed Tenders from eligible bidders for the construction **Intake and pipeline Rugene water project** whose components in the scope of works includes supply of all materials required for and the construction of :-.

CIVIL WORKS

- **Construction of intake**
- **Construction of pipe line**

3. Bidding documents (and additional copies) may be downloaded from the county government website www.merucounty.go.ke

4. Bids shall be valid for a period of 120 days after Bid opening and shall be addressed to

County secretary
Meru county government
p.o box 120-60200
meru

on or before **10th December 2018** at 10.00 am at which time they will be publicly opened in the presence of the bidders who choose to attend.

5. Qualified domestic or regional contractors may be eligible to receive a margin of

preference of 10 per cent or 7½ per cent respectively, in Bid evaluation.[1]

SECTION II: INSTRUCTIONS TO BIDDERS

INSTRUCTIONS TO BIDDERS
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A. General

1. Scope of Bid

1.1 The Employer as defined in the Contract Data, invites bids for the construction of Works, as described in the Contract Data. The name and identification number of the Contract is provided in the Contract Data.

1.2 The successful Bidder will be expected to complete the Works by the Intended Completion Date specified in the Contract Data.

2. Source of Funds

The project will be from county funds

3. Eligible Bidders

3.1 This Invitation for Bids is open to all bidders from eligible countries as defined in the Rules of Procurement. Any materials, equipment, and services to be used in the performance of the Contract shall have their origin in eligible source countries.

3.2 All bidders shall provide in Section 2, Forms of Bid and Qualification Information, a statement that the Bidder (including all members of a joint venture and subcontractors) is not associated, nor has been associated in the past, directly or indirectly, with the Consultant or any other entity that has prepared the design, specifications, and other documents for the Project or being proposed as Project Manager for the Contract. A firm that has been engaged by the Employer to provide consulting services for the preparation or supervision of the Works, and any of its affiliates, shall not be eligible to bid.

3.3 Government-owned enterprises may only participate if they are legally and financially autonomous, operate under commercial law, and are not a dependent agency to the Employer.

4. Qualification of the Bidder

4.1 All bidders shall provide in Section III, Forms of Bid and Qualification Information, a preliminary description of the proposed work method and schedule, including drawings and charts, as necessary.

4.2 In the event that prequalification of potential bidders has been undertaken, only bids from prequalified bidders will be considered for award of Contract. These qualified bidders should submit with their

bids any information updating their original prequalification applications or, alternatively, confirm in their bids that the originally-submitted prequalification information remains essentially correct as of the date of bid submission. The update or confirmation should be provided in Section III.

4.3 If the Employer has not undertaken prequalification of potential bidders, all bidders shall include the following information and documents with their bids in Section III, unless otherwise stated in the Bidding Data:

(a) copies of original documents defining the constitution or legal status, place of registration, and principal place of business; written power of attorney of the signatory of the Bid to commit the Bidder;

(b) total monetary value of construction work performed for each of the last five years;

(c) experience in works of a similar nature and size for each of the last five years, and details of work under way or contractually committed; and clients who may be contacted for further information on those contracts;

(d) major items of construction equipment proposed to carry out the Contract;

(e) qualifications and experience of key site management and technical personnel proposed for the Contract;

(f) reports on the financial standing of the Bidder, such as profit and loss statements and auditor's reports for the past five years;

(g) evidence of adequacy of working capital for this Contract (access to line(s) of credit and availability of other financial resources);

(h) authority to seek references from the Bidder's bankers;

(i) information regarding any litigation, current or during the last five years, in which the Bidder is involved, the parties concerned, and disputed amount; and

(j) proposals for subcontracting components of the Works amounting to more than 10 percent of the Contract Price.

4.4 Bids submitted by a joint venture of two or more firms as partners shall comply with the following requirements, unless otherwise stated in the Bidding Data:

(a) the Bid shall include all the information listed in Sub-Clause 4.3 above for each joint venture partner;

(b) the Bid shall be signed so as to be legally binding on all partners;

(c) all partners shall be jointly and severally liable for the execution of the Contract in accordance with the Contract terms;

(d) one of the partners will be nominated as being in charge, authorized to incur liabilities, and receive instructions for and on behalf of any and all partners of the joint venture; and

(e) the execution of the entire Contract, including payment, shall be done exclusively with the partner in charge.

4.5 To qualify for award of the Contract, bidders shall meet the following minimum qualifying criteria:

(a) annual volume of construction work of at least the amount specified in the Bidding Data;

(b) experience as prime contractor in the construction of at least two works of a nature and complexity equivalent to the Works over the last 10 years (to comply with this requirement, works cited should be at least 70 percent complete);

(c) proposals for the timely acquisition (own, lease, hire, etc.) of the essential equipment listed in the Bidding Data;

(d) a Contract Manager with five years' experience in works of an equivalent nature and volume, including no less than three years as Manager; and

(e) liquid assets and/or credit facilities, net of other contractual commitments and exclusive of any advance payments which may be made under the Contract, of no less than the amount specified in the Bidding Data.

A consistent history of litigation or arbitration awards against the Applicant or any partner of a Joint Venture may result in disqualification.

4.6 The figures for each of the partners of a joint venture shall be added together to determine the Bidder's compliance with the minimum qualifying criteria of Sub-Clause 4.5(a) and (e); however, for a joint venture to qualify, each of its partners must meet at least 25 per cent of minimum criteria 4.5(a), (b), and (e) for an individual Bidder, and the partner in charge at least 40 percent of those minimum criteria. Failure to comply with this requirement will result in rejection of the joint venture's Bid. Subcontractors' experience and resources will not be taken into account in determining the Bidder's compliance with the qualifying criteria, unless otherwise stated in the Bidding Data.

4.7 Bidders applying for eligibility for a margin of preference in bid

evaluation, shall supply all information to satisfy the criteria for eligibility as described in Clause 30 of these Instructions to Bidders.

5. One Bid per Bidder

5.1 Each Bidder shall submit only one Bid, either individually or as a partner in a joint venture. A Bidder who submits or participates in more than one Bid (other than as a subcontractor or in cases of alternatives that have been permitted or requested) will cause all the proposals with the Bidder's participation to be disqualified.

6. Cost of Bidding

6.1 The Bidder shall bear all costs associated with the preparation and submission of his Bid, and the Employer will in no case be responsible or liable for those costs.

7. Site Visit

7.1 The Bidder, at the Bidder's own responsibility and risk, is encouraged to visit and examine the Site of Works and its surroundings and obtain 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.

B. Bidding Documents

8. Content of Bidding Documents

8.1 The set of bidding documents comprises the documents listed in the table below and addenda issued in accordance with Clause 10:

Section	II	Instructions to Bidders
	III	Forms of Bid and Qualification Information
	IV	Conditions of Contract
	V	Contract Data
	VI	Specifications
	VII	Drawings
	VIII	Bill of Quantities
	IX	Forms of Securities

8.2 Three copies of Sections III, V, and VIII are supplied to the prospective Bidder. The number of copies to be completed and returned with the Bid is specified in the Bidding Data.

9. Clarification of Bidding Documents

9.1 A prospective Bidder requiring any clarification of the bidding documents may notify the Employer in writing or by cable ("cable"

includes telex and facsimile) at the Employer's address indicated in the invitation to bid. The Employer will respond to any request for clarification received earlier than 28 days prior to the deadline for submission of bids. Copies of the Employer's response will be forwarded to all purchasers of the bidding documents, including a description of the inquiry, but without identifying its source.

10. Amendment of Bidding Documents

10.1 Before the deadline for submission of bids, the Employer may modify the bidding documents by issuing addenda.

10.2 Any addendum thus issued shall be part of the bidding documents and shall be communicated in writing or by cable to all purchasers of the bidding documents. Prospective bidders shall acknowledge receipt of each addendum by cable to the Employer.

10.3 To give prospective bidders reasonable time in which to take an addendum into account in preparing their bids, the Employer shall extend, as necessary, the deadline for submission of bids, in accordance with Sub-Clause 20.2 below.

C. Preparation of Bids

11. Language of Bid

11.1 All documents relating to the Bid shall be in the language specified in the Contract Data[1]. Provided that any printed literature furnished by the Bidder may be written in another language, as long as such literature is accompanied by a translation of its pertinent passages in the language specified in the Contract Data; in which case, for purposes of interpretation of the Bid, the translation shall govern.

12 Documents Comprising the Bid

12.1 The Bid submitted by the Bidder shall comprise the following:

(a) The Bid (in the format indicated in Section III);
(b) Bid Security;
(c) Priced Bill of Quantities;[2]
(d) Qualification Information Form and Documents;
(e) Alternative offers where invited;

and any other materials required to be completed and submitted by bidders, as specified in the Bidding Data.

13. Bid Prices

13.1 The Contract shall be for the whole Works, as described in Sub-Clause 1.1, based on the priced Bill of Quantities[3] submitted by the Bidder.

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

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

13.4 The rates and prices quoted by the Bidder shall be subject to adjustment during the performance of the Contract if provided for in the Bidding and Contract Data and the provisions of Clause 47 of the Conditions of Contract. The Bidder shall submit with the Bid all the information required under the Contract Data and Clause 47 of the Conditions of Contract.

14. Currencies of Bid and Payment

14.1 The unit rates and prices shall be quoted by the Bidder entirely in the currency of the Employer's country as specified in the Contract Data. Foreign currency requirements shall be indicated as a percentage of the Bid price (excluding provisional sums) and shall be payable at the option of the Bidder in (a) the currency of the Bidder's home country or (b) a currency widely used in international trade, always provided that a Bidder expecting expenditures in currency(ies) other than those stated in (a) or (b) above for portions of the foreign currency requirements, and wishing to be paid accordingly, shall indicate the relevant currencies and percentages in the Bid.

14.2 The rates of exchange to be used by the Bidder in arriving at the local currency equivalent and the percentage(s) mentioned in paragraph. 14.1 above shall be the selling rates for similar transactions established by the authority specified in the Bidding Data prevailing on the date 15 days prior to the latest deadline for submission of bids. These exchange rates shall apply for all payments so that no exchange risk will be borne by the Bidder. If the Bidder uses other rates of exchange, the provisions of Clause 28.1 shall apply. In any case, payments will be computed using the rates quoted in the Bid.

14.3 Bidders shall indicate details of their expected foreign currency requirements in the Bid.

14.4 Bidders may be required by the Employer to clarify their foreign currency requirements and to substantiate that the amounts included in the rates and prices and in the Contract Data are reasonable and responsive to Sub-Clause 14.1.

15. Bid Validity

15.1 Bids shall remain valid for the period specified in the Bidding Data.

15.2 In exceptional circumstances, the Employer may request that the bidders extend the period of validity for a specified additional period. The request and the bidders' responses shall be made in writing or by cable. A Bidder may refuse the request without forfeiting the Bid Security. A Bidder agreeing to the request will not be required or permitted to otherwise modify the Bid, but will be required to extend the validity of Bid Security for the period of the extension, and in compliance with Clause 16 in all respects.

15.3 In the case of contracts in which the Contract Price is fixed (not subject to price adjustment), if the period of bid validity is extended beyond 60 days, the amounts payable in local and foreign currency to the Bidder selected for award, shall be increased by applying to both the local and the foreign currency component of the payments, respectively, the factors specified in the bidding data or in the request for extension, for the period of delay beyond 60 days after the expiry of the initial bid validity, up to the notification of award. Bid evaluation will be based on the Bid prices without taking the above correction into consideration.

16. Bid Security

16.1 The Bidder shall furnish, as part of the Bid, a Bid Security in local currency or in a freely convertible currency, in the amount specified in the Bidding Data.[4]

16.2 The Bid Security shall, at the Bidder's option, be in the form of a certified check, bank draft, letter of credit, or a bank guarantee from a reputable bank located in the country of the Employer or in any eligible country abroad. The format of the Bid Security should be in accordance with the form of Bid Security included in Section IX or another form acceptable to the Employer. Bid Security shall be valid for 28 days beyond the validity of the Bid.

16.3 Any bid not accompanied by an acceptable Bid Security shall be rejected by the Employer. The Bid Security of a joint venture must define as "bidder" all joint venture partners and list them in the following manner: a joint venture consisting of "_____," "_____," and "_____".

16.4 The Bid Security of unsuccessful bidders will be returned within one week after concluding the contract and after a performance security has been furnished by the successful Bidder.

16.5 The Bid Security of the successful Bidder will be discharged when the Bidder has signed the Agreement and furnished the required Performance Security.

16.6 The Bid Security may be forfeited

(a) if the Bidder withdraws the Bid after Bid opening during the

period of Bid validity;

(b) if the Bidder does not accept the correction of the Bid price, pursuant to Clause 27; or

(c) in the case of a successful Bidder, if the Bidder fails within the specified time limit to

(i) sign the Agreement; or

(ii) furnish the required Performance Security.

17. Alternative Proposals by Bidders

17.1 Bidders shall submit offers that comply with the requirements of the bidding documents, including the basic technical design as indicated in the drawings and specifications. Alternatives will not be considered, unless specifically allowed in the Bidding Data. If so allowed, Sub-Clause 17.2 shall govern.

17.2 If so allowed in the Bidding Data, bidders wishing to offer technical alternatives to the requirements of the bidding documents must also submit a Bid that complies with the requirements of the bidding documents, including the basic technical design as indicated in the drawings and specifications. In addition to submitting the basic Bid, the Bidder shall provide all information necessary for a complete evaluation of the alternative by the Employer, including design calculations, technical specifications, breakdown of prices, proposed construction methods and other relevant details. Only the technical alternatives, if any, of the lowest evaluated Bidder conforming to the basic technical requirements shall be considered by the Employer.

18. Format and Signing of Bid

18.1 The Bidder shall prepare one original of the documents comprising the Bid as described in Clause 12 of these Instructions to Bidders, bound with the volume containing the Form of Bid, and clearly marked "ORIGINAL." In addition, the Bidder shall submit copies of the Bid, in the number specified in the Bidding Data, and clearly marked as "COPIES." In the event of discrepancy between them, the original shall prevail.

18.2 The original and all copies of the Bid shall be typed or written in indelible ink and shall be signed by a person or persons duly authorized to sign on behalf of the Bidder, pursuant to Sub-Clauses 4.3(a) or 4.4(b), as the case may be. All pages of the Bid where entries or amendments have been made shall be initialed by the person or persons signing the Bid.

18.3 The Bid shall contain no alterations or additions, except those to comply with instructions issued by the Employer, or as necessary to correct

errors made by the Bidder, in which case such corrections shall be initialed by the person or persons signing the Bid.

18.4 The Bidder shall furnish information as described in the Form of Bid on commissions or gratuities, if any, paid or to be paid to agents relating to this Bid, and to contract execution if the Bidder is awarded the contract.

D. Submission of Bids

19. Sealing and Marking of Bids

19.1 The Bidder shall seal the original and all copies of the Bid in two inner envelopes and one outer envelope, duly marking the inner envelopes as "ORIGINAL" and "COPIES".

19.2 The inner and outer envelopes shall

(a) be addressed to the Employer at the address provided in the Bidding Data;

(b) bear the name and identification number of the Contract as defined in the Bidding and Contract Data; and

(c) provide a warning not to open before the specified time and date for Bid opening as defined in the Bidding Data.

19.3 In addition to the identification required in Sub-Clause 19.2, the inner envelopes shall indicate the name and address of the Bidder to enable the Bid to be returned unopened in case it is declared late, pursuant to Clause 21.

19.4 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.

20. Deadline for Sub-mission of Bids

20.1 Bids shall be delivered to the Employer at the address specified above no later than the time and date specified in the Bidding Data.

20.2 The Employer may extend the deadline for submission of bids by issuing an amendment in accordance with Clause 10, in which case all rights and obligations of the Employer and the bidders previously subject to the original deadline will then be subject to the new deadline.

21. Late Bids

21.1 Any Bid received by the Employer after the deadline prescribed in Clause 20 will be returned unopened to the Bidder.

22. Modification and Withdrawal of Bids

22.1 Bidders may modify or withdraw their bids by giving notice in writing before the deadline prescribed in Clause 20.

22.2 Each Bidder's modification or withdrawal notice shall be prepared, sealed, marked, and delivered in accordance with Clauses 18 and 19, with the outer and inner envelopes additionally marked "MODIFICATION" or "WITHDRAWAL," as appropriate.

22.3 No Bid may be modified after the deadline for submission of Bids.

22.4 Withdrawal of a Bid between the deadline for submission of bids and the expiration of the period of Bid validity specified in the Bidding Data or as extended pursuant to Sub-Clause 15.2 may result in the forfeiture of the Bid Security pursuant to Clause 16.

22.5 Bidders may only offer discounts to, or otherwise modify the prices of their bids by submitting Bid modifications in accordance with this clause, or included in the original Bid submission.

E. Bid Opening and Evaluation

23. Bid Opening

23.1 The Employer will open the bids, including modifications made pursuant to Clause 22, in the presence of the bidders' representatives who choose to attend at the time and in the place specified in the Bidding Data.

23.2 Envelopes marked "WITHDRAWAL" shall be opened and read out first. Bids for which an acceptable notice of withdrawal has been submitted pursuant to Clause 22 shall not be opened.

23.3 The bidders' names, the Bid prices, the total amount of each Bid and of any alternative Bid (if alternatives have been requested or permitted), any discounts, Bid modifications and withdrawals, the presence or absence of Bid Security, will all be announced by the Employer at the bid opening. Further, any such other details as the Employer may consider appropriate, will also be announced.

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

23.5 The Employer will prepare minutes of the Bid opening, including the information disclosed to those present in accordance with Sub-Clause 23.3.

23.6 No bid will be rejected at bid opening except for late bids, which will be returned unopened to the bidder, pursuant to ITB Clause 21.

24. Process to Be Confidential

24.1 Information relating to the examination, clarification, evaluation, and comparison of bids and recommendations for the award of a contract shall not be disclosed to bidders or any other persons not officially concerned with such process until the award to the successful Bidder has been announced. Any effort by a Bidder to influence the Employer's processing of bids or award decisions may result in the rejection of his Bid.

25. Clarification of Bids and Contacting the Employer

25.1 To assist in the examination, evaluation, and comparison of bids, the Employer may, at the Employer's discretion, ask any Bidder for clarification of the Bidder's Bid, including breakdowns of unit rates.[5] The request for clarification and the response shall be in writing or by cable, telex, or facsimile, but no change in the price or substance of the Bid shall be sought, offered, or permitted except as required to confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the bids in accordance with Clause 27.

25.2 Subject to sub-clause 25.1 no Bidder shall contact the Employer on any matter relating to its bid from the time of the bid opening to the time the contract is awarded. If the Bidder wishes to bring additional information to the notice of the Employer, it should do so in writing.

25.3 Any effort by the Bidder to influence the Employer in the Employer's bid evaluation, bid comparison or contract award decisions may result in the rejection of the Bidder's bid.

26. Examination of Bids and Determination of Responsiveness

26.1 Prior to the detailed evaluation of bids, the Employer will determine whether each Bid (a) meets the eligibility criteria defined in Clause 3; (b) has been properly signed; (c) is accompanied by the required securities; and (d) is substantially responsive to the requirements of the bidding documents.

26.2 A substantially responsive Bid is one which conforms to all the terms, conditions, and specifications of the bidding documents, without material deviation or reservation. A material deviation or reservation is one (a) which affects in any substantial way the scope, quality, or performance of the Works; (b) which limits in any substantial way, inconsistent with the bidding documents, the Employer's rights or the Bidder's obligations under the Contract; or (c) whose rectification would affect unfairly the competitive position of other bidders presenting substantially responsive bids.

26.3 If a Bid is not substantially responsive, it will be rejected by the Employer, and may not subsequently be made responsive by correction or withdrawal of the nonconforming deviation or reservation.

27. Correction of Errors

27.1 Bids determined to be substantially responsive will be checked by the Employer for any arithmetic errors. Errors will be corrected by the Employer as follows:[6]

(a) where there is a discrepancy between the amounts in figures and in words, the amount in words will govern; and

(b) where there is a discrepancy between the unit rate and the line item total resulting from multiplying the unit rate by the quantity, the unit rate as quoted will govern, unless in the opinion of the Employer there is an obviously gross misplacement of the decimal point in the unit rate, in which case the line item total as quoted will govern, and the unit rate will be corrected.

27.2 The amount stated in the Bid will be adjusted by the Employer in accordance with the above procedure for the correction of errors and, with the concurrence of the Bidder, shall be considered as binding upon the Bidder. If the Bidder does not accept the corrected amount, the Bid will be rejected, and the Bid Security may be forfeited in accordance with Sub-Clause 16.6(b).

28. Currency for Bid Evaluation

28.1 Bids will be evaluated as quoted in the currency of the Employer's country as defined in the Contract Data in accordance with Sub-Clause 14.1, unless a Bidder has used different exchange rates than those prescribed in Sub-Clause 14.2, in which case the Bid will be first converted into the amounts payable in different currencies using the rates quoted in the Bid and then reconverted to the Employer's currency using the exchange rates prescribed in Sub-Clause 14.2.

29. Evaluation and Comparison of Bids

29.1 The Employer will evaluate and compare only the bids determined to be substantially responsive in accordance with Clause 26.

29.2 In evaluating the bids, the Employer will determine for each Bid the evaluated Bid price by adjusting the Bid price as follows:

(a) making any correction for errors pursuant to Clause 27;

(b) excluding provisional sums and the provision, if any, for contingencies in the Bill of Quantities, but including Daywork, where priced competitively;

(c) making an appropriate adjustment for any other acceptable

variations, deviations, or alternative offers submitted in accordance with Clause 17; and

(d) making appropriate adjustments to reflect discounts or other price modifications offered in accordance with Sub-Clause 22.5.

29.3 The Employer reserves the right to accept or reject any variation, deviation, or alternative offer. Variations, deviations, and alternative offers and other factors which are in excess of the requirements of the bidding documents or otherwise result in unsolicited benefits for the Employer will not be taken into account in Bid evaluation.

29.4 The estimated effect of any price adjustment conditions under Clause 47 of the Conditions of Contract, during the period of implementation of the Contract, will not be taken into account in Bid evaluation.

30. Preference for Domestic or Regional Bidders

30.1 If so indicated in the Bidding Data, domestic or regional contractors may receive a margin of preference in Bid evaluation, for which the following Option A shall apply if domestic preference is granted, and, alternatively, Option B if regional preference is granted.

Option A: Domestic Preference

30.2 Domestic contractors shall provide all evidence necessary to prove that they meet the following criteria to be eligible for a 10 per cent margin of preference in the comparison of their bids with those of contractors who do not qualify for the preference, A contractor is deemed domestic if:

(a) its legal constitution is in accordance with the laws of Kenya where it must have its registered office and undertake the majority of its activities; and

(b) the majority of the capital shares are held by nationals of that country, and

(c) the majority of the members of the board of directors are nationals of that country, and

(d) not less than 50 per cent of the key personnel are nationals of that country, and

(e) there is no arrangement whereby any major part of the net profits or other tangible benefits of the domestic contractor will accrue or be paid to persons not nationals of that country or to firms which would not be eligible under this Sub-Clause.

30.3 Joint ventures between domestic and foreign firms may be eligible for the margin of preference provided the domestic partner or partners

(a) individually satisfy the above criteria of eligibility for the preference;

(b) demonstrate a beneficiary interest of no less than 50 percent in the joint venture, as demonstrated by the profit and loss sharing provisions of the joint venture agreement;

(c) will, under the arrangements proposed, carry out at least 50 percent of the Works, measured in terms of value, which shall exclude any materials or plant which are to be directly imported by the domestic partner (s) (always provided that the domestic partner or partners are qualified to carry out that amount of work, in accordance with the criteria of Sub-Clause 4.3); and

(d) satisfy any other criteria specified for the purpose of domestic preference eligibility, as specified in the Bidding Data.

30.4 The following procedure will be used to apply the margin of preference:

(a) Responsive bids will be classified into the following groups:

(i) Group A: bids offered by domestic bidders and joint ventures meeting the respective criteria of Sub-Clauses 30.2 and 30.3 above; and

(ii) Group B: all other bids.

(b) For the purpose of further evaluation and comparison of bids only, an amount equal to 10 percent of the evaluated Bid prices determined in accordance with Clause 29.2 (a), b), and (d), will be added to all bids classified in Group B.

Option B: Regional Preference

30.2 Contractors from regional Member countries that have joined the Kenya country in a regional cooperation agreement designed to foster economic integration by a customs union or free trade area (in this Clause referred to as "Regional contractors") shall provide all evidence necessary to prove that they meet the following criteria to be eligible for a 7½-percent margin of preference in the comparison of their bids with those of bidders who do not qualify for the preference. A contractor is deemed to be a Regional contractor if:

(a) it is legally constituted in accordance with the laws of a regional Member country which is party to the established regional preferential arrangement and has a registered office in that particular country and does business mainly in the same or other countries that are parties to the said regional preferential arrangement; and

(b) at least a majority of its capital shares is owned by nationals of countries that are parties to the said regional preferential arrangement; and

(c) the majority of the members of the board of directors are nationals of countries that are parties to the said regional arrangement; and

(d) not less than 50 percent of its key personnel are nationals of countries that are parties to the said regional preferential arrangement; and

(e) there are no arrangements whereby any major part of the net profits of other tangible benefits of the Regional contractor or will accrue or be paid to persons not nationals of the countries which are parties to the said regional preferential arrangement or to firms that would not be eligible under this Sub-Clause[36].

30.3 Joint ventures between Regional contractors and foreign firms may be eligible for the margin of preference provided the Regional contractor or contractors

(a) individually satisfy the above criteria of eligibility for the preference;

(b) demonstrate a beneficiary interest of no less than 50 percent in the joint venture, as demonstrated by the profit and loss sharing provisions of the joint venture agreement;

(c) will, under the arrangements proposed, carry out at least 50 percent of the Works, measured in terms of value, which shall exclude any materials or plant which are to be directly imported by the Regional contractor (s) are qualified to carry out that amount of works, in accordance with the criteria of Sub-Clause 4.3); and

(d) satisfy any other criteria specified for the purpose of regional preference eligibility, as specified in the Bidding Data.

30.4 The following procedure will be used to apply the margin of preference:

(a) Responsive bids will be classified into the following groups:

(i) Group A: bids offered by Regional contractors and joint ventures meeting the respective criteria of Sub-Clauses 30.2 and 30.3 above; and

(ii) Group B: all other bids.

(b) For the purpose of further evaluation and comparison of bids only, an amount equal to 7½ percent of the evaluated Bid prices determined in accordance with Clause 29.2 (a), (b), and (d), will be added to all bids classified in Group B.

F. Award of Contract

31. Award Criteria

31.1 Subject to Clause 32, the Employer will award the Contract to the Bidder whose Bid has been determined to be substantially responsive to the bidding documents and who has offered the lowest evaluated Bid price, provided that such Bidder has been determined to be (a) eligible in accordance with the provisions of Clause 3, and (b) qualified in accordance with the provisions of Clause 4.

32. Employer's Right to Accept any Bid and to Reject any or all Bids

32.1 Notwithstanding Clause 31, the Employer reserves the right to accept or reject any Bid, and to cancel the bidding process and reject all bids, at any time prior to the award of Contract, without thereby incurring any liability to the affected Bidder or bidders or any obligation to inform the affected Bidder or bidders of the grounds for the Employer's action.

33. Notification of Award and Signing of Agreement

33.1 The Bidder whose Bid has been accepted will be notified of the award by the Employer prior to expiration of the Bid validity period by cable, telex, or facsimile confirmed by registered letter. This letter (hereinafter and in the Conditions of Contract called the "Letter of Acceptance") will state the sum that the Employer will pay the Contractor in consideration of the execution, completion, and maintenance of the Works by the Contractor as prescribed by the Contract (hereinafter and in the Contract called the "Contract Price").

33.2 The notification of award will constitute the formation of the Contract, subject to the Bidder furnishing the Performance Security in accordance with Clause 34 and signing the Agreement in accordance with Sub-Clause 33.3.

33.3 The Agreement will incorporate all agreements between the Employer and the successful Bidder. It will be signed by the Employer and sent to the successful Bidder, within 28 days following the notification of award. Within 21 days of receipt, the successful Bidder will sign the Agreement and deliver it to the Employer.

33.4 Upon the furnishing by the successful Bidder of the Performance Security, the Employer will, within one week, notify the other bidders that their bids have been unsuccessful.

34. Performance Security

34.1 Within 21 days after receipt of the Letter of Acceptance, the successful Bidder shall deliver to the Employer a Performance Security in the amount and in the form (Bank Guarantee

34.2 If the Performance Security is provided by the successful Bidder in the form of a Bank Guarantee, it shall be issued either (a) at the Bidder's option, by a bank located in the country of the Employer or a foreign bank through a correspondent bank located in the country of the Employer, or (b) with the agreement of the Employer directly by a foreign bank acceptable to the Employer.

34.3 If the Performance Security is to be provided by the successful Bidder in the form of a Bond, it shall be issued by a surety which the Bidder has determined to be acceptable to the Employer.

34.4 Failure of the successful Bidder to comply with the requirements of Sub-Clause 34.1 shall constitute sufficient grounds for cancellation of the award and forfeiture of the Bid Security

35. Advance Payment and Security

35.1 The Employer will provide an Advance Payment on the Contract Price as stipulated in the Conditions of Contract, subject to a maximum amount[7], as stated in the Bidding Data.

36. Corrupt or Fraudulent Practices

37.1 The Employer requires that Bidders as well as Suppliers/Contractors under Bank-financed contracts, observe the highest standard of ethics during the procurement and execution of such contracts. In pursuance of this policy, the Employer:

(a) defines, for the purposes 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 a public official in the procurement process or in contract 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 practice among Bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive the

Employer of the benefits of free and open competition;

(b) will reject a proposal for award if its "no objection" has been requested or issued on the basis of incomplete, inaccurate or misleading information furnished by the Employer, or if it is established, by a decision of a court of law, or following a special audit, that the contract was awarded on the basis of corrupt practices. In that event the bidder may also be sanctioned by curtailing its participation on Bank funded projects for a specified period of time determined by the Bank.

37.2 Furthermore, Bidders shall be aware of the provision stated in sub-clause 59.2 of the General Conditions of Contract;

G. Bidding Data

Instructions to Bidders Clause Reference

(2.1) The Employer is county government of Meru

(2.1) The Project is **Construction of intake and pipe line Rugene water project**
which involves:

The construction of the following but not limited to:

CIVIL WORKS

- **Drilling and casing of two borehole**
- **Submersible pump installation**
- **Construction of pipelines**
- **Construction of 50CM storage tank and 5CM BPT**
- **Construction of intakes, valve chamber and fabricated distribution motors**
- **Canal lining**

(4.3) The information required from bidders in Sub-Clause 4.3 is modified as follows: “none”.

(4.4) The qualification data required from bidders in Sub-Clause 4.4 are modified as follows: “none”.

(4.5) The qualification criteria in Sub-Clause 4.5 are modified as follows: none”.

(4.5a) The minimum required annual volume of construction work for the successful Bidder in any of the last five years shall be **Kshs 2,000,000.00.**

(4.5c) The essential equipment to be made available for the Contract by the successful Bidder shall be

- **10 ton Lorries 2 No.**
- **Pneumatic Compressor**
- **Concrete Mixer 2 no.**
- **Concrete Loader trolley**
- **Steel bending and cutting equipment**
- **1No. pick-up**
- **Drainage water pump**
- **Concrete vibrator**
- **Back pour excavator**
- **10 No. Wheelbarrow**
- **100m steel tape**

(4.5e) The minimum amount of liquid assets and/or credit facilities net of other contractual commitments of the successful Bidder shall be Kshs 20,000,000.00

(8.2)
(18.1) The number of copies of the Bid to be completed and returned shall be one original and four copies.

(13.4) The Contract "is not" subject to price adjustment in accordance with Clause 47 of the Conditions of Contract.

(14.1) The specified trading currency shall be Kenya Shillings (Kshs).

(15.1) The period of Bid validity shall be 120 days after the deadline for Bid submission specified in the Tendering Data.

(15.3) The adjustment of Tender price in accordance with Clause 15.3 shall be calculated on the basis of an annual increase for foreign costs of….. percent and an annual increase for local costs as per conditions of contract.

(16.1) The amount of Tender Security shall be 2% of Tenderers Tender price in Kshs.

(17.0) Alternative proposals to the requirements of the bidding documents "will not," be permitted.

(19.2) The Employer's address for the purpose of Bid submission is :-

COUNTY GOVERNMENT OF MERU
P.O BOX 120-60200
MERU

(20.1) The deadline for submission of bids shall be on (**10th December 2018**
The date of the exchange rate is date 28 days before Bid opening. The authority for establishing the rates of exchange shall be Central Bank of Kenya.

(30.0) Domestic contractors "may" as appropriate receive a margin of preference in Bid evaluation.

(34.0) The Standard Form of Performance Security acceptable to the Employer shall be "Bank Guarantee from a Bank acceptable to the Employer in the format given in section VI.
.

(35.0) The Advance Payment shall be limited to 30 percent (%) of the Contract Price, subject to completion of 50% of works

(36.1) The Adjudicator proposed by the Employer is
Governor meru county
The hourly fee for this proposed Adjudicator shall be Kshs 5000.00.

SECTION III. FORMS OF BID, QUALIFICATION INFORMATION

Letter of Acceptance, and Agreement

Contractor's Bid

.....
[date]

To:
Director procurement
County government of meru
P.O BOX 120-60200
meru

We offer to execute the **Construction of intake and pipeline Rugene water project**
in accordance with the Conditions of Contract accompanying this Bid for the Contract Price of ..... [amount in numbers], ...
.....,,,.....[amount in words]

The Contract shall be paid in the following currencies:

Currency	Percentage payable in currency	Rate of exchange: one foreign equals [insert local]	Inputs for which foreign currency is required
(a)			
(b)			

The advance payment required is:

Amount	Currency
(a)	
(b)	

We accept the appointment of..... [name proposed in Bidding Data] as the Adjudicator.

[or]

We do not accept the appointment of ..... as the Adjudicator, and propose instead that [name] be appointed as Adjudicator, whose daily fees and biographical data are attached.

This Bid and your written acceptance of it shall constitute a binding Contract between understand that you are not bound to accept the lowest or any Bid you receive.

Commissions or gratuities, if any, paid or to be paid by us to agents relating to this Bid, and to contract execution if we are awarded the contract, are listed below:

Name and address of agent	Amount and Currency	Purpose of Commission or gratuity
_____	_____	
_____	_____	
_____	_____	

(if none, state "none").

We hereby confirm that this Bid complies with the Bid validity and Bid Security required by the bidding documents and specified in the Bidding Data.

Authorized Signature:____
Name and Title of Signatory:____
Name of Bidder:___
Address:____
us. We

Qualification Information

Notes on Form of Qualification Information

The information to be filled in by bidders in the following pages will be used for purposes of post-qualification or for verification of prequalification as provided for in Clause 4 of the Instructions to Bidders. This information will not be incorporated in the Contract. Attach additional pages as necessary. Pertinent sections of attached documents should be translated into English. If used for prequalification verification, the Bidder should fill in updated information only.

1. Individual Bidders or Individual Members of Joint Ventures

1.1 Constitution or legal status of Bidder: [attach copy]

Place of registration: ..... [insert]

Principal place of business: ..... [insert]

Power of attorney of signatory of Bid: [attach]

1.2 Total annual volume of construction work performed in five years, in the internationally traded currency specified in the Bidding Data:..... [insert]

1.3 Work performed as prime Contractor on works of a similar nature and volume over the last five years. The values should be indicated in the same currency .... including expected completion date.

Project name and country	Name of client and contact person	Type of work performed and year of completion	Value of contract
(a)			
(b)			

1.4 Major items of Contractor's Equipment proposed for carrying out the Works. List all information requested below. Refer also to Sub-Clause 4.3(c) of the Instructions to Bidders.

Item of equipment	Description, make, and age (years)	Condition (new, good, poor) and number available	Owned, leased (from whom?), or to be purchased (from whom?)
(a)			
(b)			

1.5 Qualifications and experience of key personnel proposed for administration and execution of the Contract. Attach biographical data. Refer also to Sub-Clause 4.3(e) of the Instructions to Bidders and Sub-Clause 9.1 of the Conditions of Contract.

Position	Name	Years of experience (general)	Years of experience in proposed position
(a)			
(b)			

1.6 Proposed subcontracts and firms involved. Refer to Clause 7 of Conditions of Contract.

Sections of the Works	Value of subcontract	Subcontractor (name and address)	Experience in similar work
(a)			
(b)			

1.7 Financial reports for the last five years: balance sheets, profit and loss statements, auditors' reports, etc. List below and attach copies.

1.8 Evidence of access to financial resources to meet the qualification requirements: cash in hand, lines of credit, etc. List below and attach copies of support documents.

1.9 Name, address, and telephone, telex, and facsimile numbers of banks that may provide references if contacted by the Employer.

1.10 Information on current litigation in which the Bidder is involved.

Other party(ies)	Cause of dispute	Amount involved
(a)		
(b)		

1.11 Statement of compliance with the requirements of Sub-Clause 3.2 of the Instructions to Bidders.

1.12 Proposed Program (work method and schedule). Descriptions, drawings, and charts, as necessary, to comply with the requirements of the bidding documents.

2. Joint Ventures

2.1 The information listed in 1.1 - 1.11 above shall be provided for each partner of the joint venture.

2.2 The information in 1.12 above shall be provided for the joint venture.

2.3 Attach the power of attorney of the signatory(ies) of the Bid authorizing signature of the Bid on behalf of the joint venture.

2.4 Attach the Agreement among all partners of the joint venture (and which is legally binding on all partners), which shows that

(a) all partners shall be jointly and severally liable for the execution of the Contract in accordance with the Contract terms;

(b) one of the partners will be nominated as being in charge, authorized to incur liabilities, and receive instructions for and on behalf of any and all partners of the joint venture; and

(c) the execution of the entire Contract, including payment, shall be done exclusively with the partner in charge.

3. Additional Requirements

3.1 Bidders should provide any additional information required in the Bidding Data or to fulfill the requirements of Sub-Clause 4.1 and Clause 30 of the Instructions to Bidders, if applicable.

Letter of Acceptance

[letterhead paper of the Employer]

Notes on Standard Form of Letter of Acceptance

The Letter of Acceptance will be the basis for formation of the Contract as described in Clauses 33 and 34 of the Instructions to Bidders. This Standard Form of Letter of Acceptance should be filled in and sent to the successful Bidder only after evaluation of bids has been completed.

.....
[date]
To: ..... [name and address of the Contractor]

This is to notify you that your Bid dated [date] for execution of the..... [name of the Contract and identification number, as given in the Contract Data] for the Contract Price of the equivalent of .....[amount in numbers and words] [name of currency], as corrected and modified[2] in accordance with the Instructions to Bidders is hereby accepted by our Agency.

(a) We accept that ..... [name proposed by bidder] be appointed as the Adjudicator.[3]
(b) We do not accept that .....[name proposed by bidder] be appointed as adjudicator, and by sending a copy of this letter of acceptance to [insert the name of the Appointing Authority], we are hereby requesting [name], the Appointing Authority, to appoint the Adjudicator in accordance with Clause 36.1 of the Instructions to Bidders.[4]

We instruct you to submit to us latest (insert date 21 days after receipt) the Performance
Security stipulated in the Contract.
You are hereby instructed to proceed with the execution of the said Works in accordance with the Contract documents.

Authorized Signature:
Name and Title of Signatory: ____
Name of Agency: ___
Attachment: Agreement

Agreement

This Agreement, made the ..... day of..... [month], ...[year] between **county government of meru** (hereinafter called "the Employer") and .....[name and address of Contractor] (hereinafter called "the Contractor") of the other part.

Whereas the Employer is desirous that the Contractor execute **Construction of** intake **and pipeline rugene water project** (hereinafter called "the Works") and the Employer has accepted the Bid by the Contractor for the execution and completion of such Works and the remedying of any defects therein.

Now this Agreement witnessed as follows:

1. In this Agreement, words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to, and they shall be deemed to form and be read and construed as part of this Agreement.

2. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy any defects therein in conformity in all respects with the provisions of the Contract.

3. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects wherein the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

In Witness whereof the parties thereto have caused this Agreement to be executed the day and year first before written.

For the Employer:

Name of Signatory

For the Contractor:

Name of Signatory

SECTION IV. CONDITIONS OF CONTRACT

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Conditions of Contract
A. General

1. Definitions

1.1 Boldface type is used to identify defined terms.

The Adjudicator is the person appointed jointly by the Employer and the Contractor to resolve disputes in the first instance, as provided for in Clauses 24 and 25 hereunder.

Bill of Quantities means the priced and completed Bill of Quantities forming part of the Bid.

Compensation Events are those defined in Clause 44 hereunder.

The Completion Date is the date of completion of the Works as certified by the Project Manager, in accordance with Sub-Clause 55.1.

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

The Contractor is a person or corporate body whose Bid to carry out the Works has been accepted by the Employer.

The Contractor's Bid is the completed bidding document submitted by the Contractor to the Employer.

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

Days are calendar days; months are calendar months.

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

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

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

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

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

The Employer is the party who employs the Contractor to carry out the Works.

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

The Initial Contract Price is the Contract Price listed in the Employer's Letter of Acceptance.

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

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

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

The Project Manager is the person named in the Contract Data (or any other competent person appointed by the Employer and notified to the Contractor, to act in replacement of the Project Manager) who is responsible for supervising the execution of the Works and administering the Contract.

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

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

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

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

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

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

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

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

2. Interpretation

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

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

2.3 The documents forming the Contract shall be interpreted in the following order of priority:

(1) Agreement,

(2) Letter of Acceptance,

(3) Contractor's Bid,

(4) Contract Data,

(5) Conditions of Contract,

(6) Specifications,

(7) Drawings,

(8) Bill of Quantities,[8] and

(9) any other document listed in the Contract Data as forming part of the Contract.

3. Language and Law

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

4. Project Manager's Decisions

4.1 Except where otherwise specifically stated, the Project Manager will decide contractual matters between the Employer and the Contractor in the role representing the Employer.

5. Delegation

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

6. Communications

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

7. Subcontracting

7.1 The Contractor may subcontract with the approval of the Project Manager, but may not assign the Contract without the approval of the Employer in writing. Subcontracting shall not alter the Contractor's obligations.

8. Other Contractors

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

9. Personnel

9.1 The Contractor shall employ the key personnel named in the Schedule of Key Personnel, as referred to in the Contract Data, to carry out the functions stated in the Schedule or other personnel approved by the Project Manager. The Project Manager will approve any proposed replacement of key personnel only if their relevant qualifications and abilities are substantially equal to or better than those of the personnel listed in the Schedule.

9.2 If the Project Manager asks the Contractor to remove a person who is a member of the Contractor's staff or work force, stating the reasons, the Contractor shall ensure that the person leaves the Site within seven days and has no further connection with the work in the Contract.

10. Employer's and Contractor's Risks

10.1 The Employer carries the risks which this Contract states are Employer's risks, and the Contractor carries the risks which this Contract states are Contractor's risks.

11. Employer's Risks

11.1 From the Start Date until the Defects Correction Certificate has been issued, the following are Employer's risks:

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

(i) use or occupation of the Site by the Works or for the purpose of the Works, which is the unavoidable result of the Works or

(ii) negligence, breach of statutory duty, or interference with any legal right by the Employer or by any person employed by or contracted to him except the Contractor.

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

11.2 From the Completion Date until the Defects Correction Certificate has been issued, the risk of loss of or damage to the Works, Plant, and Materials is an Employer's risk except loss or damage due to

(a) a Defect which existed on the Completion Date,

(b) an event occurring before the Completion Date, which was not itself an Employer's risk, or

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

12. Contractor's Risks

12.1 From the Starting Date until the Defects Correction Certificate has been issued, the risks of personal injury, death, and loss of or damage to

property (including, without limitation, the Works, Plant, Materials, and Equipment) which are not Employer's risks are Contractor's risks.

13. Insurance

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

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

(b) loss of or damage to Equipment;

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

(d) personal injury or death.

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

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

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

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

14. Site Investigation Reports

14.1 The Contractor, in preparing the Bid, shall rely on any Site Investigation Reports referred to in the Contract Data, supplemented by any information available to the Bidder

15. Queries about the Contract Data

15.1 The Project Manager will clarify queries on the Contract Data.

16. Contractor to Construct the Works

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

17. The Works to Be Completed by the Intended Completion Date

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

18. Approval by the Project Manager

18.1 The Contractor shall submit Specifications and Drawings showing the proposed Temporary Works to the Project Manager, who is to approve them if they comply with the Specifications and Drawings.

18.2 The Contractor shall be responsible for design of Temporary Works.

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

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

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

19. Safety

19.1 The Contractor shall be responsible for the safety of all activities on the Site.

20. Discoveries

20.1 Anything of historical or other interest or of significant value unexpectedly discovered on the Site shall be the property of the Employer. The Contractor shall notify the Project Manager of such discoveries and carry out the Project Manager's instructions for dealing with them.

21. Possession of the Site

21.1 The Employer shall give possession of all parts of the Site to the Contractor. If possession of a part is not given by the date stated in the Contract Data, the Employer will be deemed to have delayed the start of the relevant activities, and this will be a Compensation Event.

22. Access to the Site

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

23. Instructions

23.1 The Contractor shall carry out all instructions of the Project Manager which comply with the applicable laws where the Site is located.

24. Disputes

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

25. Procedure for Disputes

25.1 The Adjudicator shall give a decision in writing within 28 days of receipt of a notification of a dispute.

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

25.3 The arbitration shall be conducted in accordance with the arbitration procedure published by the institution named and in the place shown in the Contract Data.[9]

B. Time Control

27. Program

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

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

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

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

28. Extension of the Intended Completion Date

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

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

29. Acceleration

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

29.2 If the Contractor's priced proposals for an acceleration are accepted by the Employer, they are incorporated in the Contract Price and treated as a Variation.

30. Delays Ordered by the Project Manager

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

31. Management Meetings

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

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

32. Early Warning

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

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

C. Quality Control

33. Identifying Defects

33.1 The Project Manager shall check the Contractor's work and notify the Contractor of any Defects that are found. Such checking shall not affect the Contractor's responsibilities. The Project Manager may instruct the

Contractor to search for a Defect and to uncover and test any work that the Project Manager considers may have a Defect.

34. Tests

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

35. Correction of Defects

35.1 The Project Manager shall give notice to the Contractor of any Defects before the end of the Defects Liability Period,[10] which begins at Completion, and is defined in the Contract Data. The Defects Liability Period shall be extended for as long as Defects remain to be corrected.

35.2 Every time notice of a Defect is given, the Contractor shall correct the notified Defect within the length of time specified by the Project Manager's notice.

36. Uncorrected Defects

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

D. Cost Control

37. Bill of Quantities[11]

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

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

38. Changes in the Quantities[12]

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

38.2 The Project Manager shall not adjust rates from changes in quantities if thereby the Initial Contract Price is exceeded by more than 15 percent,

except with the prior approval of the Employer.

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

39. Variations

39.1 All Variations shall be included in updated Programs[13] produced by the Contractor.

40. Payments for Variations

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

40.2 If the work in the Variation corresponds with an item description in the Bill of Quantities and if, in the opinion of the Project Manager, the quantity of work above the limit stated in Sub-Clause 38.1 or the timing of its execution do not cause the cost per unit of quantity to change, the rate in the Bill of Quantities shall be used to calculate the value of the Variation. If the cost per unit of quantity changes, or if the nature or timing of the work in the Variation does not correspond with items in the Bill of Quantities, the quotation by the Contractor shall be in the form of new rates for the relevant items of work.[14]

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

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

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

41. Cash Flow Forecasts

41.1 When the Program[15] is updated, the Contractor shall provide the Project Manager with an updated cash flow forecast. The cash flow forecast shall include different currencies, as defined in the Contract, converted as necessary using the Contract exchange rates.

42. Payment Certificates

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

42.2 The Project Manager shall check the Contractor's monthly statement and certify the amount to be paid to the Contractor.

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

42.4 The value of work executed shall comprise the value of the quantities of the items in the Bill of Quantities completed.[16]

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

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

43. Payments[5]

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

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

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

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

44. Compensation Events

44.1 The following shall be Compensation Events:

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

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

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

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

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

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

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

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

(i) The advance payment is delayed.

(j) The effects on the Contractor of any of the Employer's Risks.

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

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

44.2 If a Compensation Event would cause additional cost or would prevent the work being completed before the Intended Completion Date, the

Contract Price shall be increased and/or the Intended Completion Date shall be extended. The Project Manager shall decide whether and by how much the Contract Price shall be increased and whether and by how much the Intended Completion Date shall be extended.

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

44.4 The Contractor shall not be entitled to compensation to the extent that the Employer's interests are adversely affected by the Contractor's not having given early warning or not having cooperated with the Project Manager.

45. Tax

45.1 The Project Manager shall adjust the Contract Price if taxes, duties, and other levies are changed between the date 28 days before the submission of bids for the Contract and the date of the last Completion certificate. The adjustment shall be the change in the amount of tax payable by the Contractor, provided such changes are not already reflected in the Contract Price or are a result of Clause 47.

46. Currencies

46.1 Where payments are made in currencies other than the currency of the Employer's country, the exchange rates used for calculating the amounts to be paid shall be the exchange rates stated in the Contractor's Bid.

47. Price Adjustment

47.1 Prices shall be adjusted for fluctuations in the cost of inputs only if provided for in the Contract Data. If so provided, the amounts certified in each payment certificate, after deducting for Advance Payment, shall be adjusted by applying the respective price adjustment factor to the payment amounts due in each currency. A separate formula of the type indicated below applies to each Contract currency:

$$P_c = A_c + B_c \ Imc/Ioc$$

where:

P_c is the adjustment factor for the portion of the Contract Price payable in a specific currency "c".

A_c and B_c are coefficients[17] specified in the Contract Data, representing the nonadjustable and adjustable portions, respectively, of the Contract Price payable in that specific currency "c"; and

Imc is the index prevailing at the end of the month being invoiced and Ioc is the index prevailing 28 days before Bid opening for inputs payable; both in the specific currency "c".

47.2 If the value of the index is changed after it has been used in a calculation, the calculation shall be corrected and an adjustment made in the next payment certificate. The index value shall be deemed to take account of all changes in cost due to fluctuations in costs.

48. Retention

48.1 The Employer shall retain[18] from each payment due to the Contractor the proportion stated in the Contract Data until Completion of the whole of the Works.

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

48.3 On completion of the whole Works, the Contractor may substitute retention money with an "on demand" Bank guarantee.

49. Liquidated Damages

49.1 The Contractor shall pay liquidated damages[19] to the Employer at the rate per day stated in the Contract Data for each day that the Completion Date is later than the Intended Completion Date. The total amount of liquidated damages shall not exceed the amount defined in the Contract Data. The Employer may deduct liquidated damages from payments due to the Contractor. Payment of liquidated damages shall not affect the Contractor's liabilities.

49.2 If the Intended Completion Date is extended after liquidated damages have been paid, the Project Manager shall correct any overpayment of liquidated damages by the Contractor by adjusting the next payment certificate. The Contractor shall be paid interest on the overpayment, calculated from the date of payment to the date of repayment, at the rates specified in Sub-Clause 43.1.

50. Bonus

50.1 The Contractor shall be paid a Bonus[20] calculated at the rate per calendar day stated in the Contract Data for each day (less any days for which the Contractor is paid for acceleration) that the Completion is earlier than the Intended Completion Date. The Project Manager shall certify that the Works are complete, although they may not be due to be complete.

51. Advance Payment

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

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

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

52. Securities

52.1 The Performance Security shall be provided to the Employer no later than 21 days after receipt of the Letter of Acceptance and shall be issued in an amount and form and by a bank or surety acceptable to the Employer, and denominated in the types and proportions of the currencies in which the Contract Price is payable. The Performance Security shall be valid until a date 28 days from the date of issue of the Certificate of Completion in the case of a Bank Guarantee, and until one year from the date of issue of the Completion Certificate in the case of a Performance Bond.

53. Day works

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

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

53.3 The Contractor shall be paid for Dayworks subject to obtaining signed Dayworks forms.

54. Cost of Repairs

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

E. Finishing the Contract

55. Completion

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

56. Taking Over

56.1 The Employer shall take over the Site and the Works within seven days of the Project Manager's issuing a certificate of Completion.

57. Final Account

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

58. Operating and Maintenance Manuals

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

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

59. Termination

59.1 The Employer or the Contractor may terminate the Contract if the other party causes a fundamental breach of the Contract.

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

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

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

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

(d) a payment certified by the Project Manager is not paid by the Employer to the Contractor within 84 days of the date of the Project Manager's certificate;

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

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

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

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

For the purpose of this paragraph:

"corrupt practice" means the offering, giving, receiving or soliciting of any thing of value to influence the action of a public official in the procurement process or in contract execution.

"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 practice among Bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive the Employer of the benefits of free and open competition.

59.3 When either party to the Contract gives notice of a breach of Contract to the Project Manager for a cause other than those listed under Sub-Clause 59.2 above, the Project Manager shall decide whether the breach is fundamental or not.

59.4 Notwithstanding the above, the Employer may terminate the Contract for convenience.

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

60. Payment upon Termination

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

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

61. Property

61.1 All Materials on the Site, Plant, Equipment, Temporary Works, and Works shall be deemed to be the property of the Employer if the Contract is terminated because of the Contractor's default.

62. Release from Performance

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

SECTION V. CONTRACT DATA

Section V: Contract Data

The following documents are also part of the Contract:

58.0 Schedule of Operating and Maintenance Manuals

8.0 Schedule of Other Contractors

9.0 The Schedule of Key Personnel

14.0 Site Investigation Reports

1.1 The Funds for this Contract have been made available by county government

The Employer is county government of meru represented by

The Project Manager is the director water technical services

The name and identification number of the Contract
Construction of intake and pipeline Rugene water project

Contract No. **NEGOTIATION NO. 697999/2018-2019**

The Works consist of.

CIVIL WORKS

A. Construction of intake

B. Construction of pipeline

C. PRELIMINARY AND GENERAL ITEMS

D. Services to the Engineer during Construction Supervision

The Start Date shall be after one week from date of signing the contract.

The Intended Completion Date for the whole of the Works shall be 18 months after commencement of the works.

The following documents also form part of the Contract:

(1) Agreement,
(2) Letter of Acceptance,
(3) Contractor's Bid,
(4) Contract Data,

(5) Conditions of Contract,
(6) Specifications,
(7) Drawings,
(8) Bill of Quantities, and
(9) any other document listed in the Contract Data as forming part of the Contract.

27.0 The Contractor shall submit a revised Program for the Works within 28 days of delivery of the Letter of Acceptance.

21.0 The Site Possession Date shall be immediately after signing contract.

1.0 The Site is located within Meru County and is defined in drawings listed in list of drawings

35.0 The Defects Liability Period is 12 Months

44.0 The following events shall also be Compensation Events: **None**

27.0 The period between Program updates is **28 days**.

The amount to be withheld for late submission of an updated Program is **Ksh 150,000.00**.

3.0 The language of the Contract documents is **English**

The law that applies to the Contract is the Law of the Republic of Kenya.

25.0 Institution whose arbitration procedures shall be used**:** **UNICITRAL United Nations.**

Fees and types of reimbursable expenses to be paid to the Adjudicator: Fees **Ksh 5,000.00** per hour plus approved Expenditures.

26.0 Appointing Authority for the Adjudicator: Institution of Engineers of Kenya

25.0 Arbitration will take place in accordance with **UNICITRAL** rules and regulations.

46.0 The currency of the Employer's country is the **Kenya shillings**

47.0 The Contract "is" subject to price adjustment in accordance with Clause 70 of the Conditions of Contract, and the following information regarding coefficients "does" apply.

The coefficients for adjustment of prices are applicable

48.0 The Index I for local currency will be [enter index]. **Not applicable**.

The Index I for the specified international currency will be [enter index]. **Not applicable**.

The Index I for currencies other than the local currency and the specified international currency will be [enter index]. **Not applicable**

The proportion of payments retained shall be 10% percent.

49.0 The liquidated damages for the whole of the Works is KShs. 100,000 per day.

The maximum amount of liquidated damages for the whole of the Works is 10% percent of the final Contract Price.

50.0 The Bonus for the whole of the Works is **0%** per day. The maximum amount of Bonus for the whole of the Works is 0 % percent of the final Contract Price. **Not applicable**.

51.0 The Advance Payment will be **30%** and will be paid to the Contractor upon completion of 50% of works and after the contractor supplies an advance payment bond from a reputable bank.

The Performance Security shall be for the following minimum amounts equivalent as a percentage of the Contract Price:

(36) **Bank Guarantee 10% of contract sum**

The standard form(s) of Performance Security acceptable to the Employer shall be "an Unconditional Bank Guarantee," as preferred by the Employer of the type presented in Section IX of the Bidding Documents.

58.0 The date by which operating and maintenance manuals are required is **one month** after issuance of completion certificate.

The date by which "as built" drawings are required is **one month** after issuance of completion certificate.

The amount to be withheld for failing to produce "as built" drawings and/or operating and maintenance manuals by the

date required is Kshs 1,000,000.00

60.0 The percentage to apply to the value of the work not completed, representing the Employer's additional cost for completing the Works, is 30%

SECTION VI. SPECIFICATIONS

Section VI. Specifications

1.0 General

1.1 MATERIAL AND WORKS STANDARDS

All materials, equipment and testing apparatus etc. to be furnished and works to be executed by the contractor in this Contract shall conform to the requirements of the latest Kenya Standard (KS), International Standard Organization (ISO), French Standards "French Norms" (NF), British Standard Specification (BSS) or other approved applicable standard in Kenya, unless otherwise specifically stated.

Equipment to be purchased shall be from well- recognized manufacturers whose products are standardized and controlled by any recognized standard organization. All dimensions and measurement units shall be of Standard International (S.I.) units.

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

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

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

1.2 OFFICE AND ACCOMMODATION FOR RESIDENT ENGINEER

The Contractor is required to provide the offices for the Resident Engineer and his supervision site staff within 8 weeks from the date of commencement of work, all to the satisfaction of the Engineer.

The offices for the use of the Resident Engineer and his staff shall be thoroughly waterproof. The office shall have a firm floor area of 210 square metres,(at least 3 rooms) and located as directed by the Engineer and shall be provided with the equipment and furnishings as detailed under this clause.

The Contractor shall arrange for the provision of telephones (and if necessary extensions) with suitable privacy for conversation for the exclusive use of the Resident Engineer and his staff by means of a separate connection to the

Telephone exchange. The Contractor shall include in the sum installation, maintenance and removal only of the telephones. All charges for hiring and telephone calls, shall be borne by the Employer, provision for which is made in Bill of Quantities-Bill No. 1

All items for the Resident Engineer's offices are inclusive of furniture and maintenance thereof during the contract period.

While the offices are being completed as specified, the Contractors shall be required to make alternative arrangements for these items to the satisfaction of the Engineer for the period during which the office is under preparation. O/H costs arising out of such arrangements shall be borne by the Contractor. In case of failure of the Contractor to comply with this provision the Employer shall make such arrangements and the costs will be debited to the account of the Contractor.

Office furniture and equipment shall be as specified hereunder. Provision shall also be made for all necessary gas, kerosene, water, light, attendance and stationery required in connection with execution of the Contractor.

The Resident Engineer's offices shall also be regularly and properly cleaned to the satisfaction of the Engineer. Two messengers shall be provided by the Contractor exclusively for the Resident Engineer's offices and also Security Guards shall be provided for day and night security as requested by the Resident Engineer. The offices, furniture and equipment shall be insured against fire, theft and natural calamity.

Unless the offices are accessible via an existing paved road the Contractor shall, if so required by the Resident Engineer's, provide an all-weather access road at least 3 meters wide to the Resident Engineer's office, together with a 90 metres square car parking area of at least 150 mm consolidated thickness of gravel properly graded, cambered, drained and adverted. Carports for the Resident Engineer's vehicles are to be provided at the shed. The Contractor is deemed to have covered costs for providing all above services/items in his rates.

1.2.1 PROVISION FOR OFFICE FURNITURE

Furniture Description	Quantity	Remarks
Writing desk with lockable drawers	2No.	
Drawing Table with drawing board	Nil	
Drawing Table Stool	Nil	
Plan Chest with 4 lockable drawers suitable for Al Size drawings	1No	

Lockable steel cupboard	1no.	
Paper punch	2 no.	
Pin board 2,5 mx 1.25m	2 no	
Office chairs	10	
Pentium IV PC with Windows XP Operating System, 3.4ghz/2gbRAM/250gb HHD with DVD +RW DL writer, Supply Ms Office 2007, Ms Project and AutoCAD2009, TFT Screen 17", Suitable Antivirus. Complete with keyboard and electrical mouse	3no.	
A3 Deskjet Printer 14ppm, 1200dpi\coloured	1no	
A4Laserjet Printers	3no	
Copiers 35ppm with printing port and Scanner cum fax machine	1no	each
Filing Trays	4 no.	
Steel fire proof Cabinet with locks/4 drawers	2 no.	
Small portable scientific electronic calculator with Print out facility	2no	
Stapling machine	2no and 1 no	Small and Large respectively.
First Aid Kit (for 25 persons	1no.	
Fire Extinguisher (5 lit)	2no.	
Meeting Table 3 mx 1.2m	1no.	
Small scissors	2no.	
Waste paper basket	6 no.	
Electric kettle	1no.	
Coffee/Tea making facility including crockery for all Supervisory staff and 10 additional guests	1 set	
Electric fan	3 no.	
Air Conditioner	3 no.	180000BTU installed in RE's

		office
UPS rated 500VA	3 no.	
Refrigerator (6cum. Capacity)	1no.	
Book shelves with glass Frontage 2m x 1.5m	1 no.	
Stationery as required by the Engineer at monthly intervals to include but not limited to: Staples, paper clips, pens, pencils files and folders, hardbacks covers and Perspex front covers for monthly progress reports, printed flysheets for monthly reports, binding strips for monthly reports, such printed forms as considered necessary, triplicate and duplicate books, cello-tape, drafting tape, detail paper etc		
Toilets: Water borne with septic tank, toilet roll holder, toilet pan and cistern, wash hand basin and mirror. Supply of lavatory paper, soap and towels is to be provided and maintained, clean towels to be supplied each day.		

1.2.2 PROVISION FOR ACCOMMODATION

The furnished rented houses for the Resident Engineer and his staff shall be approved by the Engineer, and shall comply with all the requirements as directed by the Engineer. Provision for this is made in Bill No. 1

All costs in connection with the supply, consumption and maintenance of Water Supply and electrical power shall be borne by the Contractor.

The Resident Engineer's house should be provided with a telephone and all Cost for its installation and rental be deemed to be covered in the rates.

The furniture in the rented houses should as a minimum have the following furnishing all to the approval of the Engineer.

Table 1.2 Furniture in the rented houses for RE and Staff.

Furniture Description	Senior Staff	Junior Staff
Double bed with mattress	1 No.	1 No.
Single bed with mattress	3 No.	2 No.
Dressing table with mirror	2 No.	1 No.
Stool for dressing table	2 No.	1 No.
Chest of drawers (6 Nos.) with 2 no. mirrors.	1 No.	2 No.
Bedside cabinet	5 No.	4 No.
Bedside light lamps	4 No.	2 No

Shaver power point	1 No.	1 No.
Bedroom chairs	3 No.	2 No.
Dining chairs	6 No.	6 No.
Sideboard	1 No.	1 No.
Lounge chairs	4 No.	2 No
Cofee table	2 No.	1 No.
Occasional tables	2 No.	1 No.
Bookcase	1 No.	1 No.
Standard lamp	1 No.	1 No.
Writing table and chair	1 No.	
Kitchen Table	1 No.	
Kitchen Chair	1 No.	
Water Filter	1 No.	1 No.
Refrigerator (0.5 cu,m. capacity, including a deep freezer compartment of 73ulfils. 0.15 cu.m)	1 No.	1 No.
Cooker (incorporating Grill four plates and oven	1 No.	1 No.
Hurricane lamps	2 No.	2 No.
Bathroom wall mirror with shelf	1 No.	1 No.
Shower with curtain	1 No.	
Stool for bathroom	1 No.	1 No.
Towel rail	1 No.	1 No.
Bathroom medicine cabinet	1 No.	1 No.
Lamp shades	for all light fittings	

1.3 PROVISION OF VEHICLES

The Contractor will supply and maintain for the duration of the contract 3No. 4x4WD double cabin vehicle for the sole use of the Resident Engineer and his staff.

The capacity of the vehicle is to be not less than 2800cc diesel driven engine, with rear mounted benches on either side, and a metal grill to support pipes etc carried on the rear, one spare wheel tyre two sets of keys wheel spanner, etc. The contractor shall provide fuel lubricants and oil and fully maintain vehicle for the duration of the contract.

The Contractor shall provide a licensed driver for the exclusive use of and to the satisfaction of the Resident Engineer, The driver shall be available at all times during normal working hours and when specifically required by the Resident Engineer, outside these hours. The Contractor shall for the duration of the contract or for such other period as directed, maintain project vehicles for the exclusive use by the Resident Engineer and his staff. The quantity will be as set out in Preliminaries and General Items of Bill of Quantities.

The Contractor shall ensure that all vehicles are licensed, comprehensively insured at all times, serviced and maintained in good condition to the satisfaction of the Resident Engineer, so that the Resident Engineer shall at all times have the number of vehicles ordered available for use in good serviceable condition. In the event of any vehicle being unserviceable for whatsoever reason, the Contractor shall provide an alternative vehicle at his own cost of the same model in compliance with the provisions of the clause.

Payment for maintenance shall include for provision of fuels, lubricants and tyres, all regular maintenance, minor and major repairs, including those occasioned by accidental damage from whatever cause arising, transfer of these vehicles to the employer, and everything else necessary to satisfy fully the requirements of this Clause.

All above payments will be subject to deductions of Retention Money. The Contractor shall, at completion bring the vehicles to the appropriate dealers for testing. The dealers shall recommend to the what repairs in addition to the ordinary services are required to be carried out on the vehicles. A certificate of roadworthiness and satisfactory mechanical condition to be obtained from agents prior to handing over. On receiving these recommendation the Engineer will issue the necessary instruction for transfer of vehicles to the employers name.

1.4 PROVISION OF SURVEY EQUIPMENT

Supply and install Survey equipment		
(a)TOTAL STATION survey equipment: Topcon electronic digital TOTAL STATION, pulse GTS 751, 1 second accuracy Survey Equipment or similar approved complete with batteries, tripod, carrying case and all accessories.	Nr	1
(b) Reflectors and targets for (a) above		
ITopcon Automatic level Model AT-G6 or similar approved Complete with tripod carrying case and all accessories	nr	1
(d)Levelling staff 3m long telescopic calibrated \in metric units including staff level and levelling plate	nr	1
ISteel measuring tape 100m long	nr	1
(f)Steel measuring tape50m long	nr	1
(g)Steel measuring tape 3m long	nr	3
(h)Ranging rods length 2m	nr	6
(i)Spirit level	nr	1
(a) Survey Umbrellas	nr	2

1.5 OFFICE FOR THE CONTRACTOR

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

Notwithstanding anything contained in Clause 67 (1) of the General Conditions of Contract, any notice to be given to or served upon the Contractor shall be deemed and taken to be efficiently given or served by the delivery thereof at such office on the site.

1.6 CONTROL OF TRAFFIC

In the event of single way traffic becoming necessary on any particular section of the works, or on the approaches to the works, the Contractor shall, in maintaining through traffic routes, provide a width of at least 3 metres for single way traffic. He shall also ‘ provide approved electrically operated signals for traffic control on each of the affected sections and any additional traffic signs as may be directed in accordance with Clause 106. Signal lights are to be operated by competent operators provided by the Contractor, if and when required by the Engineer. Manually operated “Stop-Go” signs will only be permitted if approved by the Engineer, and shall be of the size, colour and type authorized. The Contractor shall be responsible for liaison with Police.

1.7 TEMPORARY DIVERSION OF TRAFFIC

Temporary diversion ways, including those listed in any schedule to the Bill of

Quantities shall be constructed whenever the site is intersected by existing public and private roads, footpaths, cycle tracks, farm accesses, temporary and accommodation roads.

Any diversion way shall be of such a standard of construction what it is suitable in all respects for the class or classes of traffic requiring to use it. It shall be constructed in advance of the taking up of the existing way and regularly maintained for so long as required in a satisfactory condition all to the approval of the Engineer.

1.8 TEMPORARY TRAFFIC SIGNS

The contractor shall erect and maintain on the works and at prescribed points on the approaches to the works, all traffic signs necessary for the warning, direction and control of traffic and the size of all such signs and the lettering and wording thereon shall be 76ulfils7676zed76 and adequately illuminated at night by approved means.

1.9 PROTECTION WORKS

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

1.10 SURVEY BEACONS

During the progress of the works, the Contractor shall not remove, damage, alter or destroy in any way whatsoever, any plot or survey beacons. He shall notify the Engineer of the need to interfere with any beacon. The Engineer shall authorize any removal and reinstatement that he considers necessary. Should any beacons be found to be above or below the level of the finished work, the Contractor shall immediately report the same to the Engineer.

Should any beacon be damaged or destroyed, the Contractor shall forthwith report the damage to the Engineer and to the Director or surveyors and shall be liable for the cost of reinstatement thereof.

1.11 DAMAGE TO LANDS

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

1.12 RIVERS AND DRAINS

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

1.13 REINSTATEMENT OF ROADS AND FOOTWAYS

The final reinstatement of adopted public roads will in all cases be carried out by the appropriate authority at the Contractor's expense, and in this connection the Contractor shall, before commencing any such excavations, obtain a Road Opening Permit from the authority. The Contractor will be deemed to have ascertained the prices before filling in his rates for final reinstatement

The Contractor shall be responsible for all liaisons with Police for opening up roads.

1.14 TEMPORARY WORKS

The Contractor shall provide, maintain and remove on completion of the works ail temporary works including roadways, sleeper tracks and stagings etc., over roads, footpaths suitable in every respect to carry all plant required for the work or for providing access or for any other purposes.

Details of Temporary works shall be submitted in advance to the Engineer for his approval and the approval shall no relieve the Contractor of complete responsibility for their safety and satisfactory operation.

1.15 LIGHTING AND GUARDING OF OBSTRUCTIONS

The details of the method of signing and guarding an obstruction to traffic caused in the course of the execution of the works shall be submitted to the Engineer for approval before that portion of the works is commenced.

No greater area of the road than the Engineer considers necessary shall be closed at any one time.

Temporary traffic signs shall comply with Clause 106 Generally the following precautions will be required:

Signing

An advance warning sign at least 1.22m x 0.92 m in size and 70 metres in advance of the obstruction will be required, where an appreciable change of direction is necessary at the obstruction, a sign (of the arrow of chevron type) at the obstruction itself. At particular danger points more comprehensive signing may be required.

Guarding

The obstruction shall be marked by posts earning red flags or reflective red markers and by red maps. The latter shall be spaced at 6 metres intervals in the direction of traffic flow and at 0.9 meters intervals across this direction. At least 3 lamps shall be placed across this direction of traffic flow. The flags and lamps on the traffic side of the obstruction shall be at least 5 meters from it.

Footpaths

Where a footpath is affected by an obstruction in any way it shall be separated from both obstruction and traffic by effective banners and red lamps spaced at 0.9 metre intervals.

1.16 DIVERSION SERVICES

The Contractor shall acquaint himself with position of all existing services, such as sewers, water drains, cables for electricity and telephone lines, telephone and lighting poles, water mains etc., before commencing any excavation or other work likely to affect the existing services.

The cost of all plant, equipment and materials, labour , technical and professional staff, transport and the like necessary for determining such location, including the making good of any damage caused to such services all to the satisfaction of the Engineer shall be deemed to be included in the tender rates. No other payment shall be made for the costs of such operations, nor for the making good of damage caused thereby to the existing services.

The contractor shall be held responsible for injury to the existing structures, works or services and shall indemnify and keep indemnified the employer against any claims in this respect (including consequential damages)

The contractor shall be responsible for arranging for moving of services, subject to the agreement of the Engineer, where necessitated by the works and shall pay charges arising from the moving of the services or alteration to services such as power lines, telephone lines, water pipes and the like. Prime cost sums for this sums have been included in Bill of Quantities. Subject to the agreement of the Engineer and upon production of receipts, the contractor shall be reimbursed in interim payments certificates the net cost of such moving or alternative plus the percentage inserted in the Bill of Quantities and profit in making the payment.

1.17 PRIVATELY OWNED OR PUBLIC SERVICES

If any privately owned or public services passing through the site will be affected by the works, the Contractor shall provide at his own expense a satisfactory alternative service In full working order to the satisfaction of the owner of the services approved by the Engineer, before the cutting off the existing service Any damage to private or public services shall be made good by the Contractor at his cost.

In any case the remedial work is not executed promptly by the Contractor; the Engineer may make alternative arrangements for the execution of the work and debit the costs to the Contractor.

1.18 WATER SUPPLY

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

1.19 ADDITIONAL LAND

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

1.20 USE OF HEAVY PLANT:

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

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

1.21 POVISION OF INSTRUMENTS AND LABOUR

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

1.22 ACCESS TO SITES

The Contractor shall construct and maintain all temporary accesses required for the execution of the works. Access roads shall be constructed and maintained up to the site office and Resident Engineer's houses. The cost of all these works shall be deemed to be .covered by rates and prices quoted by the Contractor.

1.23 POLLUTION

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

1.24 TREE PROTECTION

Trees within the permanent and temporary easement are the property of owners. Specific trees will be identified by the Engineer, prior to construction, and the Contractor shall neither remove nor cut in their roots unless otherwise directed by the Engineer. If the roots of such trees appear within the trencn areas, the Contractor shall handle the roots with maximum care so that no portion of the roots will be damaged. During the excavation of the

trench, the exposed roots may be moved to the position that will not damage the roots and will not interfere with the pipe laying. During the Construction, the roots shall be thoroughly protected by appropriate cover and wetted as directed. After the pipes are laid, the moved roots shall be placed back to the original locations and backfilled carefully be the selected soft soil, which can support vegetation.

1.25 GEOLOGICAL DATA

If any geological data is made available to the Contractor, relevant to the Works, will be for his guidance only and no guarantee is given that other ground conditions will not be encountered. No claims based on the geological data provided shall be entertained by the Engineer. The Contractor shall be deemed to have made any additional investigation required before submission of the Tender.

1.26 WATCHING, FENCING AND LIGHTING

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

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

1.27 TIPS

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

1.28 TROPICALISATION

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

1.29 MONTHLY SITE MEETINGS

Throughout the project period, site meetings will be held at the Resident Engineer's office once every calendar month to discuss due progress of the work, schedule for the ensuing month, methods of construction, procurement, transportation, labours, etc. These meetings can be called at any other time intervals at the request of the Contractor or as directed by the Engineer.

1.30 INSPECTION BY ENGINEER DURING DEFECTS LIABILITY PERIOD

Before incorporating in the finished work any materials or articles which he

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

1.31 RESPONSIBILITY FOR ORDERING MATEMALS AND MANUFACTURED ARTICLES AND
SAMPLES OR TESTING

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

With regard to any item in the Bills of Quantities, which is the subject of P.C. sum, the Contractor shall notify the Engineer of his requirements in ample time for the Engineer to make necessary arrangements so that no delay occurs in the progress of the work.

1.32 TESTS OF MATERIALS AND MANUFACTURING ARTICLES BEFORE

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

1.33 REJECTED MATERIALS

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

1.34 QUALITY OF MATERIALS AND WORKMANSHIP

The materials and workmanship shall be of their respective kinds and shall be to the approval of the Engineer. In the reading of this specification the Works "to the approval of the Engineer" shall be deemed to be included in the description of all materials incorporated in the works, whether manufactured

or natural and in the description of all operations for the due execution of the Works.

1.35 TEST RUNNING OF THE SCHEME

Upon substantial completion of the scheme and official inspection, which agrees to this, the Contractor shall operate the entire scheme for the test period, indicated in the Bill of Quantities.

The Contractor shall supply all necessary personnel; electricity, fuels oils and chemicals for the test running and together with the Resident Engineer shall compile a list of detailed operating instructions that all be incorporated into the Operations and Maintenance Manual. The Contractor shall further bring to the attention of the Resident Engineer and of the employer's operational staff any problem or defects he encounters during this period of test running so that solutions may be found and any necessary alterations made.

1.36 EQUIPMENT FOR THE RESIDENT ENGINEER

The Contractor shall provide a suitable digital camera with standard lens with appropriate memory capacity for the exclusive use of the Resident Engineer and his staff for the purpose of taking record photographs of the progress of the Works. The Contractor shall be required to bear the cost of developing a given set of photographs if so instructed by the engineer. The cost of his service are deemed to be covered by the Contractor in his rates in the Bill of Quantities.

1.37 OPERATION AND MAINTENANCE MANUAL

A draft Operation and Maintenance Manual has been compiled prior to commencement of construction of the Works. This Manual has to be revised and brought to a final draft state prior to the test running of the scheme. The Contractor is required to provide in triplicate and in English details of all the different manufactured plant and components incorporated in the Works including but not limited to all pertinent manufacturers brochures. Substantial completion of the scheme will not be considered until such detailed information as is required has been submitted to an accepted by the Engineer.

1.38 CONSTRUCTION PROGRAMME

The Contractor shall submit a revision of the Construction Programme attached to the Tender to the Engineer for approval in four (4) no. copies and after approval to the employer in two (2)No. copies in the following manner:

(36) Within thirty (30) days after receiving Letter of Acceptance, the Contractor shall submit to the Engineer for approval a detailed programme based on the key date stated hereinafter or other dates which will be given in the Letter of Acceptance in the form of a Critical Path method (hereinafter referred to as CPM Network) showing the order of procedure in which he- proposes to carry out the Works including design, manufacture, delivery to the site, transport, storage,

survey, construction, commissioning and maintenance. This programme shall indicate clearly all activities and its duration along with the earls and the latest event, times and the first and last dates of the submission of the Drawings and each date of shop inspection by the Engineer for the section or portion of the works.

The programme so prepared shall be rearranged in the form of a Time Bar-Chart Schedule of which size shall be 841 mm x 594 mm (A-l size). This time Bar-Chart Schedule shall be submitted to the Engineer together with CPM network.

(2) The CPM network shall be in accordance with commonly accepted practice and shall show graphically with each other from the start of construction to the completion of the Contract. The Time Bar-Chart Schedule shown in weeks shall list all main activities and its applicable sub-activities.

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

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

The Contractual Programme approved shall supersede all other programmes and shall be deemed to be the programme on which the Contractor has based his Contract Sum and in accordance with which he will undertake the execution of the works. This programme shall become part of the Contract

The Contractor shall pay his full attention on Works especially Electrical and Mechanical Works which may be carried out by the Electrical/Mechanical Contractor, intimately related with the overall works under the Contract for efficient execution of the Works, and shall clearly indicate them on the construction program.

The Contractor shall also describe the conditions of working shifts, if necessary, to execute works and night and / or on Sundays ad holidays, to be applied in the particular Works of his construction programme. Whenever the Contractor proposes to change the Contractual Programme, approval of the revision shall be taken in writing from the Engineer. If the Contractor has fallen behind the approved Contractual Programme or could foresee delay(s) therein, he shall, immediately after such default or event occurred or be foreseen or at the request of the Engineer submit the reasons of such delay and the proposed measures to recover such delay or to complete the works on time, for the approval of the Engineer.

2. 0. Site Clearance

2.1 CLEARING SITE

The Contractor shall demolish, break up and remove buildings, walls, gates fences, advertisements and other structures and obstructions, grub up and remove Trees. Hedges, bushes and shrubs and clear the site of the works at such time, and: the extent required by the Engineer but not otherwise, subject to the provisions, of Cause 21 of the conditions of Contract: the materials so obtained shall so far as suitable be reserved and stacked for further use; all rubbish and materials for unsuitable for use shall be destroyed or removed from the site, as directed by the Engineer.

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

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

2.2 VEGETATION

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

2.3 BUSHES AND SMALL TREES

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

2.4 HEDGES

Where directed by the Engineer hedges shall be uprooted and disposed by burning

2.5 FELLING TREES

Where shown on the Drawings or directed by the Engineer, trees shall be uprooted or cut down as near to the ground level as possible, and the rates entered in the Bills of Quantities shall include for cutting down, removing branches and foliage, cutting useful timber into suitable lengths, loading, transporting no more than 1 km and stacking or disposing of all as directed by the Engineer.

For the purpose of measurement trees cut down shall be classified according to their girth at 1 meter above ground level, the cost of grubbing roots shall be deemed to be covered by the rate for felling trees.

2.6 GRUBBING-UP ROOTS

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

2.7 WEED CONTROL

The Contractor shall take all necessary precaution against the growth on the site of weeds and remove them as necessary throughout the period of works and maintenance. The finished base of all footways and elsewhere as directed shall be sprayed with an approved persistent total herbicide at the rate recommended by the manufacturer. The application shall be by an even spray in a high volume of water at about 0.7 to 0.11 liters per square meter. After this application the footways shall receive at least two further watering before the surface is sealed.

3.0 Excavation

3.1 DEFINITION AND CLASSIFICATION OF EXCAVATED MATERIALS

Excavation in the bills of quantities shall be classified in two classes:-

1. Common/normal Excavation
   Any material which in the opinion of the Engineer can be excavated by use of pick axes and hand levers shall be classified as common/normal excavation. Water logged material shall be included in this class. Murram in any form shall be classified as common excavation.

2. Rock

   Rock in the bills of quantities will be itemized in three classes:-

Class 'A'

Soft rock of the type known locally as 'tuff' or 'magadi' which in the opinion of the Engineer cannot be considered as hard rock but which considerably increases the amount of labour needed for its removal shall be considered as class 'A' rock.

Class 'B'

Very weathered blacktrap or lava containing many fissures and faults shall be known as hard rock. This type of rock contains stones and boulders of unweathered or incompletely formed blacktrap or lava. A boulder or outcrop of hard rock 1.5m^3 or less, and first quality Nairobi blue, grey or green building stone in a formation which is massive and geologically homogenous, will be deemed to be class 'B, rock.

Class 'C'

Blacktrap in the formation which is massive and geologically homogenous shall be known as class 'C' rock.

3.2 STORAGE AND HANDLING OF EXPLOSIVES AND BLASTING

The removal of hard materials by use of explosives will be normally be permitted subject to compliance by the Contractor in all respects with the Explosives Laws of Kenya.

In the Bills of Quantities hard materials are classed as rock where blasting will be permitted subject to this Clause and also rock where blasting will not be permitted.

The Contractor shall provide proper buildings or magazines in suitable positions for the storage or explosives in manner and quantities to be approved, he shall also be responsible for the prevention of any unauthorized issue or improper use of any explosives brought on the works and employ only licensed and responsible men to handle explosives for the purpose of the

works.

The shots shall be properly loaded and tamped and where necessary, the Contractor shall use heavy mesh blasting nets. Blasting shall be restricted to such periods and such part of the works the Engineer may prescribe If in the opinion of the Engineer, blasting would be dangerous to persons or property or any finished work or is being carried on in a reckless manner, he may prohibit rt, and the rock to be excavated by other means and payment will be made at the rate for rock for excavation where blasting is permitted The use of Explosives by the Contractor in large blasts, as in seams, drifts, pits or large holes, is prohibited unless authorized in writing by the Engineer. In the event of wasting of rock through any such blasting, the contractor shall if required by the Engineer, furnish an equivalent amount of approved materials for fill, 1 cubic meter of rock in-situ being taken to equal 1.5 cubic meter of material in embankment.

3.3 EXCAVATION FOR FILL

Where excavation reveals a combination of suitable and unsuitable materials, the Contractor shall, wherever the Engineer consider it practicable, carry out excavation in such a manner that the suitable materials are placed separately for use in the works without contamination by the unsuitable materials. If any suitable material excavated from within the site is, with the agreement of the Engineer, taken by the Contractor for his use, sufficient suitable material to occupy specified compaction, a volume corresponding to that which the excavated material occupied, shall, unless otherwise directed by the Engineer be provided by the Contractor from his own sources.

3.4 COMPACTION OF FILL

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

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

Nevertheless, if with any material the Engineer doubts whether compaction will be obtained within the above moisture limits he may require compaction to proceed only when the limits of moisture content for the compaction of non-plastic materials are within the range of the optimum moisture content and 3% below the optimum moisture content as determined by the laboratory compaction test method described in BSS 1377: Methods of Test for Soil Classification and Compaction.

If any such non-plastic material on excavation is too wet for satisfactory

compaction and the Engineer orders the moisture content to be lowered or raised such work shall be treated as included in the rates. All adjustments of moisture content shall be carried out in such a way that the specified moisture content remains uniform throughout compaction,

Work shall be continued until a state of compaction is reached throughout the fill, shall have relative compaction determined according to BSS 1377 not less than 85% of maximum dry density at optimum moisture contents. For excavation under Roads, House Drive and Car Parking the backfilling shall be compacted in 150mm layers to 100% maximum dry density.

If with non-plastic material and the compacted material has become drier in the interval between the completion of compaction and the measurement of slate of compaction, then the moisture content to be used for calculation of the air content shall be the mean moisture content for the compaction of such materials as specified above.

3.5 EMBANKMENTS OVER SEWERS & WATER PIPES

In carrying the embankments over the sewer or water pipes, shall be taken by the contractor to have the embankment brought up equally on both sides and over the top of any such structures. Earth embankments shall be formed and compacted in layers of 200mm as the Engineer may direct The filling immediately adjacent to structures shall be deposited and accordance with the Drawings and approved by the Engineer. The cost of this works shall be included in the prices entered in the Bills of Quantities for the excavations from which the embankments are formed.

3.6 STONE REVERTMENTS (STONE PITCHING)

Where shown on Drawings, the slopes of embankment, rivers, streams, watercourses and other surfaces shall be protected against water or other action by handset stone facing set on end. The larger stones shall be roughly dressed on the bed and face, roughly square to the full depth of the joints No rounded boulder shall be used, or stones less than 225 mm in depth of 0.05 cubic meters in volume.

The stone shall be laid to break bond, gravel or fin rubble rammed to a uniform surface and the whole work finished to the satisfaction of the Engineer. Where required, a trench shall be excavated at the bottom of the slope to such a depth as will ensure a safe foundation for the revetment.

3.7 TIPPED REFUSE ON SITE

Tipped refuse other than artificial deposits of industrial waste or shale found on the site shall be removed and disposed of in a spoil heap to be provided by the Contractor.

3.8 REMOVAL OF INDUSTRIAL WASTE, ETC

Artificial deposit of industrial waste or shale found on the site shall be removed and disposed of as directed by the Engineer. Should any particular

deposit consist of or contain materials which in the opinion of the Engineer is suitable for the incorporation in fills, all such material shall be used accordingly and deposited in layers and compacted as specified The prices entered in the Bills of Quantities for the excavation of the materials shall include loading, transportation, disposal and compaction of same as and where directed.

3.9 LANDSLIPS

Remedial works and / or the removal of the materials in slips or subsidence's and over breaks of rock extending beyond the lines and slopes, or below the levels shown on the Drawings or required by the Engineer, will not be paid for.

3.10 CLASSIFICATION OF MATERIAL FROM SLIPS

The classification of materials from slips or slides will be in accordance with its condition at the time of removal, regardless of prior condition. Measurement of over break in rock excavation shall be that of the space originally occupied by surface material before the slide occurred and regardless of its subsequent classification.

3.11 BORROW PITS

Where for any reason, it becomes necessary to form pits, these shall be located »d the work executed in all respects to the instructions of the Engineer. They shall be regular in width and shape and admit of ready and accurate measurement, and shall be properly graded and drained and finished with neatly trimmed dopes.

3.12 STREAMS, WATERCOURSES AND DITCHES

Excavations carried out in the permanent diversion, enlargement deepening, or straightening of streams, watercourses, or ditches shall be performed as directed by the Engineer. The rates for such excavations shall include for excavated materials and all pumping, timbering works, plant and materials necessary for dealing with the flow of water.

3.13 FILLING OLD WATERCOURSES

Where watercourses have to divert from the site of embankments or other work, me original channel shall be cleared of ail vegetable growths and soft deposits »d carefully filled in with approved materials deposited and compacted as directed by me Engineer.

3.14 OPEN DITCHES

Open ditches for drainage purposes shall be cut where and of such cross-section as the Engineer shall direct and where so required by him they shall be constructed before the cutting are opened or the embankments begin. The sides shall be dressed fair throughout and the bottom accurately graded so as to carry off the water to the outlet to be provided. The material excavated

from the ditches shall be disposed of as directed by the Engineer.

3.15 CLEARING EXISTING DITCHES

Where directed by the Engineer existing ditches shall be cleared by removing vegetable growths and deposits. The sides shall be shaped fair throughout and the bottoms properly graded. Materials removed from existing ditches shall be disposed of in tips provided by the Contractor. The rates included in the Bills of Quantities for clearing ditches shall include for maintaining and keeping clean until and up to maintenance period.

3.16 EXCAVATION FOR FOUNDATIONS BELOW OPEN WATER

The tales for excavation for foundations below the water level shall include (or the cost of all temporary close timbering and shoring, sheet piling, coffer dam caissons, pumps and other special appliances required.

3.17 TRENCHES OF GREATER WIDTH AND DEPTH THAN NECESSARY

The Contractor shall not be entitled to payment in respect of excavation to any greater extent, whether horizontally or vertically, than is necessary to receive any structure for which the excavation is intended, except where a separate item is provided for additional working space, timbering, or other temporary work. Excavation to a greater depth or width than directed shall be made good with suitable materials to the satisfaction of the Engineer.

3.18 SUPPORTS FOR TRENCHES

The sides of the trenches shall where necessary be adequately supported to the satisfaction of the Engineer by timber or other approved means.

3.19 PROVISION OF SPOIL HEAPS

The Contractor shall provide spoil heaps at his own expense for the disposal of surplus materials and all rubbish collected when clearing the site and during the construction of the works. The site for these shall be approved by the Engineer.

3.20 USE OF VIBRATORY COMPACTION PLANT

Where vibratory rollers or other vibratory compaction plant is used the mechanism for vibration shall be kept working continuously during compaction operations except during periods when the Engineer permits or directs discontinuance of vibration.

3.21 WATER IN EXCAVATIONS

All excavations shall be kept free from water at all times during construction of works until in the opinion of the Engineer, any concrete or other works therein are sufficiently set.

The Contractor shall construct any sumps, cofferdams, caissons or temporary drams that the Engineer may deem necessary and shall be responsible for the removal and disposal of all water entering the excavations from whatever source and shall deal with and dispose of such water in a manner approved by the Engineer so as to ensure that excavations are kept dry.

The Contractor shall provide all plant, labour and materials required for such work and all costs incurred shall be deemed to be included in his rates for excavation.

4.0 Concrete

Scope of Section

This section covers the materials, design of mixes mixing, transport, planning, compaction and curing of concrete and mortar required in the Works. It also covers frame work and reinforcement for concrete.

Definitions

Structural concrete in any class of concrete which is used in reinforced, pre-stressed or unreinforced concrete construction, which is subject to stress.

Non-Structural concrete is composed of materials complying with the Specification but for which no strength requirements are specified and which is used only for filling voids, blinding foundations and similar purposes where it is not subjected to significant stress.

A formed surface is a face which has been cast against formwork.

An unformed surface is a horizontal or nearly horizontal surface produced by screeding or 92ulfils9292 to the level and finish required.

A pour refers to the operation of placing concrete into any mould, bay or formwork, etc and also to the volume which has to be filled. Pours in vertical succession are referred to as lifts.

4.1 THE DESIGN OF CONRETE MIXES

a) Classes of concrete

The Classes of structural concrete to be used in the works shall be those shown on the Drawings and designated in table 4.1 in which the class designation includes two figures. The first figure is the nominal strength at 28 days expressed in N/mm2 and the second figure is the maximum nominal size of aggregate in the mix expressed in millimeters

b) Design of Proposed Mixes to BSS5328

The Contractor shall design all the concrete mixes called for on the Drawings, making use of the ingredients which have been approved by the Engineer for use in the works and in compliance with the following requirements:-

i) The aggregate portion shall be well graded from the nominal maximum size of stone down to the 150 micron size.

ii) The cement content shall be such as to achieve the strengths called for in table 4.1 but in any case not less than the minimum necessary for impermeability and durability shown in Table 4.1

iii) The workability shall be consistent with ease of placing and proper presence of reinforcement and other destructions.

iv) The water/cement ratio shall be the minimum consistent with adequate workability but in any case not greater than that shown in Table 4.1 taking due account of any water contained in the aggregates. The Contractor shall take into account that this requirement may in certain cases require the inclusion of a workability agent in the mix.

36) The drying shrinkage determined in accordance with BS1881 shall not be greater than 0.05 per cent.

TABLE 4.1 – MINIMUM CEMENT CONTENT

Class of Concrete	**Minimum Cement Content kg/m3 of compacted concrete**		
	Moderate Exposure	**Intermediate Exposure**	**Severe Exposure**
10/75; 15/75	200	220	270
15/40; 20/40, 25/40	240	270	290
30/40			
15/20; 20/20, 25/20	260	300	330
30/20	300	320	330
40/20	300	340	390
20/10; 25/10, 30/10	340	340	390
40/10			

Note: The minimum cement contents shown in the above table are required in order to achieve permeability and durability. In order to meet the strength requirements in the Specification higher contents may be required.

The categories applicable to the works are based broadly on the factors listed hereunder:

Moderate Exposure: Surface sheltered from sewer rain Buried concrete, concrete continuously under water

Intermediate Exposure: Surface exposed to driving rain; alternate wetting and drying: corrosive fumes: heavy condensation

Severe Exposure: Surface exposed to sea water, moorland water having a pH of 4.5 or less, groundwater containing sulphates.

36) **Trial Mixes**

At least six weeks before commencing placement of concrete in the Permanent Works trial mixes shall be prepared for each class of concrete Specified.

For each mix of concrete for which the Contractor has prepared a design, He shall prepare three separate batches of concrete using the materials which have been approved for use in the works and the mixing? Plant which he proposes to use for the Works. The volume of each batch shall be the capacity of the concrete mixes proposed for full production.

Samples shall be taken from each batch and the following action taken, all in accordance with BS1881:- or Local Standards (KS EAS 18 – 1:2001(KEBS 2005) Cement Part 1

i) The slump of the concrete shall be determined.

ii) Six test cubes shall be cast from each batch. In the case of concrete having a maximum aggregate size of 40mm of less, 130mm cubes shall be used. In the case of concrete containing 75mm of larger aggregate. 200mm cubes shall be used and in addition any pieces of aggregate retained on a 53mm standard sieve shall be removed from the mixed concrete before casting the cubes.

iii) Three cubes from each batch shall be tested for compressive strength at seven days and the remaining three at 28 days.

iv) The density of all the cubes shall be determined before the strength tests are carried out.

Subject to the agreement of the Engineer, the compacting factor apparatus may be used in place of a slump cone. In this case the correlation between slump and compacting factor shall be established during preparation of the trial mixes.

The average strength of the nine cubes tested at 28 days shall be not less than the target mean strength shown in Table 4.1

The Contractor shall also carryout tests to determine the drying shrinkage of the concrete unless otherwise directed by the Engineer.

Based on the results of the tests on the trail mixes, the Contractor shall submit full details of his proposals for mix design to the Engineer, including the type and source of each ingredient, the proposed proportions of each mix and the results of the tests on trial mixes.

If the Engineer does not agree to a proposed concrete mix for any reason, the Contractor shall amend his proposals and carry out further trial mixes. No

mix shall be used in the works without the written consent of the Engineer.

d) Quality Control of Concrete Production

i) Sampling

For each class of concrete in production at each plant for use in the works, samples of concrete shall be taken at the point of mixing or of deposition as instructed by the Engineer, all in accordance with the sampling procedures described in BS1881 and with the further requirements set out below.

Six 150mm or 200mm cubes and appropriate shall be made from each sample and shall be cured and tested all in accordance with BS1881,/ (KS EAS 18 – 1:2001(KEBS 2005) Cement Part 1 two at seven days and the other four at 28 days.

Each sample is taken from one batch selected at random and at intervals such that each sample represents not more than 20 m^3 of concrete unless the Engineer agrees to sampling at less frequent Intervals.

Until compliance with the Specification has been established the frequency of sampling shall be three times that stated above or such lower frequency as may be instructed by the Engineer.

36) **Testing**

1) The slump or compacting factor of the concrete shall be determined for each batch from which samples are taken and in addition for other batches at the frequency instructed by the Engineer.

   The slump of the concrete in any batch shall not differ from the value established by the trial mixes by more than 25mm or one third of the value, whichever is the greater.

   The variation in value of the compacting factor, if used in place of a slump value, shall be within the following limits.

   For value of 0.9 or more +0.03

   For value of between 0.8 and 0.9 +0.04

   For values of 0.8 or less +0.05

2) The water/cement ration as estimated from the results of (a) above, determined by samples from any batch shall not very by more than five per cent from the value established during the trail mixes.

3) The air content of air entrained concrete in any batch shall be within 1.5 units of the required value and the average value of four consecutive measurements shall be within 1.0 unit of the required value, expressed as a percentage of the volume of freshly mixed concrete.

4) Until such time as sufficient test results are available to apply the method of control described in (a) below, the compressive strength of the concrete at 28 days shall be such that no single result is less than the value shown in Table 4.1 under the "heading early works test cubes" and also that the average value of any four consecutive results is not less than the value shown in Table 4.1 under the same heading. The 7 – day cube results may be used as an early strength indicator, at the discretion of the engineer.

5) When test cube results are available for at least 20 consecutive batches of any class of concrete mixed in any one plant, the average of any four consecutive results at 28 days shall exceed the nominal strength by not less than half the current margin (see below) and each individual result shall not be less than 85 per cent of the nominal strength.

The current margin shall be defined as 1.64 times the standard deviation of cube tests on at least 20 separate consecutive batches produced from one plant over a period exceeding five days but not exceeding six months or on at least 50 separate consecutive batches produced from one plant over a period not exceeding 12 months. If both figures are available, the smaller shall be taken.

The current margin shall in any case not be less than the figure given below:-

Minimum Current Margin for and above

Batches	10N/mm2	15N/mm2	20N/mm2 and above
After 20 Batches	3.3	5	7.5
After 50 Batches	1.7	2.3	3.8

Failure to comply with requirements if any one test cube result in a group of four consecutive results is less than 85% of the nominal strength but the average of the group of which it is part satisfies the strength requirement, then only the batch from which the failed cube was taken shall be deemed not to comply with the Specification

If more than one cube result in a group of four consecutive results is less than 85% of the nominal strength or if the average strength of the group fails to satisfy the strength requirement then all the batches between those represented by the first and last cubes in the group shall be deemed not to comply with the Specification, and the Contractor shall immediately adjust the mix design subject to the agreement of the Engineer to restore compliance with the Specification. After adjustment of the mix design the Contractor will again be required to comply with sub-clauses 401 © of this Section of the Specification. The Contractor shall take necessary action to remedy concrete which does not comply with this Specification. Such action may include but is not necessarily confined to the following:-

i) Increasing the frequency of sampling until control is again established.

ii) Cutting test cubes from the concrete and testing in accordance with BS1881/ (KS EAS 18 – 1:2001(KEBS 2005)

iii) Carrying out strengthening or other remedial work to the concrete where possible or appropriate

iv) Carrying out non-destructive testing such as load tests on beams.

v) Removing the concrete

TABLE 4.2: CONCRETE GRADES

Grade of Concrete	Minimum works cube strength at 28days (MN/m^2) (Characteristics strength)	Maximum size of Aggregates (mm)	Minimum cement content (Kg/m^3)	Maximum cement content (Kg/m^3)	Maximum water cement ratio	Minimum preliminary cube strength at 28 days (MN/m^2)	Minimum Target works cube strength at 7 days (MN/m^2)
30/40	30	40	300	540	0.46	40	20
30/20	30	20	310	540	0.46	40	20
30/10	30	10	340	540	0.46	40	20
25/40	25	40	280	540	0.53	33	17
25/20	25	20	295	540	0.53	33	17
25/10	25	10	325	540	0.53	33	17
20/40	20	40	260	540	0.6	28	14
20/20	20	20	280	540	0.6	28	14
15/40	15	40	220	540		20	10
15/20	15	20	250	540		20	10
10/40	10	40	220	540		13	6.5
10/20	10	20	250	540		13	6.5
7/40	7	40	220	540		9	4.5
7/20	7	20	250	540		9	4.5

4.2 MIXING CONCRETE

Before any plant for batching mixing transporting, placing, compacting and finishing concrete is ordered or delivered to site, the Contractor shall submit to the Engineer full details including drawings of all the plant which he proposes to use and arrangements he proposes to make.

Concrete for the Works shall be batched and mixed in one or more central plants unless the Engineer agrees to some other arrangement. If the Contractor proposes to use ready mixed concrete he shall submit to the Engineer for his approval full details and test results of the concrete mixes. The Engineer may approve the use of ready mixed concrete provided that:-

a) The proposed mixes, the material to be used and the method of storage and mixing comply with the requirements of the Specification and

b) Adequate control is exercised during mixing

Approval to the use of ready mixed concrete may be withdrawn if the Engineer is not satisfied with the control of the materials being used and control during mixing.

Batching and mixing plants shall be modern efficient equipment complying with the requirements of BSS 1305 and capable of producing a uniform distribution of the ingredients throughout the mass. Truck mixes shall comply with the requirements of BSS 8110 / (KS EAS 18 – 1:2001(KEBS 2005) and shall only be used with the prior agreement of the engineer. If the plant proposed by the Contractor does not fall within the scope of (KS EAS 18 – 1:2001(KEBS 2005), it shall have been tested in accordance with BSS 3963 and shall have a mixing performance within the limits specified in BSS1305.

All mixing operations shall be under the control of an experienced supervisor.

The aggregate storage bins shall be provided with drainage facilities arranged so that drainage water is not discharged to the weigh hoppers. Each bin shall be drawn down at least once per week and any accumulation of mud or silt removed.

Cement and aggregate shall be batched by weight. Water may be measured by weight or volume.

The weighing and water dispensing mechanisms shall be maintained in good order. Their accuracy shall be maintained within the tolerances described in BSS1305 and checked against accurate weights and volumes when required by the Engineer

The weights of cement and of each size of aggregate as indicated by the

mechanisms employed shall be the respective weights per batch agreed by the Engineer.

The Contractor shall provide standard test weights at least equivalent to the maximum working load used on the most heavily loaded scale and other auxiliary equipment required for checking the satisfactory operation of each scale or other measuring device. Tests shall be made by the Contractor at least once a week or at intervals to be determined by the Engineer and shall be carried out in his presence. For the purpose of carrying out these tests, there shall be easy access for personnel to the weigh hoppers. The Contractor shall furnish the Engineer with copies of the complete results of all check tests and shall make any adjustments, repairs or replacements necessary to ensure satisfactory performance.

The nominal drum or pan capacity of the mixer shall not be exceeded. The turning speed and the mixing time shall be as recommended by the manufacturer but in addition, when water is the last ingredient to be added, mixing shall continue for at least one minute after all the water has been added to the drum or pan.

The blades of pan mixers shall be maintained within the tolerances specified by the manufacturer of the mixer and the blades shall be replaced when it is no longer possible to maintain the tolerances by adjustment.

Mixers shall be fitted with an adjustment recorder registering the number of batches discharged.

The water to be added to the mix shall be reduced by the amount of free water contained in the coarse and fins aggregates. This amount shall be determined by the Contractor by a method agreed by the Engineer immediately before mixing begins each day and thereafter at least once per hour during concreting and for each delivery of aggregates during concreting. When the correct quantity of water, determined as set out in the Specification has been added to the mix, no further water shall be added, either during mixing or subsequently.

After mixing for the required time, each batch shall be discharged completely from the mixer before any materials for the succeeding batch are introduced.

Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before any fresh concrete is mixed and thereafter the first batch of concrete through the mixers shall contain only half the normal quantity of coarse aggregate. This batch shall be mixed for one minute for one minute longer than the time applicable to a normal batch.

Mixers shall be cleaned out before changing to another type of cement.

4.3. HAND – MIXED CONCRETE

Concrete for structural purposes shall not be mixed by hand. Where non-structural concrete is required, hand mixing may be carried out subject to the agreement of the Engineer.

The mixing shall be done on hard impermeable surface. The materials shall be turned over not less than three times dry, water shall then be sprayed on and the materials again turned over not less than three times in a wet condition and worked together until a mixture of uniform consistency is obtained.

For hand mixed concrete the specified quantities of cement shall be increased by 10% and not more than 0.5 cubic meters shall be mixed at one time. During windy Weather efficient precautions shall be taken to prevent cement from being blown away during the process of gauging and mixing.

4.4 TRANSPORT OF CONCRETE

The concrete shall be discharged from the mixer and transported to the works by means which shall prevent adulteration, segregation or loss of ingredients, and which shall ensure that the concrete is of the required workability at the point and time of placing. The loss of slump between discharge from the mixer and placing shall not exceed 25mm.

The time elapsing between mixing and placing a batch concrete shall be as short as practicable as and in any case not longer than will permit completion of placing and compaction before the onset of initial set. If the placing of any batch of concrete is delayed this period, the concrete shall not be placed in the Work.

4.5. PLACING OF CONCRETE

a) Consent for Placing

Concrete shall not be placing in any part of the works until the Engineer's consent has been given in writing and the Contractor shall give the Engineer at least 1 full working day's notice of his intention to place concrete.

If concrete placing is not commenced within 24 hours of the Engineer's consent the Contractor shall again request consent as specified above.

b) Preparation of surface to receive concrete

Excavated surfaces on which concrete is to be deposited shall be prepared as set out in Section 3 of this Specification.

Existing concrete surfaces shall be prepared as set out in Clause 414. Before deposition of further concrete they shall be clean, hard and sound and shall be wet but without any freestanding water.

Any flow of water into an excavation shall be diverted through proper side drains to a sump, or be removed by other suitable methods which will prevent washing away the freshly deposited concrete or any of its constituents. Any under drains constructed for this purpose shall be completely grouted up when they are no longer required by a method agreed by the Engineer.

Unless otherwise instructed by the Engineer surfaces against which concrete is to be placed shall receive a prior coating of mortar mixed in the proportion similar to those of the fines portion in the concrete. The mortar shall be well worked into all parts of the excavated surface and shall be not less than 5mm thick.

If any fissures have been cleaned out as described in Section 3 of this Specification they shall be filled with mortar or with concrete as instructed by the Engineer.

The amount of mortar placed at any one time shall be limited so that if does not dry out or set before being covered with concrete.

c) Placing Procedures

The concrete shall be deposited as nearly as possible in its final position. It shall be placed so as to avoid segregation of the concrete and displacement of the reinforcement, other embedded items, or formwork. It shall be brought up in layers approximately parallel to the construction joint planes and not exceeding 300mm in compacted thickness unless otherwise permitted or directed by the Engineer, but the layer shall not be thinner than four times the maximum size of aggregate.

Layers shall not be placed so that they from feather edges nor shall they be placed on a previous layer which has taken its initial set. In order to comply with this requirement, a layer may be started before completion of the preceding layer.

All the concrete in a single bay or pour shall be placed as a continuous operation. It shall be carefully worked round all obstructions, irregularities in the foundations and the like so that all parts are completely full of compacted concrete with no segregation or honeycombing. It shall also be carefully worked round and between water stops, reinforcement, embedded steelwork and similar items which protrude above the surface of the completed pour.

All work shall be completed on each batch of concrete before its initial set commences and thereafter the concrete shall not be disturbed before it has set hard. No concrete that has partially hardened during transit shall be used in the Works and the transport of concrete from

the mixer to the point of placing shall be such that this requirement can be complied with

Concrete shall not be placed during rain which is sufficiently heavy or prolonged to wash mortar from coarse aggregate on the exposed faces of fresh concrete. Means shall be provided to remove any water accumulating on the surface of the placed concrete. Concrete shall not be deposited into such accumulations of water.

In drying weather, covers shall be provided for all fresh concrete surfaces which are not being worked on. Water shall not be added to concrete for any reason.

When concrete is discharged above its place of final deposition, aggregation shall be prevented by the use of chutes, down pipes, trunking, baffles or other appropriate devices, as approved by the Engineer.

Forms for walls, columns and other thin sections of the significant height shall be provided with opening or other devices that will permit the concrete to be placed in a manner that will prevent segregation and accumulations of hardened concrete on the formwork or reinforcement above the level of the placed concrete.

When it is necessary to place concrete under water the Contractor shall submit to the Engineer his proposals for the method and equipment to be employed. The concrete shall be deposited either by bottom-discharging watertight containers or through funnel-shaped termites which are kept continuously full with concrete up to a level above the water and which shall have the discharging bottom fitted with a trapdoor and immersed in the concrete in order to reduce to a minimum the contact of the concrete with the water. Special care shall be taken to avoid segregation.

If the level of concrete in a termite pipe is allowed to fall to such an extent that water enters the pipe, the latter shall be removed from the pour and filled with concrete before being again lowered into the placing position. During and after concreting under water, pumping or dewatering in the immediate vicinity shall be suspended if there is any danger that such work will disturb the freshly placed concrete

d) Interruption to placing

If concrete placing is interrupted for any reason and the duration of the interruption cannot be forecast or is likely to be prolonged, the contractor shall immediately take the necessary action to form a construction joint so as to eliminate as far as possible feather edges and sloping top surfaces and shall thoroughly compact the concrete already

placed in accordance with Clause 4.6. All work on the concrete shall be completed while it is still plastic and it shall not thereafter be disturbed until it is hard enough to resist damage. Plant and materials to comply with this requirement shall be readily available at all times during concrete placing.

Before concreting is resumed after such an interruption the Contractor shall cut out and remove all damaged or encompassed concrete, feather edges or any other undesirable features and shall leave a clean sound surface against which the fresh concrete may be placed.

If it becomes possible to resume concrete placing without contravening the Specification and the Engineer consents to resumption, the new concrete shall be thoroughly worked in and compacted against the existing concrete so as to eliminate any cold joints.

e) Dimensions of pours

Unless otherwise agreed by the Engineer, pours shall not be more than two meters high and shall as far as possible have a uniform thickness over the plan area of the pour. Concrete shall be placed to the full planned height of all pours except in the circumstances described in sub-clause 4.5 (d)

The Contractor shall plan the dimension and sequence of pours in such a way that cracking of the concrete does not take place due to thermal or shrinkage stresses.

f) Placing sequence

The Contractor shall arrange that as far as possible the intervals between placing successive lifts of concrete in one section of the Works are of equal duration. This duration shall normally the not less than three or more than seven days under temperate weather conditions unless otherwise agreed by the Engineer.

Where required by the Engineer to limit the opening of construction joints due to shrinkage, concrete shall not be placed against adjacent concrete which is less than 21 days old.

When the drawing call for contraction gaps in concrete, these shall be of the widths and in the locations shown on the drawings and they shall not be filled until the full time interval shown on the drawings bas elapsed.

4.6 COMPACTION OF CONCRETE

The concrete shall be fully compacted throughout the full extent of the placed

layer. It shall be thoroughly worked against his formwork and around any reinforcement and other embedded items, without displacing them. Particular care shall be taken at arises and other confined spaces. Successive layers of the same pour shall be thoroughly worked together.

Concrete shall be compacted with the assistance of mechanical immersion vibrators, unless the Engineer agrees another method.

Immersion vibrators shall operate at a frequency of between 7,000 and 10. 000 cycles per minute. The Contractor shall ensure that vibrators are operated at pressures and voltages not less than those recommended by the manufacture in order that the comp active effort is not reduced.

A sufficient number of vibrators shall be operated to enable the entire quantity of concrete being placed to be vibrated for the necessary period and, in addition, standby vibrators shall be available for instant use at each place where concrete is being placed.

Where the concrete contains aggregate with a nominal size of 75mm or more, vibrators with a diameter of 100mm or more shall be used.

Vibrators shall be continued at each point until the concrete ceases to contract, a thin layer of mortar has appeared on the surface and air bubbles have ceased to appear. Vibrators shall not be used to move concrete laterally and shall be withdrawn slowly to prevent the formation of voids.

Vibrators shall not be applied by way of reinforcement nor shall vibrators be allowed to touch reinforcement or other embedded items. The vibrators shall be inserted vertically into the concrete to penetrate the layer underneath at regular spacing which shall not exceed the distance from the vibrator over which vibration is visibly effective.

4.7 CURING OF CONCRETE

a) General

Concrete shall be protected during the first stage of hardening from loss of moisture and from the development of temperature differentials within the concrete sufficient to cause cracking. The methods used for curing shall not cause damage of any kind to the concrete.

Curing shall be continued for as long as may be necessary to achieve the above objectives but in any case for at least seven days or until the concrete it covered by later construction whichever is the shorter period.

The above objectives are dealt with in sub-clause 4.7 (b) and (c) but nothing shall prevent both objectives being achieved by a single

method where circumstances permit.

The curing process shall commence as soon as the concrete is hard enough to resist damage from the process, and in the case of large areas or continuous pours, shall commence on the completed section of the pour before the rest of the pour is finished.

Details of the Contractor's proposals for during concrete shall be submitted to the Engineer before the placing of concrete commences in the Works.

Formed surfaces may be cured by retaining the formwork in place for the required curing period.

If the use of the foregoing methods is inappropriate surfaces which will not have further concrete bonded to them and which are not to receive an application of a finish may be cured by the application of a curing compound having an efficiency index of at least 90 per cent. Curing compounds shall contain a fugitive dye to enable the extent of the spread to be seen easily.

Curing compound used on surfaces exposed to the sky shall contain sufficient finely divided flake 106ulfils106106 in suspension to produce a complete coverage of the surface with a metallic finish when applied at the rate recommended by the manufacturer.

Curing compounds shall become stable and impervious to the evaporation of water from the concrete surface within 60 minutes of application. The material shall not react chemically with the concrete surfaces for at least the first four days of the curing period.

If instructed by the Engineer, the Contractor shall, in addition to the curing provisions set out above provide a suitable form of shading to prevent the direct rays of the sun reaching the concrete surfaces for at least the first four days of the curing period.

b) Loss of Moisture

Exposed concrete surfaces shall be closely covered with impermeable sheeting, properly secured to prevent its removal by wind and the development of air spaces beneath it. Joints in the sheeting shall be lapped by at least 300mm.

If for some reason, it is not possible to use impermeable sheeting, the Contractor shall keep the exposed surfaces continuously wet by means of a water spray or by covering with a water absorbent material which is kept wet, unless this method conflicts with sub-clause 4.7 (c)

Water used for curing shall be of the same quality as that used for mixing as stated in sub-clause 7.16 (g)

c) Limitation of Temperature Differential

The Contractor shall limit the development of temperature differentials in concrete after placing by any means appropriate to the circumstances including the following:-

i) Limiting concrete temperatures at placing as set out in sub-clause 4.9 (b)

ii) Use of low heat cement, subject to the agreement of the Engineer

iii) Insulation of exposed concrete surface by insulating blankets. Such blankets shall have an insulation value at least equivalent to 50mm of dry mineral wool.

iv) Leaving formwork in place during the curing period. Steel forms shall be suitably insulated on the outside.

v) Preventing rapid dissipation of heat from surfaces by shielding from wind

vi) Avoiding the use of water sprays when such use would cause rapid cooling of the surface

4.8 PROTECTION OF FRESH CONCRETE

Freshly placed concrete shall be protected from rainfall and from water running over the surface until it is sufficiently hard to resist damage from these causes.

No traffic shall be allowed on any concrete surface until such time as it is hard enough to resist damage by such traffic.

Concrete in the Works shall not be subjected to any loading until it has attained at least its nominal strength as defined in Clause 4.1.

If the Contractor desires to impose loads on newly-placed concrete, he shall make at least three test cubes and cure them in the same conditions as the concrete they represent. These cubes shall be tested singly at suitable intervals in order to estimate the time at which the nominal strength is reached.

4.9 CONCRETING IN HOT WEATHER

a) General

The Contractor shall prevent damage to concrete arising from exposure to extreme temperatures, and shall maintain in good working order all plant and equipment required for this purpose.

In the event that conditions become such that even with the use of the equipment the requirements cannot be met, concrete placing shall immediately cease until such time as the requirements can again be met.

b) Concrete Placing in Hot Weather

During hot weather the Contractor shall take all measures necessary to ensure that the temperature of concrete at the time of placing in the woks does not exceed 30 degrees centigrade and that the concrete does not lose any moisture during transporting and placing.

Such measures may include but are not necessarily limited to the following:-

i) Shielding aggregates from direct sunshine

ii) Use of mist water spray on aggregate

iii) Sun shields on mixing plants and transporting equipment

iv) Cooling the mixing water if ice is used for this purpose it should preferably be in flake form. Lump ice shall not be allowed to enter the tank supplying the mixer drum

v) Covering skips closely with polythene sheet so that the latter is in contact with the concrete

Areas in which concrete is to be placed shall be shielded from direct sunshine and rock or concrete surfaces shall be thoroughly wetted to reduce absorption of water from the concrete placed on or against them

After concrete in any part of an area has been placed, the selected curing process shall be commended as soon as possible. If any interval occurs between completion of placing and start of curing, the concrete shall be closely covered during the interval with polythene sheet to prevent loss of moisture.

4.10 FINISHES ON UNFORMED SURFACES

Horizontal or nearly horizontal surfaces which are not cast against formwork shall be finished to the class shown on the Drawings and defined hereunder.

UF 1 Finish

All surfaces on which no higher class of finish is called for on the Drawings or instructed by the Engineer shall be given a UF 1 finish

The concrete shall be 109ulfils109 and screened to produce a uniform plain or ridged surface, surplus concrete being struck off by a straight edge immediately after compaction

UF 2 Finish

This is a floated finish to roof or floor slabs and other surfaces where a hard trowel led surface is not required.

The surfaces shall first be treated at a Class UF 1 finish and after the concrete has hardened sufficiently, it shall be floated by hand or machine sufficiently only to produce a uniform surface free from screed marks.

UF 3 Finish

This is a hard trowel led surface for use where weather resistance or appearance is important, or which is subject to high velocity water flow.

The surface shall be floated as for a UF 2 finish but to the tolerance stated below. When the moisture film has disappeared and the concrete has hardened sufficiently to prevent laitance from being worked to the surface, it shall be steel trowel led under firm pressure to produce a dense, smooth uniform surface free from trowel marks.

TABLE 4.4 SURFACE TOLERANCES

Class of Finish	Tolerance in mm. See notes		
	A	B	C
UF 1	Not applicable	10	20 or -10
UF 2	Nil	10	20 or – 10
UF 3	Nil	5	12.5 or – 7.5

NOTES:-

1. **Col A** is the maximum allowable value of any sudden change of level in the surface

2. **Col. B** is the maximum allowable value of any gradual irregularity of the surface, as indicated by the gap between the surface and a three meter long straight edge or correctly shaped template placed on the surface

3. **Col C** is the maximum allowable value of the difference in level or position between a three meter long straight edge and correctly shaped template placed on the surface and the specified level or position or that surface.

Where dimensional tolerance is given on the Drawings or in this Special Specification they shall take precedence over those given in Table 4.4.

4.11. MORTAR

This Clause covers mortar for use ahead of concrete placing, and other uses not covered elsewhere in the Specification

Mortar shall be composed of fine aggregate complying with sub-clause 7.18 I and ordinary Portland cement complying with BSS12. The mix elsewhere in this Specification or if not stated shall be one part of the cement to two parts of fine aggregate by weight.

Small quantities of mortar may be hand mixed but for amounts over 0.5 cubic meters a mechanical mixer shall be used.

The water content of the mortar shall be as low as possible consistent with the use for which it is required but in any case the water/cement ratio shall not be more than 0.5

Mortar which is specified as “dry pack” shall be mixed with sufficient water for the mix to become cohesive but not plastic when squeezed in the hand. Dry pack mortar shall be rammed into the cavity it is required to fill, using a hand rammer with sufficient force to ensure full compaction.

4.12. CONCRETE FOR SECONDARY PURPOSES

a) Non-structural concrete (NS concrete) shall be used only for non-structural purposes where shown on the Drawings

NS concrete shall be composed of ordinary Portland cement complying with BSS 12 and aggregates complying with BSS 882, DIN 1045 including all-in aggregate within the grading limits of BSS882 and DIN4226

The weight of cement mixed with 0.3 cubic meters of combined or all-in aggregate shall not be less than 50kg. The mix shall be proportioned by weight or by volume. The maximum aggregate size shall be 40mm nominal.

The concrete shall be mixed by machine or by hand to a uniform colour and consistency before placing. The quantity of water used shall not exceed that required to produce a concrete with sufficient workability to be placed and compacted where required.

The concrete shall be compacted by hand or by mechanical vibration

b) No fines concrete (NF concrete) is intended for use where a porous concrete is required and shall only be used where shown on the Drawings or instructed by the Engineer.

The mix shall consist of ordinary Portland cement complying with BSS 5328. The aggregate size shall be 40.0mm to 10.0mm only. The weight of cement mixed with 0.3 cubic meter of aggregate shall not be less than 50 kg. The quantity of water shall not exceed that which will coat evenly the whole of the aggregate.

4.13 RECORDS OF CONCRETE PLACING

Records, in a form agreed by the Engineer, shall be kept by the Contractor of the details of every pour of concrete placed in the Works. These records shall include class of concrete, location of pour, date of pour, ambient temperature and concrete temperature at time of placing, moisture contents of aggregates, details of mixes, batch numbers, cement batch number, results of all tests undertaken, location of test cube sample points and details of any cores taken.

The Contractor shall supply to the Engineer four copies of these records each week covering work carried out the preceding week. In addition he shall supply to the Engineer monthly histograms of all 28 day cube strengths together with accumulative and monthly standard deviations and any other information which the Engineer may require concerning the concrete placed in the works.

4.14 CONSTRUCTION JOINTS

Whenever concrete is to be bonded other concrete which the hardened, the surface of contact between the sections shall be deemed a construction joint.

Where construction joints are shown on the Drawings, the Contractor shall form such joints in those positions. The location of joints which the Contractor requires to make for the purpose of the construction shall be subject to the agreement of the Engineer. Construction joints shall be in vertical or horizontal planes except in sloping slabs where they shall be normal to the exposed surface or elsewhere where the Drawings require a different arrangement

Construction joints shall be so arranged as to reduce to a minimum the effects of shrinkage in the concrete after placing, and shall be placed in the most advantageous positions with regard to stresses in the structures and the desirability of staggering joints.

Feather edges of concrete at joints shall be avoided and any feather edges which may have formed where reinforcing bars project through a joint shall be cut back until sound concrete has been reached.

The intersections of horizontal or near horizontal joints and exposed faces of concrete shall appear as straight lines produced by use of a guide strip fixed to the formwork at the top of the concrete lift, or by other means acceptable to

the Engineer.

Construction joints formed as free surfaces shall not exceed a slope of 20 per cent from the horizontal.

The surface of the fresh concrete in horizontal or near horizontal joints shall be thoroughly cleaned and roughened by means of high pressure water and air jets when the concrete is hard enough to withstand the treatment without the leaching of cement. The surfaces vertical or near vertical joints shall be similarly treated if circumstances permit the removal of formwork at a suitable time.

Where concrete has become too hard for the above treatment to be successful, the surface whether formed or free is to be thoroughly scrabbled by mechanical means or wet sand blasted and then washed with clean water. The indentations produced by scrabbling shall be not less than 10mm deep and shall not extend closer than 40mm to a finished face.

If instructed by the Engineer the surface of the concrete shall be thoroughly brushed with a thin layer of mortar composed of one part of cement to two parts of sand by weight and complying with clause 4.11 all as set out in sub-clause 4.5 (b) immediately prior to the deposition of fresh concrete. The mortar shall be kept just ahead of the fresh concrete shall be thoroughly and systematically vibrated to full depth to ensure complete bond with the adjacent layer.

No mortar or concrete may be placed in position on or against a construction joint until the joint has been inspected and passed by the Engineer.

4.15 EXPANSION AND CONTRACTION JOINTS

Expansion and contraction joints are discontinuities in concrete designed to allow for thermal or other movements in the concrete.

Expansion joints are formed with a gap between the concrete faces to permit subsequent expansion of the concrete. Contraction joints are formed to permit initial contraction of the concrete and may include provision for subsequent filling.

Expansion and contraction joints shall be formed in the positions and in accordance with the details shown on the Drawings of elsewhere in the Specifications.

4.16 WATERSTOPS

All references to water stops include grout stops.

Water stops shall be of the material and form shown on the Drawings. No

water stop material shall be brought onto site until the Contractor has submitted full details of the materials he proposes to use, including samples, and these have been approved by the Engineer. All samples shall be of adequate length for testing.

Water stops shall be made of material which are resistant to chlorides, sulphates, or other deleterious substances which may be present in the environment of the works.

Rubber water stops may be of natural rubber and shall have an elongation at breaking stress of at least 500 per cent at 24 degrees centigrade and shall allow a joint movement of at least 50mm.

Polyvinyl chloride (PVC) water stops shall be extruded from an unfilled plasticized PVC polymer or copolymer which does not contain any reclaimed or scraps PVC. PVC water stops shall have an elongation at breaking stress or at least 225 per cent at 25 degrees centigrade and shall allow a joint movement of at least 10mm.

Low modulus water stops shall be of rubber or PVC as described above but shall have an elongation of at least 200 per cent at 25 degrees centigrade under a tensile stress of 6N/mm2 and shall allow a joint movement of at least 50mm.

Water stops shall be supplied in lengths as long as possible consistent with ease of handling and construction requirements.

In rubber or plastic materials, joints other than butt joints shall be supplied ready made by the manufacturer. Butt joints shall be made on site in accordance with the manufacturer's instructions and with equipment supplied for the purpose by the manufacturer.

Water stops material shall be stored carefully on site to avoid damage and contamination with oil, grease, or other pollutants. Rubber and plastic water stops shall be stored in cool well ventilated places away from direct sunlight.

Rubber and plastic water stops which are embedded in one side of a joint more than one month before the scheduled date of placing concrete on the other side shall be protected from the sun.

Water stops shall be firmly fixed in the formwork so that they cannot be displaced during concrete placing and shall be completely free of all dirt, grease, oil, etc before placing concrete. Where eyelets are provided these shall be fully wire to the reinforcement and be the only means whereby the water stop is fixed. In no circumstances shall a water stop be punctured with nails etc. as a means of fixing.

Concrete shall be placed carefully round water stops so as to avoid distortion

or displacement and shall be fully compacted. Where water stops lie in a horizontal or nearly horizontal plane the Contractor shall ensure that no voids are left on the underside of the water stop.

Formwork round water stops shall be carefully removed to avoid damage. If water stops suffer any damage which cannot be properly repaired in-situ the Engineer may require a section of concrete to be removed and the water stop replaced.

4.17 GROUTING OF POCKETS AND HOLES AND UNDERPINNING OF BASEPLATES

Packets and holding-down bolt holes shall be thoroughly cleaned out using compressed air and water jet. Holes drilled by a diamond bit shall be roughened. The pockets and holes shall be filled with grout consisting of cement and clean fresh water mixed in proportion of two parts by weight cement to one part by weight of water. The pouring of liquid grout shall cease as soon as each hole is filled and any excess grout on the surface of the concrete foundation shall be completely removed and the surface dried off before the next operation proceeds.

The space between the top surface of foundation concrete and the underside of base plates shall be filled with a special mortar made up in the following proportions:-

Portland cement	50 kg
Fine aggregate	50 kg

An additive acceptable to the Engineer to counteract shrinkage in proportions recommended by the manufacturer.

The special mortar shall be mixed with the lowest water-cement ratio which will result in a consistency of mix of sufficient workability to enable maximum compaction to be achieved.

The special mortar shall be well rammed in horizontally below the base plate and from one edge only until it is extruded from the other three sides. The mortar which has extruded shall then be rammed back to ensure complete support without voids.

4.18 REMEDIAL WORK TO DEFECTIVE SURFACES

If on stripping any formwork the concrete surface is found to be defective in any way, the Contractor shall make no attempt to remedy such defects prior to the Engineer's inspection and the receipt of any instructions which the Engineer may give.

Defective surfaces shall not be made good by plastering.

Areas of honeycombing which the Engineer agrees may be repaired shall be cut back to sound concrete or to 75mm whichever is the greater distance. In the case of reinforced concrete the area shall be cut back to at least 25mm clear distance behind the reinforcement or to 75mm, whichever is the greater distance. The cavity shall have sides at right angles to the face of the concrete. After cleaning out with water and compressed air, a thin layer of cement grout shall be brushed on to the concrete surfaces in the cavity and it shall then be filled immediately with concrete of the same class as the main body but with aggregate larger than 20mm nominal size removed. A form shall be used against the cavity, provided with a lip to enable concrete to be placed. The form shall be filled to a point above the top edge of the cavity.

After seven days the lip of concrete shall be broken off and the surface ground smooth.

Surface irregularities which are outside the limits of tolerance set out in Clause 4.17 shall be ground down in the manner and to the extent instructed by the Engineer.

Defects other than those mentioned above shall be dealt with as instructed by the Engineer.

4.19 BENDING REINFORCEMENT

Unless otherwise shown on the drawings, bending and cutting shall comply with BSS4466

The Contractor shall satisfy himself as to the accuracy of any bar bending schedules supplied and shall be responsible for cutting, bending and fixing the reinforcement in accordance with the Drawings.

Bars shall be bending cold by the application of slow steady pressure. At temperatures below 5 degrees Centigrade the rate of bending shall be reduced if necessary to prevent fracture of the steel.

After bending, bars shall be securely tied together in bundles or groups and legibly 117ulfils117 as set out in BSS 4466.

Reinforcement shall be thoroughly cleaned and all dirt, scale, loose rust, oil and other contaminants removed before it is placed in the works.

4.20 FIXING REINFORCEMENT

Reinforcement shall be securely fixed in position within a dimensional tolerance of 20mm in any direction parallel to a concrete face and within a tolerance of 5mm at right angles to a face, provided that the cover is not

thereby decreased below the minimum shown on the drawings, or if not shown shall be not less than 25mm or the diameter of the bar, whichever is the greater. Cover on distribution steel shall not be less than 15mm or the diameter of the bar whichever is the greater.

Unless otherwise agreed by the Engineer, all intersecting bars shall either be tied together with 1.6mm diameter soft annealed iron wire and the ends of the wire turned into the body of the concrete, or shall be secured with a wire clip of a type agreed by the Engineer.

Spacer blocks shall be used for ensuring that the correct cover is maintained on the reinforcement. Blocks shall be as small as practicable and of a shape agreed by the Engineer. They shall be made of mortar mixed in the proportions of one part of cement to two parts of sand. Wires cast into the block for tying in to the reinforcement shall be 1.6mm diameter soft annealed iron.

Alternatively another type of spacer block may be used subject to the Engineer's agreement.

Reinforcement shall be rigidly fixed so that no movement can occur during concrete placing. Any the space to be occupied by the concrete being correctly placed.

No splices shall be made in the reinforcement except where shown on the drawings or agreed by the Engineer. Splice lengths shall be as shown on the drawings.

Reinforcement shall not be welded except where required by the Contractor or agreed by the Engineer. If welding is employed, the procedures shall be as set out in BSS2640 for gas welding or DIN8558 for metal is welding. Full strength butt welds shall only be used for steel complying with BSS4449, and if used on high yield deformed bars complying with BSS4449 the permissible stresses in the vicinity of the weld shall be reduced to those applicable to plain bars complying with that specification.

Mechanical splices shall not be used unless the Engineer agrees otherwise.

The Contractor shall ensure that reinforcement left exposed in the works shall not suffer distortion, displacement or other damage. When it is necessary to bend protruding reinforcement aside temporarily, the radius of the bend shall not be less than four times the bar diameter for mild steel bars or six times the bar diameter for high yield bars. Such bends shall be carefully straightened before concrete placing continues, without leaving residual links or damaging the concrete around them. In no circumstances will heating and bending of high yield bars be permitted.

Bars complying with BSS4461 or other high tensile bars shall not be bent after

placing in the works.

Before concrete is placed in any section of the works which includes reinforcement, the reinforcement shall be completely clean and free from all contamination including concrete which may have been deposited on it from previous operations.

5. Formwork

5.1. FORMWORK FOR CONCRETE

Definitions:

Formwork means the surface, against which concrete is placed to form a face, together with all the immediate supports to retain it in position while concrete is placed.

Falsework means the structural elements supporting both the formwork and the Concrete until the concrete becomes self-supporting.

A formed face is one which has been cast against formwork.

An exposed face is one which will remain visible when construction has been completed.

5.2 CONSTRUCTION OF FORMWORK AND FALSEWORK

Before construction begins, the contractor shall submit to the Engineer drawings showings details of the proposed formwork and false work.

Formwork and False work shall be constructed that they support the loads imposed on them by the fresh concrete together with additional stresses imposed by vibrating equipment and by construction traffic, so that after the concrete has hardened the formed faces shall be in positions shown on Drawings within the tolerances set out in Clause 5.6.

Ground supports shall be properly founded on footings designed to prevent settlement.

Joints in formwork for exposed faces shall, unless otherwise specified, be evenly spaced and horizontal or vertical and shall be continuous or form a regular pattern.

All joints in formwork including formwork for construction joints shall be tight against the escape of cement and fines. Where reinforcement projects through formwork, the form shall fit closely round the bars.

Formwork shall be so designed that it may be easily removed from the work without damages to the faces of the concrete. It shall also incorporate provisions for making minor adjustments in position if required, to ensure the correct location of concrete faces. Due allowance shall be made in position of all formwork for movement and settlement under the weight of fresh concrete.

Where overhangs in formwork occur, means shall be provided to permit the escape of air and to ensure that the space is filled completely with fully compacted concrete.

Formwork shall be provided for concrete surfaces at slopes of 30 degrees to the horizontal or steeper. Surfaces at slopes less than 20 degrees may be formed by screeding. Surfaces between 20 degrees and 30 degrees shall generally be formed unless the Contractor can demonstrate to the satisfaction of the Engineer that such slopes can be screeded with the use of special screed boards to hold the concrete in place during vibration.

Horizontal or inclined formwork to the upper surface of concrete shall be adequately secured uplift due to the pressure of fresh concrete. Formwork to voids within the body of the concrete shall also be tied down or otherwise secured against floating.

The internal and external angles on concrete surfaces shall be formed with fillets and chamfers of the sizes on the Drawings unless otherwise instructed by the Engineer.

Support for formwork for non-water retaining structures may be bolted to previously placed concrete provided the type of bolt used is acceptable to the Engineer. If ties through the concrete are used in conjunction with the bolts, the metal left in shall not be closer than 50mm to the face of the concrete.

Supports for formwork for water retaining structures may be bolted to previously place concrete provided the type of bolts and positions of fixing are acceptable to the Engineer. After concreting the Contractor shall remove all support bolts and seal all holes with well rammed cement / sand mortar containing approved waterproofing cement additive. Metal ties which would be left in the concrete shall not be permitted.

Formwork shall not be re-used after it has suffered damage which is sufficient to impair the finished surfaces of the concrete.

Where circumstances prevent easy within the form for cleaning and inspection, temporary opening for this purpose shall be provided through the formwork.

Shear keys shall be provided in all construction joints of the size and shape indicated on the Drawings.

Where precast concrete elements are specified for use as permanent formwork, or proposed by the Contractor and agreed by the Engineer, they shall comply with the requirements of the specification. Such element shall be set true to line and level within the tolerances prescribed for the appropriate class of finish in Clause 506 and fixed so that they cannot move when concrete is placed against them.

5.3 PREPARATION OF FORMWORK

Before any reinforcement is placed into position within formwork, the latter shall be thoroughly cleaned and dressed with a release agent. The agent shall be either suitable oil incorporating a wetting agent; an emulsion of water suspended in oil low viscosity oil containing chemical agents. The Contractor shall not use an emulsion of oil suspended in water nor release any agent which causes staining or discoloration of the concrete, air holes on the concrete surface, or retards the set of the concrete.

In order to avoid colour difference on adjacent concrete surfaces, only one type of release agent shall be used in any one section of the works.

In cases where it necessary to fix reinforcement before placing formwork, all surface preparation of formwork shall be carried out before it is placed into position. The Contractor shall not allow reinforcement or prestressing tendons to be contaminated with formwork release agent.

Before placing concrete all dirt, construction debris and other foreign matter shall be removed completely from within the placing area.

Before concrete placing commences, all wedges and other adjusting devices shall be secured against movement during concrete placing and the contractor shall maintain a watch on the formwork during placing to ensure that no movement occurs.

5.4. REMOVAL OF FORMWORK

Formwork shall be carefully removed without shock or disturbance to the concrete. No formwork shall be removed until the concrete has gained sufficient strength to withstand safely any stresses to which it may thereby be subjected.

The minimum periods which shall elapse between completing of placing concrete and removal of forms are given in table 5.1 and apply to ambient temperatures higher than 10 degrees centigrade. At lower temperatures or if cement other than Ordinary Portland are involved, the Engineer may instruct longer periods.

Alternatively, formwork may be removed when the concrete has attained the strength set out in Table 5.1 provided that the attained strength is determined by making test cubes and curing the under the same conditions as the concrete to which they refer.

Compliance with these requirements shall not relieve the contractor of his obligation to delay removal of formwork until the removal can be completed without damage to the concrete.

TABLE 5.1 – MINIMUM PERIODS FOR FORMWORK REMOVAL

Position of formwork	**Min. Period for temperature over 10 degrees Centigrade**	**Strength to be Attained**
Vertical or near vertical faces of mass concrete	24 hours	0.2 C
Vertical or near vertical faces of reinforced walls, beams and columns	48 days	0.3 C
Underside or arches beams and slabs (formwork only)	4 days	0.5 C
Support to under of arches, beams and slabs	14 days	C
Arches lining in tunnels and underground works	24 hours	4 N / mm^2

Note:

C is the nominal strength for the class of concrete used.

If the Contractor wishes to strip formwork from the underside of arches beams and slabs before the expiry of the period for supports set out above, it shall be designed so that it can be removed without disturbing the supports. The Contractor shall not remove support temporarily for the purpose of stripping formwork and subsequently replace them.

As soon as the formwork has been removed, bolt holes in concrete faces other than construction joints which are not required for subsequent operations shall be completely filled with mortar sufficiently dry to prevent any slumping at the face. The mortar shall be mixed in the same proportions as the fine aggregate and cement in the surrounding concrete and with the same materials and shall be finished flush with the face of the concrete**.**

5.5 SURFACE FINISHES ON FORMED SURFACES

Classes of finish

The surface finish to be achieved on formed concrete surfaces shall be as shown on the Drawings and defined hereunder:-

a) Class F1 finish

This finish is for surfaces against which backfill or further concrete will be placed. Formwork may be sawn boards, sheet metal or any other

suitable material which will prevent the loss of fine material from the concrete being placed.

b) Class F2 finish

This finish is for surfaces which are permanently exposed to view but where the highest standard finish is not required. Forms to provide a Class F2 finish shall be faced with wrought thicknesses tongued and groove boards with square edges arranged in a uniform pattern and close jointed or with boards or sheets shall be such that there shall be no visible deflection under the pressure exerted by the concrete placed against them. Joints between boards or panels shall be horizontal and vertical unless otherwise directed. This finish shall be such as to require no general filling of surface pitting, but fins, surface discoloration and other minor defects shall be remedied by methods agreed by the Engineer.

c) Class F3 finish

This finish is for surfaces which will be in contact with water flowing at high velocity, and for surfaces prominently exposed to view good appearance is for special importance. To achieve this finish, which shall be free of board marks, the formwork shall be faced with plywood complying with BSS6566 or equivalent material in large sheets. The sheets shall be arranged in an approved pattern. Wherever possible, joints between sheets shall be arranged to coincide with architectural features or changes in direction of the surface.

All joints between panels shall be vertical and horizontal unless otherwise directed. Suitable joints shall be provided between sheets to maintain accurate alignment in the plane of the sheets. Unfaced wrought boarding or standard steel panel will not be permitted for Class F3 finish. The Contractor shall ensure that the surface is protected from rust marks, spillages and stains of all kinds.

d) Curved surfaces

For curved surfaces where F2 or F3 finishes are called for, the formwork face shall be built up of splices cut to make a tight surface which shall be dressed to produce the required finish.

Alternatively single curvature surfaces may be faced with plaster or plywood linings attached to the backing with the adhesive or with escutcheon pins driven flush. Linings shall not bulge, wrinkle or otherwise deform when the subject to temperature and moisture changes**.**

5.6 TOLERANCES.

All parts of formed concrete surfaces shall be in the positions shown on the Drawings within the tolerances set out in Table 5.2.

In cases where the Drawings call for tolerances other than those given in Table 5.2 the Drawings shall rule.

Where precast units have been set to a specified tolerance, further adjustments shall be made as necessary to produce a satisfactory straight or curved line. When the Engineer has approved the alignment, the Contractor shall fix the units so that there is no possibility of further movement.

TABLE 5.2: TOLERANCES

Class of Finish	**Tolerance in mm (See Note below for explanations)**		
	A	**B**	**C**
F1	**10**	**10**	**+25 or -10**
F2	**5**	**10**	**+or- 15**
F3	**2**	**5**	**+or-10**

Note: The tolerances A, B and C given in the Table are defined as follows:

A Is an abrupt irregularity in the surface due to misaligned formwork or defects in the face of the formwork

B Is a gradual deviation from a plane surface as indicated by a straight edge 3 m long. In the case of curved surfaces the straight edge shall be replaced by a correctly shaped template.

C Is the amount by which the whole or part of a concrete face is displaced from the correct position shown on the Drawings.

6.0 Masonry

6.1 GENERAL

All masonry work shall be constructed from building stone as specified in Clause 7.19 or concrete blocks, as specified in Clause 7.48.

For culvert headwalls and other small works, the stone shall, unless otherwise specified, be rough dressed. For walls, facing and other exposed works the stone shall unless otherwise specified, be medium chisel-dressed.

6.2 WORKMANSHIP

The Contractor shall provide and use proper setting out rods for all work.

Stones shall be all soaked before use and the tops of walls shall be kept wet as the work proceeds. The stones shall be properly bonded so that no vertical joint in a course is within 115mm of a joint in the previous course. Alternate courses of walling at angles and intersections shall be carried through the full thickness of the adjoining walls. All perpends reveals and other angles of the walling shall be built strictly true and square.

The stones shall be bedded, jointed and pointed in mortar 1 to 3 in accordance with Clause 7.23 with beds and joints 9mm thick flushed up and grouted solid as the work proceeds.

All masonry work shall be cured in accordance with the relevant requirements of Clause 4.7.

6.3 CAST STONEWORK

Cast stone shall be as specified in Clause 7.29. Facing stones shall be brought up in courses to a height not exceeding 1 meter at a time, the concrete backing being brought up and well incorporated into the and round the backs of the stones and the projecting metal ties to ensure a complete bond. The stones shall be bonded and jointed as shown on the Drawings.

All materials, moulds, mixing, casting and surface treatment, setting, jointing and pointing, and all centering, scaffolding and labour required to complete the cast stonework specified or as shown on the Drawings, shall be included in the rates for such work,

7.0 Materials

7.1 GENERAL

The approval in writing or otherwise by the Engineer of any materials shall not in any way whatsoever relieve the Contractor from any liability or obligation under the contract and no claim by the Contractor on account of the failure, insufficient or unsuitability of any such materials will be entertained.

a) All items shall be suitable for water works purposes and for use with cold water installation and operation being in a tropical climate.

b) All item hereinafter specified shall be to such other Standard or Specification which in the opinion of the Engineer provides for a quality of material and workmanship not inferior to the Standard quoted. The Standard or Specification must be submitted to the Engineer for approval before commencement of work.

c) All ferrous pipes and fittings shall be coated with a bituminous protective paint suitable for use in and transport through a tropical climate.

d) The Contractor shall supply to the Employer a certificate stating that each item supplied has been subjected to the tests hereinafter laid down and conforms in all respects to the said Specification.

e) The Contractor shall provide adequate protection to all piping. Flanged items and valves so as to guard effectively against damage in transit and storage and ingress of foreign matter inside the valves

f) All pipe work and fittings shall be subjected to a work hydrated test pressure, which shall be not less than twice the maximum operating pressure.

g) The Contractor should exercise diligence to provide the best material

h) Where applicable the manufacture's Specification should accompany all offers. The name of the manufacturer must in every case be stated.

i) Where necessary the Contractor shall provide rubber gaskets to comply with BS 4865 and all other bolts, nuts etc. to undertake jointing at fittings etc.

j) Any article required under this Contract. Which are found to be faulty due to a crack, flaw or any other reason or is not in accordance with the Specification stipulated will not be accepted nor will the Employer be liable for any charges in respect of such an article. Where any such

rejected article can, in the opinion of the Engineer, be rendered usable, the Contractor may deal with it accordingly and include it in the Contract at a price to be mutually agreed. Straight pipes which have been cut will be accepted provided the length is not less than 4 meters or two thirds of the standard length whichever is the lesser and will be priced pro – rata.

k) Wherever possible, sample of pipes and fittings shall be submitting for approval of the Engineer prior to the contractor obtaining the total requirements.

7.2 GALVANISED PIPES AND SPECIALS

All Galvanised pipes shall conform to BS 1387 and BS 729 for medium piping. The pipes shall be screwed and 128ulfils128 or flanged.

All specials shall be of such dimensions as will mate with the piping supplied. Screw down stop valves shall conform to BS 1010. Barrel nipples shall conform to BS 21 and all other special shall conform to BS 143

All pipes supplied shall be certified by the manufacturer to have been tested in accordance with the relevant standard specification.

7.3 STEEL PIPES AND FITTINGS

7.3.1 Standard of Manufacture

Steel pipes will be manufactured to AWWA C200. Pipes from DN150mm and above will be manufactured with a spiral weld seam or with a spiral seam or longitudinal weld seam. Automatic submerged-arc fusion welding from both sides shall be used.

7.3.2 Design criteria, steel grade, minimum thicknesses and working pressures

7.3.2.1 Design Criteria

Steel grades and wall thicknesses shall meet the following criteria set out in AWWA M11 (Design manual for steel water pipe):

Internal Working Pressure of 16bars, utilization factor: 50% of min. yield stress

3% max. deflection under Trench and Vehicle Loads for 1-3 m soil cover

3% max. deflection under Trench and Vacuum Loads for 1-3m soil cover

Resistance to Buckling (Factor of Safety 2.5) under above Loads

Pipe Stiffness of 2000N/m2 for Handling (CIRIA 78 Report)

The supplier shall provide calculations to this effect.

7.3.2.2 Steels used shall be ASTM A570 Grade 33 (228 Mpa yield stress) or equivalent/superior minimum yield stress. The working pressures and test pressures for the minimum wall thickness shall be as follows:

Outside Diameter (mm)	Min. Wall Thickness (mm)	Max. Working Pressure (bars)	Works Test Pressure (bars)
88.9	2.6	67	100
114.3	2.6	52	78
168.3	2.9	39	59
219.1	2.9	30	45
273.0	3.2	27	40
323.9	3.6	25	38
355.6	4.0	26	38
406.4	4.0	22	34
457.2	4.5	22	34
508.0	4.5	20	30
610.0	5.0	19	28
711.0	5.0	16	24
812.8	6.3	18	27
914.4	7.1	18	27
1016.0	8.0	18	27

Outside Diameter (mm)	Min. Wall Thickness (mm)	Max. Working Pressure (bars)	Works Test Pressure (bars)
1219.2	10.0	19	28
1422.4	12.5	20	30
1625.6	14.2	20	30
1829.0	14.2	18	27
2032.0	16.0	18	27

7.3.3 Pipe Ends

Pipes shall be joined by either bolted sleeve couplings to AWWA C219 or be manufactured with integrally formed push fit socket and spigot joints to AWWA C200 4.13.6.

Pipes to be joined with bolted sleeve type couplings shall be delivered with plain ends square to the axis with the external spiral weld bead ground back 203mm.

Pipe with socket and spigot push fit joints shall be have the socket hot or cold expanded to incorporate an internal groove for fitting of the rubber gasket either is the socket or the spigot. The rubber gasket shall conform to BS2494

Type W. The external weld on the spigot end shall be ground back 203mm from the pipe ends.

7.3.4 **Lengths, Dimensional Tolerances and Visual Inspection**.

7.3.4.1 Pipes shall be delivered with 12 m length from 323.9 mm and above and 6m lengths for below 323.9mm. Tolerance on length will be +/- 51mm (AWWA C200 4.12.4)

7.3.4.2 Tolerance on diameters over a distance L from pipe ends shall be as follows:

Tolerances (mm)	L (mm)	Pipe Outside Diameter (mm)
+1.6/-0.8	100	88.9 – 323.9
+1.6/-1.6	150	355.6 – 1219
+1.6/-3.0	150	1422
+3.0/-3.0	150	1626 – 1829

7.3.4.3 Circumferential Tolerances of Pipe Body shall not exceed +/-1.00% of the pipe outside circumference but not exceeding a maximum of 19mm (AWWA C200 4.12.2)

7.3.4.4 Wall thickness tolerances shall not exceed +/-7.5% of the specified wall thickness

7.3.4.5 Maximum deviation from straightness shall not exceed 3.2mm over a length of 3000mm (AWWA C200 4.12.3).

7.3.4.6 Weld bead height shall not exceed 3.2mm

7.3.4.7 Defects in the parent metal of the pipe such as dents, scabs, tears, laps, slivers not greater than 12.5 percent of wall thickness shall be removed by grinding and smoothly dressed to match the pipe contour provided the minimum wall thickness tolerance is not exceeded. Defects greater than 12.5 percent of wall thickness will not be accepted. Cracks, sweats and leaks in welds shall not be acceptable.

7.3.4.8 Radial Offset of weld seams shall be 1.6mm or 0.1875 wall thickness whichever larger for thicknesses 9.5mm or less and 3.2mm or 0.1875 wall thickness for thicknesses above 9.5mm (AWWA C200 Sec 4.10.1).

7.3.5 Testing

7.3.5.1 Hydrostatic Testing

All pipes shall be hydrostatically tested. Works Test Pressures shall be carried to induce a hoop stress of 75% of the minimum yield stress of the steel

The results of all hydrostatic tests shall be recorded on a pressure recording chart. All test pressures must be held for a minimum of 10 seconds.

7.3.5.2 Destructive Testing

One set of production weld tests consisting of reduce section tensile tests, bend tests and etching tests shall be carried out on each batch of pipes in accordance with AWWA C200 Section 4.11.5. One batch is defined as 915 meters of pipes having the same diameter, thickness and steel grade

7.3.6 Chemical Composition

The steel manufacturer shall furnish a ladle analysis of each heat of steel supplied and the analysis shall conform to the requirements of ASTM A 570

7.3.7 Pipe Repairs

Pipes with defects exceeding the 12.5 percent limitation of Clause 1.4.7 shall be disposed of in following way:

7.3.7.1 Defect removed and cavity cleaned.

7.3.7.2 Defect repaired by automatic or manual welding according qualified under 4.11.2.1 or 4.11.3.1 of AWWA C200

7.3.7.3 Hydrostatic testing of the repaired pipe

7.3.7.4 Cutting off of the section containing the defect provided length limits are met.

All weld repairs shall be carried out in accordance with AWWA C200 4.11.8.

7.3.8 Pipe Couplings

7.3.8.1 Plain ends of pipes and fittings will be joined using bolted, sleeve-type couplings and manufactured in accordance with AWWA C219 (Standard for Bolted, Sleeve Type Couplings) and rated at PN 25. Deflections will be as per Table 3 of AWWA C219.

7.3.8.2 End rings and canter sleeves will be manufactured from specially shaped hot rolled steel tee sections and hot rolled steel coil respectively. After rolling into circular sections, ends will undergo automatic flash welding and welds will be tested by internal radial expansion.

7.3.8.3 All couplings will be coated internally and externally in fusion bonded epoxy to AWWA C213 to a thickness of 300-400 microns.

7.3.8.4 All coatings will be holiday tested and checked for thickness.

7.3.8.5 Rubber gaskets will be to BS2494 Type W (Nitrile) and suitable for portable water.

7.3.8.6 Bolts, nuts and washers will be hot dipped galvanised to BS729 with minimum coating weight of 305 gms/m^2.

7.3.9 **Fittings, flanges and flange gaskets.**

7.3.9.1 All fittings shall be manufactured from pipes that have been previously successfully tested. All new welds made during the fabrication of the fittings shall be subjected to non-destructive testing using wither radiological, ultrasonic or dye penetrants or a combination of these depending on the geometry of the weld.

7.3.9.2 Fittings will have dimensions in accordance with BS534 or AWWA C208 depending on the client's preference. If required fittings can be manufactured with dimensions in accordance with Ductile Iron specifications BS4772 or ISO2531. If required fittings will be reinforced in accordance with AWWA M11 and AWWA C208.

7.3.9.3 Calculation of wall thickness of bends will be carried out in accordance with AWWA C208. Reinforcement of Tees and washout tees shall be carried out with AWWA M11 and AWWA C208 respectively.

7.3.9.4 Flanges shall be manufactured in accordance with the relevant table of BS4504 for steel flanges.

7.3.9.5 Flanges gaskets will be manufactured with dimensions to BS4865 Part 1 and shall be of the inside bolt circle diameter type with material to BS2494 Type W for potable water.

7.3.9.6 Flange Bolts, nuts and washers shall manufacture to BS4190 and BS4320 respectively and hot dipped galvanised to BS729 with a minimum coating weight of 305 gms/m2.

7.3.10.1 External Coatings of Pipes and Fittings

7.3.10.1 Prior to external and internal lining, all Pipes and Fittings will be grit blasted to ISO8501-1 SA2.5 quality with a surface profile of 38-102 microns. All grit blasting machines will be fitted with air-wash systems to remove dust and fines from the surfaces during grit blasting. All surfaces will be cleaned of dust by compressed air prior to coating or lining.

7.3.10.2 Pipes and fittings will be coated externally in fusion bonded epoxy powder to AWWA C213 to a thickness of 300-400 microns. Pipes will be electrostatically sprayed and fittings will be coated using a combination of electrostatic sprays and fluidized beds.

7.3.10.3 Prior to start up of coating, the following tests will be done on epoxy powder or on steel plate specimens coated with epoxy powder by the epoxy manufacturer or the coating contractor in accordance with AWWA C213 Clause 5.3.2.

7.3.10.3.1 Specific gravity
7.3.10.3.2 Sieve analysis
7.2.10.3.3 Gel Time
7.3.10.3.4 Appearance
7.3.10.3.5 Impact
7.3.10.3.6 Bendability
7.3.10.3.7 Shear Adhesion
7.3.10.3.8 Penetration
7.3.10.3.9 Abrasion Resistance
7.3.10.3.10 Hot water resistance

7.3.10.4 During production external epoxy coatings will be tested by the pipe coating contractor according to AWWA C213 Clause 5.3.3 as follows

7.3.10.4.1 Electrical continuity, every pipe and fitting
7.3.10.4.2 Thickness, every pipe and fitting
7.3.10.4.3 Adhesion, every 10 pipes and fittings

36.I.1 **Cement Mortar Linings for Pipes and Fittings**

7.3.11.1 All Pipes and fittings will be lined internally in cement mortar to AWWA C205.

7.3.11.2 Prior to cement mortar lining, all surfaces will cleaned to remove any loose or other foreign matter that could interfere with the adherence of the cement mortar.

(36) Portland cement shall conform to ASTM C150 Type 1 or 2

(ii) Sand shall consist of inert materials having hard, strong, durable, uncoated grains conforming to ASTM C33. Sand shall be graded according to the following envelope and a sieve analysis shall be done for each day of sifting and recorded:

Size	% passing
1.18mm	100
600microns	60-90
425microns	30-98
300 microns	10-95
212microns	5-75
150microns	2-30
75microns	0-2

(iii) Water used shall be clean, odourless and free from quantities of organic matter, alkali, salt or other impurities that might reduce the strength, durability or other desirable qualities of the mortar.

(iv) Pipes will be lined using a retracting rotating spraying head that will deposit a circumferential layer of cement mortar on the internal surfaces of the pipe before the pipe is rotated at high speed for a short period of time to smoothen the lining. The pipe surface may be subjected to vibration to aid smoothening of the lining.

(v) The cement to sand ratio will be 1:1 by weight and shall be checked each day of lining application. The water to cement ratio shall not exceed 0.46:1 and shall also be checked each day of lining application.

(vi) Lining thicknesses shall be in accordance with AWWA C205 Table 1 as follows:

Pipe DN	Nom Thickness	Tolerance
80-250	6.0	-1.6/+3.2
280-580	8.0	-1.6/+3.2
600-900	10.0	-1.6/+3.2
>900	13	-1.6/+3.2

Lining Thicknesses shall be measured on each pipe using a graduated steel point for wet linings or with an electromagnetic or magnetic measuring instrument for dry linings. The average of thickness readings taken from 4 points spaced at 90 degrees along any cross sectional plane at least 50mm from the pipe ends shall be calculated and this average shall fall within the tolerances above.

(vii) Compression Tests on Mortar Lining Test Cylinders shall be done weekly in accordance with AWWA C205 Section 4.8. Compressive strength shall reach 18Mpa in 7 days and 31Mpa in 28 days.

(viii) Curing shall be done in accordance with Section 4.7 of AWWA C205. Curing shall take place under an ambient temperature of more than 5 deg C and pipes shall be kept shaded for the first 24 hours after lining to prevent cracking. Pipe ends shall be sealed with plastic end caps not later than 30 minutes after lining and the internals kept wet during the curing period. Linings have to be cured for a minimum of 4 days before shipment.

(ix) Cracks in Linings shall not exceed 1.6mm. Cracks wider than 1.6mm shall be repaired unless it can be demonstrated to the satisfaction of the purchaser that cracks will heal autogenously under constant soaking of water.

(x) Linings shall not contain defects such as sand pockets, voids, oversanded areas, blisters and cracks as a result of impacts.

Specials whose shape precludes lining by spinning shall be lined either using mechanical placement, pneumatic placement or hand application and finished to produce a smooth, dense surface. Specials larger than 610mm shall be reinforced with wire-fabric or ribbon-mesh in accordance with Section 4.5 of AWWA C205.

36.I UNPLASTICISED UPVC PIPES

Unplasticised PVC piping shall be in accordance with BS 3505.

The maximum sustained working pressures to which the pipes and fittings will be subjected is based on water at a temperature of 20 degrees centigrade.

The Contractor shall submit full details of the pipes he intends to supply.

The pipes up to and including 40mm diameter can be of a solvent weld type. The pipe shall be supplied with interchangeable sockets preformed at the factory and of such internal diameter that it takes the plain end of the pipe with the same nominal diameter.

The joint shall sustain the end thrust to which the pipe shall be subjected. The Contractor shall supply sufficient quantity of the cleaner and adhesive, which shall be required to make the joints with the pipes.

The pipes of 50mm diameter and over shall consist of a grooved socket at one end of the pipe. The socket shall be designed to give a clearance fit on the outside diameter of the parent pipe. The sealing medium, which shall seat in the groove, shall be a rubber ring.

If the formation of the socket and groove results in the thinning of the original wall thickness of the pipe, it shall be compensated for by shrinking on the socket area a reinforcing sleeve of the same material as the pipe.

The socket and groove shall incorporate no sharp angles where the stress points are created.

The joints shall take 10% deformation of the spigot at the point where it enters the socket without leakage from the pipe when subjected to the test pressure specified for the pipe. Thermal expansion of the pipe shall be capable of linear deflection upto 3 degrees.

The sealing ring shall be of first grade natural rubber and the physical properties of the mix shall meet the requirements of BS 2494.

The Contractor shall supply sufficient quantity of any lubricant or other material, which shall be needed to make the joint, which shall be assembled by hand.

The Contractor shall submit full details of the type of joint offered and a full description of the method of jointing.

The fitting shall have the same type of joint as for the pipes to be used. The Contractor shall submit full details of the materials dimensions and test pressures of the fittings offered.

Precautions shall be taken to avoid damage to the pipes and fittings.

In handling and storing the pipes and fittings, every care shall be taken to avoid distortion, flattening, scoring or other damage. The pipes and fitting shall not be allowed t drop or strike objects. Pipes lifting and lowering shall be carried out be approved equipment only.

Special care shall be taken in transit, handling and storage to avoid any

damage to the ends.

Pipes and fittings shall be marked at not greater than one metre intervals showing their class and diameter.

Pipes and fittings shall be marked at not greater than one metre intervals showing their class and diameter.

36.I GATE VALVES

Gate valves shall comply with requirement of BS 5163

The gate valves shall be suitable for use in pipelines and for operating pressure equipment to a head of 100 metres of water.

The gate valves shall double flanged. The dimensions and drilling of flanges shall be in accordance with BS 4504, flanges shall be machined flat. Flanges shall be NP 16 complying with BS 4504.

Spindles of the gate valves shall be provided with iron cast confirming to the requirements as specified under 'valve caps' in BS 5163 or handwheels if so specified.

The spindles of the gates valves shall be of non-rising type and screwed so as to close the valves when rotated in a clockwise direction. The direction of closing shall be clearly case on the valve cap or handwheel.

The gate valves shall be subject to 'closed end test' in accordance with the procedure head by manual operation.

7.6 FIRE HYDRANT

Fire hydrants shall be in accordance with BSS750. They shall be for installation underground and shall be in accordance with BSS750.

The spindle shall be provided with a cast iron cap confirming to dimension under spindle cap in BSS 5163.

The spindle of the fire hydrant shall be on the non-arising type and screwed so as to close the hydrant when rotated in a cloakwise direction viewed from above. The direction of closing shall be clearly cast on the valve cap.

The flanged outlet of the outlet bend shall have a gayonet joint cutlet for a 63mm standpipe. The outlet of the hydrant shall be of the hooked type with hocks 112mm apart.

The outlet shall have a gun metal standpipe seating and be covered by a loose case iron cap, which shall be attached to the hydrant by means of a chain.

Both flanges shall be 63mm drilled to requirements of BSS 2035.

The outlets bends shall be subject to a hydrostatic test in accordance with procedure set out in BSS 750 and shall be water tight against a rest pressure of 1.95 pa. head of water.

7.7 AIR VALVE

The contractor shall provide air valves to suit the site on which the main is located and the maximum water pressure specified. The body and cover of air valves shall comply with BSS 1452.

The body, cover, splash cowl and joint support ring of the air valve shall be of mechanite cast iron with flanges drilled to British Standards or other approved standards.

The internal screwed isolating valve shall have the valve and seating of gunmetal, operating screws of bronze, nuts of gunmetal, and glands and cap of machinate.

The small orifice valve shall have a rubber-covered ball and the air release nipple shall be of special alloy screwed into a bronze plug. The ball guiders may be lined with gunmetal.

The large orifice valve shall have a vulcanite covered ball closing on a moulded dexine seat ring. The bush may be in gunmetal.

The double orifice type of air valve shall comprise a small and large orifice unit with common connection to the main and screw down isolating valve to permit inspect of valve. The spindle of isolating valve shall be screwed so as to close the valve when rotated in a clockwise direction and be provided with a spindle cap to dimension as specified in a BSS 5163.

Design of the air valves shall be such that the balls do not blow shut under any working or test conditions when large volumes of air are being released.

7.8 WATER METERS

All water meters upto 50mm size be of the rotary piston positive action with all moving parts composed of non-corrosive material.

75mm diameter and over, meters shall be of the inferential helix full flow type.

The body of the 12mm to 25mm size of meter shall be of brass, the larger sizes in cast iron. The external surface of the brass bodies shall be coated with baked enamel and the cast iron bodies shall be painted to suit.

The working chamber of rotary type meter shall be made of bronze or similar on corrosive material and the piston shall be in ebonite or similar material.

The working parts of the helix type meter shall facilitate removal for repair or replacement without removing the meter body from the pipeline. The working parts shall be interchangeable and the working chamber so designed as to be full of water under all conditions of flow.

The dial of the meter shall be of the direct reading type registered in cubic meters with suitable lid locking device.

The capacities of the piston type meter shall not be less than the following amounts per month:-

12mm meter	250cubic metres
19mm meter	350 cubic metres
25mm meter	500cubic metres
50mm	700 cubic metres

The helix type meter shall be capable of continuous working with a head loss not exceeding 300mm at the following rates of flow:-

75mm meter	-	2.5c.u/hr
100mm meter	-	45cu.m/hr
150mm meter	-	90cu.m/hr

All meters shall be accurate to within +0 1/3 over the range of the meter upwards from the minimum flows given for each size:

12mm	-	23litres/hour
19mm	-	29litres/hours
25mm	-	32litres/hour
38mm	-	110litres/hour
50mm	-	190litres/hours
75mm	-	2.5cu.m/hour
100mm	-	2.8cu.m/hour
150mm	-	4.5cu.m/hour

Meters above 150mm diameter should conform to specifications as set out by the Engineer. The 12mm and 18mm sizes shall be guaranteed to register commencing at 5 litres/hour. The meters shall be tested to a head of not less than 184 meters of water.

7.9 STOP VALVES

All stop valves shall be in accordance with BS 1010. Sample of valves be submitted for test and approval to the Engineer.

7.10 CHECK VALVES (DIRECTIONAL VALVES)

Check valves of 65mm diameter and under shall comply with the requirements of BSS 6282 with cast iron body and cover, gunmetal doors with leather facing discs and fernal screwed ends in accordance with BSS 2591

Check valves of 75mm diameter and over shall comply with the requirements of BSS 6282 with cast iron body and cover, gunmetal doors with bronze facing rings and flanges connections in accordance with BSS, NP 16.

7.11 PENSTOCKS

The penstocks shall be made of cast iron and shall be in accordance with BSS 1452. Seating faces shall be of gunmetal or bronze.

The spindles shall be threaded as necessary and non-rising unless otherwise specified. The spindles shall be of aluminium bronze or manganese bronze and extension spindles may be of mild steel.

Handwheels shall be of cast iron and word “OPEN” and “SHUT” marked on the upper side with appropriate direction arrows.

7.12 FLANGED JOINTS

All flange on fittings and pipework where flanged connection are required must comply with the requirements of BS 4504 and NP 16, unless otherwise specified.

Inspection gaskets for flanged joints shall be rubber reinforced with cotton 3m thick and shall be in accordance with BS 4865. Bolts and nuts for flanges joints shall be of thick mild steel complying with BS 4190.

7.13 FLEXIBLE JOINTS

All flexible coupling (Viking Johnson or other approved type) shall be supplied complete with rubber gaskets, bolts, nuts and washers. All couplings shall be coated with red oxide primer and bituminous composition suitable for us with portable water.

7.14 PRESSED STEEL TANKS

The pressed Steel tanks (or similar approved), towers and associated materials and fittings shall comply with BSS 1564.

Detailed drawings of steel tank should be submitted to the Engineer for approval prior to acceptance.

The pressed steel tank to BSS 1564 Type A (2) or of similar approval shall be supplied completer with:-

a) All stays, clests, bolts, nuts, washers, joining compound and associated materials and fittings.

b) Connection for inlet, outlet, washout and overflow

c) Galvanized access ladders 450mm wide

d) Steel roof cover to fit the tank complete with access manhole and mosquito proof cowl ventilators.

e) Water level indicator.

Jointing material to the tank to be a non-toxic plastic compound, which does not impact taste, colour nor odour to the water.

Connection to the tank shall be wheeled to the outside of the tank plate and drilled and tapped to suit flanges to BS 4504, NP 16 unless otherwise stated.

The cover to the tank shall be of mild steel cambered for external use and adequately supported by rolled steel or pressed steel bearers or trusses.

The tank tower shall be supplied complete with:-

a) Anchor bolts

b) Bolts, nuts, washers and associated materials and fittings

c) Access ladder 450mm wide extending from ground level to the top of the tank. Safety rings shall be at 1.2m centre.

The supports to the tank shall consist of steel joints designed to carry imposed load under each transverse joint and the two ends of the tank.

The columns of the tank shall consist of rolled steel joint sections or similar. For such columns shall be provided with adequate bracing.

Internal surfaces of the tank and tower shall be painted with approved non-toxic primer and not toxic bituminous paint.

External surfaces of the tank and tower shall be painted with approved primer and approved bituminous aluminium paint.

7.15 PAINTS

All priming, undercoating and finishing paints shall be in accordance with BSS 5212 as appropriate.

The painting of all building works shall comprise a special paint recommended for external work while all other paints, plastic emulsion coating etc. are to be of an approved manufacturer. All paints, diatempers etc. shall be delivered on site intact in the original drums or tins, and shall be mixed and applied in accordance with the manufacturer's printed directions. The only addition which will be allowed to be made will be liquid thinners, driers etc. Supplied by the makers for the purpose.

All surfaces must be thoroughly cleaned down prior to painting and decorating work and no external painting shall be carried out in rainy weather. All paint must be thoroughly well worked on and excess of paint in any coat must be avoided.

All colors will be selected by the Engineer by the Engineer from the standard Range of colours.

7.16 PRECAST CONCRETE UNITS

Precast concrete covers to be precast units for use in the works, whether instructed under the Contract or proposed by the Contractor.

a) Formwork For Precast Units

Moulds shall be so constructed that they do not suffer distortion or dimensional changes during use and are tight against loss of cement grout of fines from the concrete.

Moulds shall be set up on firm foundations so that no settlement occurs under the weight of the fresh concrete.

Moulds shall be constructed so that units may be removed from them without sustaining any damage.

Release agents used for demoulding shall not stain the concrete or affect its properties.

b) Reinforcement For Precast Units

Reinforcement in precast units shall comply with the requirement of Clauses 7.30 and 4.19-4.20. When preformed cages are used the cages shall be made up on jigs to ensure dimensional accuracy and shall be carefully supported within the mould in such a way that they cannot move when concrete is placed.

Reinforcement complying with BSS4449 may be tack welded where bars cross to provide rigidity in the cage but reinforcement complying

with BSS4461 shall not be welded.

Cover to main reinforcement shall be as shown on the drawings, or if not shown shall be not less than 25mm or the diameter of the bar, whichever is the greater. Cover on distribution steel shall not be less than 15mm or the diameter of the bar whichever is the greater.

Bars shall be spend so that the minimum clear distance between them is the maximum nominal aggregate size plus five 146ulfils146146ze but in any cast not less that the diameter of the bars.

Bars may be placed in pairs provided that there are no laps in the paired lengths.

c) Casting of Units

Concrete for precast units shall comply with Clauses 7.18 and 4.1-4.10 using the class of concrete specified on the drawings.

If lightweight aggregates are specified, they shall comply with BSS3797.

The area in which units are cast shall be adequately protected from the weather so that the process is not affected by rain, sun or drying winds.

d) Curing Precast Units

Requirements for curing shall be generally as set out in Clause 4.7.

The Contractor shall ensure that units do not suffer any loss of moisture or sudden changes of temperature for at least four days after casting. If a water spray is used for curing, the water shall be at a temperature within 5 degrees centigrade of the temperature of the unit being cured.

If Contractor proposed curing at elevated temperatures, the method shall be subject to the agreement of the Engineer and shall include means whereby units are heated and subsequently cooled evenly without sudden changes of temperature.

e) Dimensional Tolerances of Precast Units

Units shall be accurately formed to the dimensions shown on the drawings unless closer tolerances are called for by the Engineer.

f) Surface Finish of Precast Units

The formed faces of precast units shall be finished to Class F3 as set out in Clause 5.5 (c) unless another class of finish is specified on the

drawings.

Free faces shall be finished to class UF2 unless another class of finish is specified on the drawings.

In cases where a special finish is required a trial panel shall be constructed by the Contractor which after approval by the Engineer shall be kept available for inspection at the place of casting and production units shall thereafter match the approved pattern.

Those parts of the unit which are to be joined to other units or to in situ concrete shall be brushed with a stiff brush before the concrete has fully hardened. Alternatively, if the concrete has been allowed to harden the surface shall be roughened by sand blasting or by the use of a needle gun.

g) Handling and Storage of Precast Units

Precast units shall be handled in a manner which will not cause damage of any kind and shall be stored on a hard impermeable base.

Prestressed units and large precast normally reinforced units shall be handled and stored so that no stresses shall be induced in excess of those which they will incur in their final positions in the works unless they have been designed to resist such stresses.

Units shall be provided with adequate lifting holes or loops, placed in the locations shown on the drawings or agreed by the Engineer and they shall be lifted only by such holes or loops. Where it is not possible to provide holes or loops, suitable sling positions shall be indicated in paint on the units.

Units shall be marked indelibly with the reference number and date of casting and shall be stacked on suitable packers, which will not damage the concrete or stain the surfaces. Not more than two packers shall be placed under each unit and these shall be located either at the positions of the permanent support points or in positions such that the induced stresses in the unit will be a minimum.

h) Testing Precast Units

Precast units shall be capable of safely sustaining the loads which they have been designed to carry. The Contractor shall subject units selected by the Engineer to load tests simulating the working conditions. Detail of such tests shall be agreed between the Engineer and the Contractor.

In the case of units subject to bending loads the test piece shall be supported at full span and a loading equivalent to 1.25 times the sum o the live and dead loads which were assumed in the design shall be maintained for one hour without the appearance of any signs of distress. The recovery one hour after the removal of load shall be not less than 75 percent of the full load deflection.

If the unit fails to meet the above requirement, further tests shall be carried out on two more units. If either of these fails the whole batch of unit will be rejected.

If the Engineer so requires, a test to destruction shall also be carried out which on units subject to bending shall be as follows: -

The unit shall be supported at full span and a load applied in increments instructed by the Engineer up to 95 per cent of the

designed ultimate load. This load shall be held for 15 minutes without failure of the unit. The deflection at the end of this period shall be not more that 1/40th of the span. The load shall then be further increased until failure occurs.

If the unit fails to sustain the required load for the prescribed period or if the deflection exceed the specified amount the Engineer may order two further tests, and if either of these fail, the batch of units which they represent may be rejected.

7.17 SUBMISSION OF SAMPELS

As soon as possible after the contract has been awarded, the Contractor shall submit to the Engineer a list of the suppliers from whom the proposes to purchase the materials necessary for the execution of the Works. Each supplier must be willing to admit the Engineer or his representatives, to his premises during ordinary working hours for the purpose of obtaining samples of the materials in question. Alternatively, if desired by the Engineer, the Contractor shall deliver the samples of the materials to the Engineer's office without charge.

The information regarding the names of the suppliers may be submitted at different times, as may be convenient, but no source of supply shall be changed without the Engineer's prior approved once a supplier, source or material has been approved.

Samples of materials approved will be retained at the Engineer's office until the completion of the contract. Samples may be tested to destruction.

All materials delivered to site must be at least equal in all respects to approved samples; otherwise they shall be rejected. No special payment will be made for compliance with clauses specifying tests etc. to ensure quality control etc. unless specifically itemized in Bills of Quantities.

7.18 MATERIALS FOR CONCRETE

a) General

The Contractor shall submit to the Engineer full details of all materials, which he proposes to use for making concrete. No concrete shall be placed in the works until the Engineer has approved the materials of which it is composed. Approved materials shall not thereafter be altered or substituted by other materials without the consent of the Engineer

b) Cement

Cement shall comply with the following standards: -

BSS12 for Ordinary Portland cement

BS12 for Rapid Hardening Portland cement plus all special conditions to its use stipulated by the manufacturer.

BSS12 for Sulphate Resisting or High Alumina cement.

Cement shall be free flowing and free of lumps. It shall be supplied in the Manufacturer's sealed unbroken bags or in bulk. Bagged cement shall be transported in vehicles with effective means of ensuring that it is protected from the weather.

Bulk cement shall be transported in vehicles or in containers built and Equipped for the purpose.

Cement in bags shall be stored in a suitable weatherproof structure of which the interior shall be dry and well ventilated at all times. The floor shall be raised above the surrounding ground level and shall be so constructed that no moisture rises through it.

Each delivery of cement in bags shall be stacked together in one place.

The bags shall be closely stacked so as to reduce air circulation but shall not be stacked against an outside wall. If pallets are used, they shall be constructed so that bags are not damaged during handling and stacking. No stack of cement bags shall exceed 3m in height. Different types of cement in bags shall be clearly distinguished by visible markings and shall be stored in separate stacks.

Cement from broken bags shall not be used in the works.

Cement in bags shall be used in order in which it is delivered.

Bulk cement shall be stored in weather-proof silos, which shall bear a clear indication of the type of cement contained in them. Different types of cement shall not be mixed in the same silo.

The Contractor shall provide sufficient storage capacity on site to ensure that his anticipated programme of work is not interrupted due t lack of cement.

Cement which has become hardened or lumpy or fails to comply with the Specifications in any way shall be removed from the site.

All cement for any one structure shall be from the same source.

All cement used in the Works shall be tested by the manufacturer or the Contractor in a laboratory acceptable to the Engineer. The tests to be performed shall be those set out in BSS12 and the Contractor shall supply

two copies of each certificate to the Engineer.

Each set of tests carried out by the manufacturer of Contractor shall relate to not more than one day's output of each cement plant, and shall be made on samples taken from cement which is subsequently delivered to the site. Alternatively, subject to the agreement of the Engineer, the frequency of testing shall be one set of tests for every 200 tones of cement delivered to site from each cement plant.

Cement which is stored on site for longer than one month shall be retested in an a laboratory approved by the Ministry of Public Works Republic of Kenya or at the Kenya Bureau of Standard at the rate of one set of tests as shown in BSS12 for every 200 tonnes, and at monthly intervals thereafter.

Cement which does not comply with the Specification shall not be used in Works and it shall be disposed of by the Contractor.

The Contractor shall keep full records of all data relevant to the manufacture, delivery; testing and use of all cement used in the Works and shall provide the Engineer with two copies thereof.

c) Fine Aggregate

Fine aggregate shall be clean hard and durable and shall be natural sand, crushed gravel sand or crushed rock sand complying with SRN 108. All the material shall pass through a 5mm standard sieve and the grading shall be in accordance with Zone 1, 2 or 3 of BSS882. In order to achieve an acceptable grading, it may be necessary to blend materials from more than one source. Fine aggregate for mortar only shall comply with BSS1200

The fine aggregate shall not contain iron pyrites or iron oxides. It shall not contain mica, shale, coal or other laminar, soft or porous materials or organic matter unless the Contractor can show by comparative tests, on finished concrete as set out in BSS1881, that the presence of such materials does not adversely affect the properties of the concrete.

Other properties shall be as set out below: -

Content passing a 75 micron standard sieve shall not exceed 3 per cent for natural of crushed gravel sand of 15 per cent for crushed rock sand.

Chlorides soluble in a 10 per cent solution by weight of nitric acid shall not exceed 0.05 per cent by weight expressed as chloride ion when tested as set out in BSS812, subject also to the further restriction given in the note on total chloride content in sub-clause 7.18(d).

Sulphate soluble in a 10 per cent solution by weight of hydrochloric acid

shall not exceed 0.4 per cent by weight expressed as SO_3, when tested as set out in BSS1377, subject also to the further restriction given in the note on total sulphate content in sub-clause 7.18(d).

Soundness: after five cycle of the test in AASHTO or an approved equivalent the aggregate shall not show a weight loss of more than 10 per cent.

Organic impurities:

If the test for presence of organic impurities in aggregates described below shows that more than a trace of organic impurities is present, the fine aggregate shall not be used in the Works unless the Contractor can show by tests on finished concrete as set out in BSS1881 that the presence of organic impurities does not adversely affect the properties of the concrete.

Test for presence of organic impurities in aggregates:

This test is designed to indicate the presence of organic impurities in aggregates used for making concrete.

A 350 cc graduated bottle shall be filled to the 120 cc mark with a sample of the aggregate to be tested and a 3% solution if sodium hydroxide in water added until the volume of aggregate and liquid after shaking gives a total volume of 200 cc. The bottle shall be stopped, shaken thoroughly and allowed to stand for 24 hours. If, after 24 hours, the colour of the solution is no darker than a pale brown, the aggregate under test may be deemed satisfactory.

d) Coarse Aggregate

Coarse aggregate shall be clean, hard and durable crushed rock, crushed gravel or natural gravel complying with the requirements of BSS882. The material shall not contain any iron pyrites, iron oxides, flaky or laminated material, hollow shells coal or other soft or porous material, or organic matter unless the Contractor can show be comparative tests on finished concrete as set out in BSS1881 that the presence of such materials does not adversely affect the properties of the concrete. The pieces shall be angular rounded or irregular as defined in BSS12.

Coarse aggregate shall be supplied in the nominal sizes called for in the Contract and shall be graded in accordance with BSS882 for each nominal size.

Other properties shall be as set out below:-

The proportion of clay, slit and other impurities passing a 75 micron standard sieve shall be not more than one per cent by weight.

The content of hollow and flat shells shall not be such as will adversely affect the concrete quality when tested as set out in BSS1881. The total content of aggregate shall not be more than the following:-

40mm nominal size and above 2% of dry weight

20mm nominal size 5% of dry weight

10mm nominal size 15% of dry weight

Chlorides soluble in a 10 per cent solution by weight of nitric acid shall not exceed 0.03 per cent by weight, expressed as chloride ion when tested as set out in BSS812 but subject also to the further restriction under the note on total chloride content hereunder. Sulphate solution in a 10 per cent solution by weight of hydrochloric acid shall not exceed 0.4 per cent by weight expressed as 50g when tested as set out in BSS1377 subject also to the further restriction given in the note on total sulphate content hereunder.

Soundness: After 5 cycles of the test in AASHO T104 or approved equivalent, the aggregate shall not show a weight loss of more than 12 per cent.

When tested in accordance with test C289 of the American Society for Testing of Materials or approved equivalent, the aggregate shall be non-reactive.

Flakiness Index when tested in accordance with BSS812 shall be as set out hereunder:-

For 40mm stone and above, not more than 40

For 20mm stone and below, not more that 35

If the Flakiness Index of the coarse aggregate varies by more that five units from the average value of the aggregate used in the approved trial mix, then a new set of trial mixes shall be carried out if the workability of the mixes has been adversely affected by such variation.

Impact value: Not more than 45 per cent when tested in accordance with BSS812.

Ten per cent fines value: Not less than 50kN when tested in accordance with BSS812.

Shrinkage: When mixed with other ingredients in the approved proportions for concrete and tested as set out in BSS1881, the shrinkage factor shall not exceed 0.05 per cent.

Organic impurities: If the test for presence of organic impurities in aggregate shows that more than a trace of organic impurities is present, the aggregate shall not be used in the Works unless the Contractor can show by tests on finished concrete as set out in BSS1881 that the presence of organic impurities does not adversely affect the properties of the concrete.

Water absorption:

The aggregate shall not have water absorption of more than 2.5 per cent when tested as set out in BSS812.

Aggregate Crushing Value (ACV): not more than 35 per cent.

Los Angeles Abrasion (LAA): Not more than 50 per cent.

NOTE: Total chloride and sulphate content:

The total chloride content, expressed as chloride ion, arising from all ingredients in a mix including cement, water and admixtures shall not exceed the following limits, expressed as a percentage of the weight of cement in the mix:-

- For prestressed, concrete, steam cured concrete or concrete containing sulphate resisting or supersulphated cement: 0.05 per cent.

- For any other reinforced concrete: 0.3 per cent in 95 per cent of all test results provided no result is more than 0.5 per cent.

The total sulphate content expressed as 50g of all the ingredients in a mix including cement, water and admixtures shall not exceed 0.4 per cent by weight of the aggregate or 4.0 per cent of the weight of cement in the mix, whichever is the lesser.

e) Testing Aggregates

(i) Acceptance testing

The Contractor shall deliver to the Engineer samples containing not less than 50 kg of any aggregate which he proposes to use in the Works and shall supply such further samples as the Engineer may require. Each sample shall be clearly 155ulfils155 to shoe its origin and shall be accompanied by all the information called for in BSS812.

Tests to determine compliance of the aggregates with the requirements of sub-clause 7.18(c) and (d) shall be carried out by the Contractor in laboratory acceptable to the Engineer. If the tested materials fall to comply with the specification, further tests shall be made in the presence of the Contractor and the Engineer and acceptance of the material shall be based on such tests.

A material shall be accepted if not less than three consecutive sets of test results show compliance with the Specification.

(ii) Compliance testing

The Contractor shall carry out routine testing of aggregate for compliance with the Specification during the period that concrete is being produced for the Works.

The tests set out below shall be performed on aggregate from each separate source on the basis of one set of tests for each day on which aggregates are delivered to site provided that no set of tests shall represent more than 250 tones of fine aggregate nor more than 500 tons of coarse aggregate, and provided also that the aggregate are of uniform quality, if the aggregate from any source is variable, the frequency of testing shall be increased as instructed by the Engineer.

Grading BSS812

Silt and clay contents BSS812

Moisture content BSS812

Check on organic impurities

In addition to the above routine tests, the Contractor shall carry out the water content of the concrete as required by the Specification.

Moisture c content: As frequently as may be required in order to control the water content of the concrete as required by the Specification.

Chloride content: As frequently as may be required to ensure that the

proportion of chlorides in the aggregate does not exceed the limit stated in the Specification.

The Contractor shall take account of the fact that when the chloride content is variable it may be necessary to test every load in order to prevent excessive amounts of chloride contaminating the concrete. For this purpose the Contractor shall use the rapid field test (the Quantab test). In the event of disagreement regarding the results of the field test, the chloride content of the aggregate shall be determined in the laboratory as described in BSS812 (the volhard test).

(f) Delivery and Storage of Aggregates

Aggregate shall be delivered to site in clean and suitable vehicles. Different types or sizes of aggregate shall not be delivered in one vehicle.

Each type or size of aggregate shall be stored in a separate bin or compartment having a base such that contamination of the aggregate is prevented. Dividing walls between bins shall be substantial and continuous so that no mixing of types or sizes occurs.

The storage of aggregates shall be arranged so that as far as possible rapid drying out in hot weather is prevented in orders to avoid sudden fluctuation in water content. Storage of fine aggregates shall be arranged so that they can drain sufficiently before use in order to prevent fluctuations in water content of the concrete.

(g)Water for concrete and mortar

Seawater or brackish water containing more than 1000 ppm chloride ion or 2000 ppm sulphate ion shall not be used for mixing or curing concrete.

Water shall be clean and free from harmful matter and shall comply with the requirements of BSS3148.

The Contractor shall carry out tests in accordance with BSS3148 to establish compliance with the Specification.

(h) Admixtures

(i) General

The use of the admixtures in concrete may be required under the contract to promote special properties in the finished concrete or may be proposed by the Contractor to assist him in compliance with the Specification.

In all cases the Contractor shall submit to the Engineer full details of the admixture he proposes to add it to the mix. The information provided shall include: -

a) The typical dosage, the method of dosing and the detrimental effects of an excess or deficiency in the dosage.

b) The chemical names of the main active ingredients in the admixture.

c) Whether or not the admixture contains chloride, and if so the chloride ion content expressed as a percentage by weight of admixture.

d) Whether the admixture leads to the entertainment of air when used at manufacturer's recommended dosage and if so, the extent to which it does so.

e) Details of previous uses of the admixture in Kenya.

The chloride ion content of any admixture shall not exceed 2 per cent by weight of the admixture nor 0.03 per cent by weight of the cement in the mix.

Admixture shall not be mixed together without the consent of the Engineer.

Calcium chloride or admixtures containing calcium chloride shall not be used in pre-stressed concrete.

(ii) Workability agents

Workability agents shall comply with BSS5075 and shall not have any adverse effect on the properties of concrete.

7.19 BUILDING STONE

All building stone shall be capable of withstanding when wet a crushing stress of 1.4kg. /sq.mm. The source of stone shall be approved by the Engineer and stone supplied there from shall be free from Magadi (bicarbonate compounds), overburden, mudstone, cracks, sand holes, veins, laminations or other imperfections.

The stone shall be chisel dressed into true rectangular blocks, with each surface even and at right angles to all adjoining surface, to the size specified. For exposed stonework the maximum permissible variation of any of the specified dimensions shall be 6mm provided that cut stone, supplied as rock face stone may be hammer dressed on one face only, or on one face and one end, if in other respects it conforms to this specification. Stones shorter than 375mm will not be accepted.

Unless the Engineer allows otherwise the Contractor shall at his own expense provide and dress four 100mm cubes of stone for testing.

The stone shall be sound when tested in accordance with BSS1438 except

that:-

I) The treatment shall be repeated for 10 cycles only 1 and

II) The second criterion of failure shall be amended to allow for a loss of weight of not more than 20k of its original weight.

7.20 STONE DUST

Stone dust for blinding shall be blackstrap screened to the following grading:-

Passing 10mm sieve	-	100%
Passing No. 4 sieve	-	85% - 100%
Passing No. 100 sieve	-	5% - 25%

7.21 MURRAM

Murram shall be from an approved source quarried so as to exclude vegetable matter, loam, topsoil or clay. The California Bearing Ratio of the murram, as determined for a sample compacted t maximum density (as defined under BSS1377) and allowed to soak in water for four days, shall not be less than 30%. This C.B.R. is a guide to quality only and the compaction in the work will be judged by density.

7.22 WATER FOR CEMENT TREATED MATERIALS

If water for the works is not available from the Employer's supply, the Engineer's approval must be obtained regarding the source of supply and manner of its use. Water to be used with cement or lime shall be free from salt, oil, alkali, organic matter and other deleterious substances. If the water is required to be tested, this shall be done in accordance with BSS3148: Tests for water for making concrete, all to the cost of the Contractor.

7.23 CEMENT MORTAR

Cement mortar shall consist of proportions by volume as specified of Portland cement and natural sand or crushed natural stone or a combination of both as specified on BSS1200 and BSS1199: Building Sands from Natural Sources. The constituent materials shall be accurately gauged and mixed in an approved manner.

Cement mortar shall be made in small quantities only as and when required, and any mortar which has begun to set or which has been mixed for a period of more than one hour shall be rejected.

7.24 HYDRATED LIME

Hydrated lime shall comply with BSS890: Building Limes, and shall be of the semi – hydrated type.

7.25 CALCIUM CHLORIDE

Calcium chloride shall be of good industrial grade, and shall be obtained from an approved source.

7.26 LIME MORTAR

Lime mortar shall consist of proportions by volume as specified by hydrated lime and natural sand or crushed natural stone or a combination of both as specified for cement mortar in Clause 7.23. The constituent materials shall be accurately gauged and mixed in an approved manner.

7.27 CEMENT – LIME MORTAR

Cement- lime mortar shall consist of Portland cement, hydrated lime and natural sand or crushed natural stone or a combination of both, as specified for cement mortar in Clause 7.23. The constituent materials shall be accurately gauged and mixed by volume in an approved manner in proportion specified.

Cement – lime mortar shall be made only in small quantities as and when required and any mortar which has begun to set or which had been mixed for a period of more than two hours shall be rejected.

7.28 CEMENT GROUT

Cement grout shall consist of Portland cement and water mixed in the proportion of one part by volume of cement and one and a half parts by volume of water. The grout shall be used within one hour of mixing.

7.29 CAST STONE

Cast stone shall be manufactured by an approved manufactures to the shapes and dimensions shown on the drawings, and shall conform to the requirements of BSS1217: Cast Stone. It shall have dense and even surface of the texture and colour detailed on the drawings or required by the Engineer. Where indicated, exposed faces of the stone shall be formed of a specially graded mix. Metal bond ties of approved manufacture shall be cast in with the stone as shown on the drawings. Sample of the completed stone shall be submitted for the Engineer's prior approval.

All stones shall be protected from damage during transport and erection by means of cement slurry coating or by other approved methods.

7.30 REINFORCEMENT FOR CONCRETE

Reinforcement which shall comply with the following Standard, covers plain and deformed bar reinforcement and steel fabric to be cast into concrete in any part of the works but does not include prestressing tendons or any other embedded steel.

BSS4449 for hot rolled plain bar and high yield deformed bar

BSS4461 for cold worked steel bar

BSS4483 for steel mesh fabric

All reinforcement shall be from an approved manufacturer and, if required by the Engineer, the Contractor shall submit a test certificate from the manufacturer.

All reinforcement for use in the works shall be tested for compliance with the appropriate Standard in a laboratory acceptable the Engineer and two copies of each test certificate shall be supplied to the Engineer. The frequency of testing shall be as set out in the relevant Standard.

In addition to the testing requirement described above, the Contractor shall carry out additional tests as instructed by the Engineer.

Any reinforcement which does not comply with the Specification shall be removed from site.

All reinforcement shall be delivered to site either in straight lengths or cut and bent. No reinforcement shall be acceptable in long lengths which have been transported bent over double.

Any reinforcement which is likely to remain in storage for a long period shall be protected form the weather so as to avoid corrosion and pitting. All reinforcement which has become corroded or pitted to an extent which, in the opinion of the Engineer, will affect its properties shall either be removed from site or may be tested for compliance with the appropriate Standard at the Contractor's expense.

Dowel Bars

Dowel bars and tie bars shall consist of mild steel, or deformed bars of high yield steel all complying with BSS4461 and they shall be free from oil, paint other than bond – breaking compound, dirt, loose rust and scale.

Dowel bars and tie bars shall be of sizes as shown on the drawings and directed by the Engineer, and shall be straight, free from burred edges, or other irregularities and shall have their sliding ends sawn or, if approved, sheared.

Bond breaking compound for dowel bars shall consist of 66 per cent of 200

pen bitumen blended hot with 14 per cent light creosote oil and, when cold, brought to the consistency of paint by the addition of 20 per cent solvent naptha or other approved compound meeting the following requirements.

36) It shall not retard or in any other way affect the setting of concrete.

II) The average bond stress on bars coated with the compound with half their length cast into concrete specimens and subject to pull out tests at 7 days shall not exceed 0.14 newtons per square 161ulfils161161z and the total movement of the dowel bar relative to the concrete shall not be less than 0.25 millimeters at that stress. The concrete specimens shall be 150 millimeters in section and 0.45 metre long and made with the same mix proportions as used in the Works.

7.31 STRUCTURAL STEEL FOR WELDED WORK

Structural steel for welded work shall comply with the requirements of BSS4360 : Structural Steel, BSS4449 : The use of Structural Steel in Building and for welded work, BSS4360 : High Yield Stress and High Tensile Structural Steel, High Tensile (Fusion Welding Quality) Structural Steel for Bridges, etc, and General Building Construction.

7.32 WATERPROOF UNDERLAY

Waterproof underlay shall consist of either waterproof paper complying with BSS1521 : Waterproof Building Paper, containing approved fibrous reinforcement, or 900 Gauge polythene sheeting as stated in the Bill of Quantities.

7.33 PREFORMED JOINT FILLER

Preformed joint filler be of the thickness shown on the drawing or as stated in the Bill of Quantities.

The material comprising joint filler shall be as stated on the drawings or approved by the Engineer.

7.34 JOINT PRIMER

Joint priming compound shall be entirely in accordance with the manufacturer's recommendations for the joint sealant to be used.

7.35 JOINT SEALING COMPOUND

Poured joint sealing material shall consist of an approved rubber- bitumen compound, complying with the requirements of BSS5212 or a two component, cold applied compound complying with BSS5212 as stated in the Bill of Quantities. Test Certificates, prepared by an approved testing laboratory, shall be supplied by the Contractor to show that the material does in fact

comply in respect of cone penetration, flow and bond with the under-mentioned requirement :

Test Cone	Hot – poured Materials	Cold – poured Materials
Penetration0.15 kg. For. At 25 degrees centi grade using standard grease cone	Penetration not to exceed 9mm than 5mm and Penetration to be not less	Penetration to be not less not more than 27.5mm

Flow

Test Cone	Hot – poured Materials	Cold – poured Materials
Penetration0.15 kg. For. At 25 degrees centi grade using standard grease cone	Penetration not to exceed 9mm than 5mm and Penetration to be not less	Penetration to be not less not more than 27.5mm

Bond

Test Cone	Hot – poured Materials	Cold – poured Materials
25mm wide joint extended 12mm at rate of 4mm per hour at 18 degree centigrade. Not more than one specimen in three to develop a crack separation or other opening more than 4mm deep.	Five cycles of extension and recompression	Three cycles of extension and recompression

Approved hot-poured materials shall also comply with a requirement whereby when heated for a period of 6 hours at a temperature of 80 degrees centigrade above recommended pouring temperature or 30 degree centigrade below the safe heating temperature whichever is the greater shall still comply with the

flow requirement of this Clause.

In addition to materials complying with BSS5212, the Engineer may approve the use of alternative materials provided that they meet the requirements of this Clause relating to cold-poured joint sealing compounds.

7.36 CONCRETE PIPES AND SPECIALS

Concrete pipe and special shall comply with the requirements of BSS5911. They shall carry the relevant Standards Institution registration certification trade mark, or test certificates shall be furnished by the manufacturers.

7.37 CONCRETE POROUS PIPES

Concrete porous pipes shall comply with the requirements of BSS1194 : porous pipes for under-drainage.

7.38 CONCRETE DRAIN INVERT BLOCKS

Precast concrete invert blocks shall be manufactured to the details drawings supplied from concrete Class 20/10 as specified in Table 4.2 using maximum 12mm size aggregates. The Invert Block Drains are to be manufactured in accordance with BSS 340. If required, cube test certificates shall be supplied by the manufacturer.

7.39 CONCRETE SLABS FOR OPEN DRAINS

Precast concrete slabs for lining open drains shall be manufactured to the detail drawing supplied from concrete Class 20/10 as specified in Table 4.2 using maximum 12mm size aggregate. The slabs are to be manufactured in accordance with the relevant provisions of BSS 368. If required cube test certificates shall be supplied by the manufacturer.

7.40 AGRICULTURAL TILES AND PIPES

Agricultural tiles and pipes shall be best well-burnt earthenware, true and circular in bore and with an external flat bottom and plain ends suitable for laying with open or butt joints.

7.41 MANHOLE COVERS AND FRAMES

Manhole covers and frames shall be basically in accordance with the requirements of BSS497: Cast Manhole Covers, Road Gully Gratings and Frames for Drainage Purposes except that the manhole covers shall be constructed of mild steel, concrete filled, in accordance with the standard detail drawings.

Foul water sewer manhole shall have triangular Grade ‘A’ heavy duty covers and frames. Circular manhole covers and frames shall be used on surface water

sewer manhole.

7.42 GULLY GRATING AND FRAMES

Gully grating and frames shall be basically in accordance with the requirements of BSS497, nominal size 500mm x 350mm except that the gully grating shall be constructed of mild steel concrete filled in accordance with the standard detail drawings.

Where indicated as being kerb inlet type, the gullies shall conform to the shape and dimensions given on the detail drawings supplied, but in respect of materials and workmanship conforms to BSS497

7.43 PRECAST CONCRETE MANHOLE AND INSPECTION CHAMBERS

Precast concrete manholes and inspection chambers shall comply with the requirements of BSS5911 : Concrete Cylindrical Pipes and Fitting including Manholes, Inspection Chambers and Street Gullies and they shall carry the relevant Standard Institution registered certification trade mark, or test certificates shall be furnished by the manufacturer.

7.44 PRECAST CONCRETE GULLIES

Precast concrete gullies shall be unreinforced and shall comply with the requirements of BSS5911: Concrete Cylindrical Pipes and Fitting including Manholes, Inspection Chambers and Street Gullies.

7.45 MANHOLE STEP IRONS

Step irons of general-purpose type shall comply in all respects with BSS1247: Malleable Step Irons.

7.46 TIMBER

Timber shall be sound, well seasoned and entirely free from worm, beetle, warps, shakes, splits and all forms of rot and deadwood. Where required, all timber shall be treated with creosote, as specified in BSS144: Coal Tar Creosote for the preservation of Timber or an alternative approved timber preservative.

7.47 WATER BARS

Water bars shall be 'Dumbbell' type and be of natural or synthetic rubber or extruded PVC. They shall be flexible, tough, elastic and durable and of dimensions detailed. They should be unaffected on contact with dilute acids or alkalis. Joints and junctions shall, when possible, be prefabricated by the manufacturer's instruction including recommended adhesive shall be followed and used. Samples shall be submitted for approval of the Engineer before use of any material.

7.48 CONCRETE BLOCKS

Solid and hollow concrete blocks for walling shall comply with BSS6398 in every respect.

All solid and hollow concrete blocks used in the walling must be capable of withstanding a crushing pressure of not less than 0.35 per square millimetre after 29 days. The blocks shall be cast in metric sizes.

7.49 MECHANICAL FLOCCULATORS

The Flocculation shall be of mechanical type installed in each chamber. Its peripheral velocity shall be 0.6m/s. The detention time shall be a minimum of 15 minutes at velocity gradient of $G=30s^{-1}$- $60s^{-1}$ and product GT=30,000 – 100,000.

The blades shall be of stainless steel material and fixed to stainless steel shaft and connected to and driven by electric motor mounted on steel cheaquer plate with angle iron supports.

The motor shall be weather proof type mounted outside exposed to wet and dry weather conditions.

7.50 BULK FLOW MEASUREMENTS AND INDICATORS

Flow measurement and Indication

Flow meters shall operate on either the differential pressure principle on level measurement over a weir or on direct mechanical indication. Venturi tubes shall be inserted into the rising mains of the respective pump stations and installed together with transmitters in meter chambers adjoining the stations. The differential pressure shall be converted to 4+20mA electrical output.

The venture tube shall be flanged and fitted with vents and cocks in the pressure connection outlet.

The receivers operated from venture tube transmitters shall consist of rate of flow indicators (liters per second) and total aggregate flow (cubic meters) instruments.

Flow measurement equipments shall be installed as indicated in the table below.

Location	Equipment		Max pressure	Rate of flow	
	Type	Size		Min (l/s)	Max (l/s)
Aerator outlet	weir		Atmospheric		600
Backwash pumps	Venture	200	25		100

Raw water pumps	Venture	450	100		600
Treated water pumps	Venture	450	150		600

Pressure switches
Pressure switches shall be of pressure controlled electrical type. All parts coming in contact with water shall be constructed of corrosion resistant materials. The switch shall allow for adjustment to the required head at which contact shall be actuated.

Level Switches
Level switches shall be float operated or electrode type two of which shall be installed in the sumps of each pump station.

7.51 LIFTING APPLIANCES

Provision for treated Water Pump station of installation of one number manually operated gantry crane on mono rail of lifting capacity 5 tons in the treated water pump station.

The manually operated gantry cranes shall be of single girder type with crab suitable for the works arrangement. The lifting capacity of each crane shall be sufficient to lift the heaviest load when erecting or dismantling all items of plant located within ranger of the crane, and in any case of lifting capacity of not less than 5 tons.

The travelled carriage shall run on bridge rails securely fixed to the gantry. The treads of the 166ulfils166166 carriage wheels shall machined. The crab hoisting gear shall such that one man shall be capable of easily lifting the maximum load.

The crane design shall be designed in accordance with the requirements of class III overhead travelling cranes and also the general requirements of British Standards Specifications and or Kenya Bureau of Standards.

Longitudinal and traverse motions shall be provided to allow speedy operation without impairing safety in working.

The longitudinal and transverse motions shall be operated by means of a hand chains which shall extend to within 500mm of floor level. Ball bearings shall be employed on all motions. All gears shall be machine formed.

The load chain and hook shall of sufficient length to reach the main access floor level. The crab unit shall include a reliable braking and locking arrangement on

the hoist mechanism as well as a load chain connection box.
The load hook shall revolve on a ball swivel and incorporate a safety catch.

7.51 LIFTING APPLIANCES

The grading of the filter media shall be in accordance to the table of grading shown on the drawings.

Filter media must be free from fines which would clog the air spaces, and free from dirt, silt and all foreign matter.

The media shall be delivered in clean vehicles and if stored it shall be placed on a clean and firm surface and if it is liable to be contaminated, protected with sheets. Different sizes of media shall be kept strictly separate.

8.0 Workmanship

8.1 HANDLING OF PIPES AND FITTINGS

The Contractor shall exercise care in the handling of all pipes, specials, valves etc. to prevent damage to the structure surfaces and to the ends of the pipes.

8.2 LOADNG AND UNLOADING

Normally loading and unloading of small diameter pipes and Fittings can be undertaken by hand; where mechanical means are used care should be exercised to ensure that the handling methods do not damage the pipes and fittings.

8.3 STORAGE

The Contractor shall comply with the manufacturer's specification regarding the storage of pipes, fitting and valves. Where storage dumps are to be provided along the route of the pipeline, these will be subject to the Engineer's approval. The cost of so providing shall be borne by the Contractor and deemed to be covered by his rates in the Bill of Quantities.

8.4 TRANSPORT

The Contractor shall provide such transport arrangements as will effectively

Cater for the lengths of pipes provided and the material of the piping. Adequate support shall be provided so as to ensure that the piping and fittings are not subject to excessive movement.

8.5 EXAMINATION OF PIPES AND FITTINGS

The Contractor shall examine all pipes, valves or other materials to ascertain that they are in perfectly sound condition before commencing to lay the pipes, valves etc.

8.6 INTERFEENCE WITH FENCES, DRAINS AND OTHER SERVICES

The Contractor shall ensure the proper reinstatement of fences, drains, telephone lines, KPLC cables etc, where effected by his work. All services shall be adequately protected and propped to the satisfaction of the Engineer. The Contractor shall be liable for any damage caused to the services due to his failure to provide adequate protection

8.7 METHOD OF EXCAVATION

The Contractor shall excavate the pipe trenches in the line and to the depths indicated on drawings or as indicated by the Engineer. Except where otherwise indicated on the drawings or directed by the Engineer, it is

intended that the trench shall be excavated to such a depth as will allow of a minimum cover of 600mm over top of the barrel of the pipe when laid plus or minus a tolerance of 40mm either way. All trenches shall be excavated in open cuttings and trenching shall not be opened too far in advance of pipe laying.

a) For the purpose of measurement, the width of trench shall be taken as the nominated width for the particular size of main, irrespective of the width of trench the Contractor may choose to excavate.

Table Trench Width to be measured

Diameter of Pipe	Nominated trench width
75mm	0.5m
100mm	0.6m
130mm	0.6m
200mm	0.6m
225mm	0.6m
250mm	0.6m
300mm	0.7m
400mm	0.8m
500mm	0.9m
600mm	1.0m
700mm	1.1m
800mm	1.2m

For two or more pipes in same trench the nominated width shall be the distance between centres of outer pipes plus the internal radial of the out pipes plus 400mm.

b) Where the trench passes through grassland actable land or garden, whether enclosed or otherwise, the turf, if any, shall be carefully pared off and stacked, and the productive soil shall be carefully removed for a width of 600mm greater than the nominated trench width, or equal to the overall width of track of excavating machine, whichever is greater, and laid aside to be subsequently used in reinstating the surface of the ground after trench has been refilled.

c) The bottom of the trench shall be properly trimmed off, and all low placed or irregularities shall be 169ulfils169 up with fine material. Where rock or large stones are encountered, they shall be cut don to a depth of at least 100mm below the level at which the bottom of the 169ulfil of the pipes or flanges are to be laid, and covered to a like depth with fine material, so as to from a fine and even bed for the pipes. The bottom of trenches to accommodate uPVC piping shall be hardened by tamping in gravel or broken stone in all soft spots. The

bedding shall consist of soil which can be properly compacted to provide support for the pipe and to comply with Clause 8.7 (b)

d) Joint holes shall be excavated to suit minimum dimensions as will allow the joints to be well and properly jointed.

e) The pipe trench shall be kept clear of water at all times as per Clause 3.21 of this Specification.

f) The Contractor shall wherever necessary by means of timbering, or otherwise support the sides of the trench so as to make them thoroughly secure, and afford adequate support to adjoining roads, land, buildings and property, during the whole time the trench remains open and shall remove such timbering when the trench has been backfilled. The cost of such timbering or other work shall be deemed to be included in the rates for excavation. In case the Contractor is instructed by the Engineer to leave any portion of such timber in position, he will be paid for accordingly.

g) The clear width inside the timbering shall be at least 150mm in excess of the external diameter of the pipe being laid in order to allow it to be freely lowered into position in the trench without damage to the external protection.

h) Should the excavation be taken out to a greater depth than is specified the bottom shall be made good to the correct level with Class 15/20 concrete or other material approved by the Engineer. No payment shall be made for any over excavation carried out by the Contractor not for the cost of filling up to required levels.

i) If a mechanical excavator is used by the Contractor, he shall indemnify the Employer against all claims for damage which in the opinion or the Engineer, may be caused by the use of this plant.

j) The Contractor shall fix sight Rails for use with boning roads at intervals o of not more than 30 meters and temporary Bench Marks related to the Survey of Kenya Datum shall be provided at intervals as directed by the Engineer.

8.8 MAIN LAYING

a) Main shall be laid in straight lines and/or smooth curves as indicated on the drawings. The vertical profile of the pipe shall be to even gradients. Any pipes not so laid shall be removed if so directed by the Engineer, and relaid in proper manner at the Contractor's expense.

In laying the pipes and specials care shall be taken not to damage the protective linings and the pipes shall be handled with tackle if so

directed by the Engineer.

The pipes and specials shall be checked for flaws before they are lowered into the trench. After the pipes or specials have been checked they shall be cleaned and set to proper gradient and line so that there is a continuous rise from each without to air valve.

When laying up pipes, final connection at any fixed joints shall be deferred until the majority of the pipeline has been covered with backfill.

36) Large diameter curves to mains shall whatever possible be formed by allowing for deflection of flexible joints, not exceeding 3 degrees or as specified by the manufacturers.

a) In jointing of the pipes and the specials the Contractor shall comply with the standards adopted for the various types of joints as specified.

b) In laying pipes and specials with flanged joints, flanges shall be brought together and bolted with the faces absolutely parallel. A rubber jointing gasket shall be used in each flange joint and one washer with each bolt.

The bolts shall be tightened up gradually and equally in the customary manner in order to distribute the stress evenly over, the flange. If it is found necessary to deviate slightly from the normal run of the flanged piping, the deflection shall be obtained by means of a 171ulfils171 gun metal ring washer between the flanges.

c) The Contractor shall fix the gate valves, air valves and washout pipes all in accordance with the drawings.

d) The Contractor shall, subject to approval of the Engineer, cut pipes to such lengths as directed. Pipes should be cut off clean and square with axis. Cut should be made with an approved cuttings device dependant on type of pipe specified. Ends of pipes should be tapered if mechanical joints are to be used.

e) Equipment for tapping off the mains under pressure may be employed in the making of service or branch connection. The Contractor is required to choose a suitable method for fixing of the ferrule to the type of pipe specified, to the Engineer's approval.

8.9 BACKFILLING OF TRENCH

a) When a section of the main has been jointed, the ends shall be closed with caps, plugs or flanges to prevent ingress of foreign matter into the pipe to the satisfaction of the Engineer. The trench shall be properly backfilled and rammed for its whole length so that the cover of the

main shall not be less than 600mm except at joint holes which shall be kept clear of all backfilling. If necessary by the use of timbering so that each joint is left fully exposed for inspection. Special care shall be exercised when using surround to uPVC pipes which shall be free from any stones and compacted to not less than 100mm above the crown of the pipe.

b) The Contractor's attention is drawn to the special requirements for bedding and side fill to uPVC pipes. Clay should not be used. Soils which are of a granular nature and provide adequate support after compaction shall be used. If unavailable from excavated material Contractor should provide suitable material for which an item in the Bill has been included.

With flexible pipes it is important that the side fill should be firmly compacted between the pipe and the sides of the trench. The bedding material shall be placed in 75mm layers up to the crown of the pipe with adequate compaction and then to a minimum height of 100mm or two thirds or the pipe diameter. The progress of filling and tamping should proceed equally on either side of the pipe so as to maintain an equal pressure on both sides.

I Where a main is laid across a road or is in such a position as to interfere seriously with the normal use of the road, the Contractor may, with the consent of the Engineer and at his own risk, fill such holes as may be necessary. Due consideration is to be given to compaction of section of the trench across the road to prevent undue settlement. In the event of leakage at this section the Contractor is required to re-excavate and repair the pipeline all at his own expense.

8.10 ANCHOR BLOCKS AND SUPPORT

Concrete Class 15/20 shall be placed in anchor blocks at all changes of direction of the pipeline exceeding 6 degrees and whatever else required to withstand thrust resulting from internal water pressure e.g. at blank ends. Concrete in plinths shall be placed where specified.

8.11 CHAMBERS AND SURFACE BOXES

Gate valves, air valves and fire hydrants etc. shall be provided with suitable chambers or surface boxes in accordance with detailed drawings. In roads and footpaths the boxes shall have metal covers laid flush with the surface. Indicator posts to suit shall also be provided.

8.12 TESTING

a) The Contractor shall test as long a section of main as possible subject to the maximum length of open trench approved by the Engineer. The test

shall be carried out within 12 working days of the completion of such section of the main.

b) The pipeline shall be adequately anchored during the test at stop ends or valves to prevent movement under the test pressures.

c) The test section shall be filled with water and great care should be taken to drive out all air through air valves, ferrules etc. The test pressure is to be at least 1.5 times the nominal working pressure for the class of pipe being tested and is to be applied for at least 3 hours.

d) The leakage from the mains and connections from each section tested shall be according to BSS 8010:2 i.e. not exceeding 0.02 litres per 173ulfils173173ze of nominal bore per 173ulfils173173 or pipeline per 24 hour per bar of pressure applied head.

e) To determine the rate of leakage, the Contractor shall furnish a suitable hydraulic test pump, pressure gauge, connections and water meter or other appliance, for measuring the amount of water pumped. The pressure shall be raised to the amount required and specified by the Engineer, and shall be so maintained for a period of not less than one hour or whatever longer period as required by the Engineer to examine every joint to satisfy himself that they are sound.

f) If the leakage is at a greater rate than that specified the Contractor shall re-excavate the trench where necessary and shall re-make the joints and replace defective work until the leakage shall be reduced to the allowable amount.

g) The Employer shall charge the Contractor the cost of any couplings required to join up tested lengths of main if, in the Engineer's opinion, greater lengths could reasonably have been tested or if failure under test, requires the pipe to be cut, or other methods of laying should have been adopted.

h) Water used in testing the main shall be supplied by the Contractor. The Contractor shall carry out all work which may be necessary for making temporary connections to the existing mains to obtain water for testing at his own expense

i) In carrying out the test for water tightness the Employer only shall authorize the operation of all valves, but the Contractor shall provide all the necessary labour to assist in the opening and closing of the valves to the Engineer's instructions, and he shall allow in his prices for all his expenses in connection with testing on completion.

j) The engineer shall be sole judge of water tightness.

8.13 CLEANING AND STERILIZING THE MAIN

a) When a pipeline is complete and where applicable, has successfully passed the test, it shall be thoroughly washed out using, if possible, an open end.

   Thereafter, it shall be sterilized by being filled with a suitable solution containing not less than 20p.p.m of free available Chlorine or such other sterilizing agent as the Engineer shall approve. After standing for 24 hours the main shall again be washed out and refilled with mains water prior to the taking of Bacteriological samples. The Contractor shall provide all necessary stop-ends, fittings and chemicals for this work.

b) Emptying and washing out of the pipes shall be done in such a manner as not to damage the trench or cause undue flooding of the vicinity, and the Contractor shall supply and use piping, specials and/or hose as may be necessary to facilitate the flow of water to the nearest drain or watercourse. Water used for washing out and sterilizing may be supplied by the Employer when a suitable supply is available but all expenses should be payable by the Contractor.

   Before any section of the main is put into use a Bacteriological sample or sample will be taken by the Engineer's Representative and only on receipt of satisfactory certificate from a Medical Research Laboratory or a similar organization will the main or section of main be permitted to be put into supply and be considered as having been substantially completed.

   Any expenditure involved in providing facilities of materials for the taking of samples shall be included in the Contractor's tendered rates and the Engineer will specify and shall be the sole judge as to the number of samples required and the points at which they are to be taken.

   The cost of the Bacteriological Examination will be borne by the Employer but if the sample or samples are not satisfactory, the cost of any subsequent analysis will be borne by the Contractor.

8.14 CLEARANCE OF SITE

The Contractor shall remove all surplus pipes, specials and other fittings as directed by the Engineer. The site of Works shall be leveled and all surplus excavation, debris, cut trees or bushes shall be carted to approved tip sites.

8.15 TESTING OF WATER RETAINING STRUCTURES

As soon as possible after completion of water retaining structures viz, storage reservoirs etc they shall be tested for water retention by filling to the normal maximum level with water at a uniform rate of not greater than 2m in 24 hours.

When first filled, the water level should be maintained by adding of further water for a stabilizing period while absorption and antogenous healing takes place. This period may be 7 days after which the level of the water surface should be recorded at 24 hours interval for a test period of 7 days. The structures shall be considered satisfactory if, during this period the total permissible drop in level, after making due exceed $1/500^{th}$ of the average water depth of the full tank 100, or another specified amount all in accordance with BSS8007. Water used in testing the structures shall be supplied by the Contractor. Sterilization of the structures is to be done as specified by the Engineer and sampling of water carried out similar to Clause 8.13.

This test shall be carried out before any backfilling has taken place.

In the event of any water retaining structures failing to pass the test, the Contractor shall make good re-test at his own expense.

9.0 Testing Of Materials

9.1 APPARATUS REQUIRED FOR TESTING ON SITE

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

a) A set of sieves complying with BSS410 Test Sieves, or the following nominal sizes.

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

Perforated plate 5mm, 6mm, 9mm, 12mm, 20mm, 38mm, 30mm, 65mm and 75mm

b) A suitable balance, a pyenometer and a stove or other approved apparatus for determining the moisture content of the aggregate. The methods of test shall be a described in Part Four of BSS812: Sampling and Testing of Mineral Aggregates, Sands and Fillers.

c) A 200ml graduated cylinder in accordance with BSS604: Graduate Measuring Cylinders, for the use in the field setting test for clay and fine silt in aggregate.

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

e) Apparatus required for testing soils in accordance with BSS6072 : Methods of Test for Soil Classification and Compaction, and BSS1924: Methods of Test for Stabilized Soil

f) Apparatus for testing concrete in accordance with BSS1881 and: Methods of Testing Concrete

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

36) Additional testing equipment as stated in the Bill of Quantities

10.0 Drains, Sewers and Manholes

10.1 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 as the Engineer may direct. Excavations taken out to a greater depth than is necessary shall be filled to the required level with approved material as specified for the pipe bed at the Contractor's own cost. 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 Engineer, the Engineer 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 authorized 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 balling and pumping, timbering, shoring and supporting of sides that may be required, and any materials necessary in carrying out the excavations and backfilling of trenches shall be taken to provide a solid and even 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.

The rate of excavation in the bills of quantities shall include for keeping trenches dry and for all bailing, pumping, timbering, shoring and supporting of the sides that may be required.

10.2 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 Engineer 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 sharing, opening in short lengths or otherwise, during the time the trenches are open.

10.3 ROCK CUTING 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 100m below the bottom of the pipes. The price inserted in the bill of quantities shall be held to cover all expenses in connection with excavating the rock, backfilling after lying of pipes and

disposing of surplus material as directed by the Engineer.

10.4 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 Engineer, any concrete or other works therein are sufficiently set, and the Contractor shall construct any sumps or temporary drains that the Engineer 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 Engineer so as to ensure the excavations are kept dry.

The Contractor shall provide all plant, labour and materials required for such work and all costs incurred shall be deemed to be included in his rates of excavation.

10.5 LAYING AND JOINTING, RIGID JOINTED CONCRETE PIPES

Concrete pipes as specified in Clause 7.36, shall be laid true to line and level, each pipe being separately bond 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 or the pipe accurately centered 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 wooden caulking tool and wooden mallet, such socket shall then be completely filled with cement mortar 1 to 2 as specified in Clause 7.23 and a fillet of the same worked all round the side. The fillet shall be 178ulfils178 off and extend for a length of not less than 30mm from the face of the socket.

For ‘Ogee’ jointed pipes, the joints shall be thoroughly cleaned before laying, and cement mortar, as specified in Clause 7.23 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 wok 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 a tight-fitting mad 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 plug shall be well secured at the end of the last laid pipe and shall be removed only when joint 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 Engineer concrete pipes shall

be bedded and launched or surrounded with concrete as specified in Clause 1019.

The price inserted in the Bill of Quantities shall include for providing laying and jointing of pipes.

10.6 PIPES LAID WITH OPNE JOINTS

Ogee porous concrete pipes as specified in clause 7.28 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 surround as directed by the Engineer with approved broken stone, sand or gravel aggregate, to the grading as shown on the drawings or stated in the Bill of Quantities. The prices inserted in the Bill of Quantities shall include the trench excavation, providing and laying pipes, supply and placing graded packing materials, refilling trench and disposing of surplus all as specified.

10.7 CAST IRON PIPES

Cast iron pipes and special castings, shall be supplied, laid and jointed with lead wool properly caulked to form perfectly uniform and watertight joints, and when laid and jointed they shall be true to line and level.

Where cast iron drains are laid on unstable ground or which is likely to settle appreciably over a period of years they shall be pointed by means of an approved self-adjusting or screwed gland joint as directed by the Engineer.

10.8 DRAINS TO BE LEFT CLEAN ON COMPLETION

On completion, all drains, manholes, etc. shall be flushed from end with water and left clean and free from obstructions.

10.9 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 Engineer. For pipes which are not surround 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.

10.10 CONNECTIONS OF EXISTING SEWER AND DRAINS

Where shown on the drawings existing sewers and drains shall be properly extended, connected and jointed to new sewers, culverts, drain or other work and a 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 connections are between pipe sewers or drains, special connecting pipes as shown on the drawings shall be supplied and laid properly jointed.

10.11 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 Engineer. Foundation slabs shall consist of concrete of the appropriate classes as specified on drawings. The side walls shall consist of similar concrete or building stone as specified in clause7.19 in accordance with the drawings.

The side walls shall be fair faced or rendered internally as specified on drawings. They shall be brought of vertically to receive a precast slab formed of concrete of the appropriate classes specified and reinforced all as shown on the drawing. Cast iron manhole covers and frames as specified in clause 7.41 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 cases 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 in clause 7.36 and clause 7.28 shall be laid and bedded in cement mortar 1 to 3 to the required lines and levels, and both sides of the appropriate class and finished smooth to the slopes and levels as shown on the drawings or directed by the Engineer. 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 metro below the finished surface of the carriageway or the adjacent ground, step irons as specified in clause 751 shall be built in with alternate steps in line vertically and with such additional hand irons as the Engineer may direct.

All manholes when completed shall be watertight and to the satisfaction of the Engineer. The prices inserted in the Bill of Quantities shall include for excavation, provision of all materials, construction, refilling and disposal of surplus.

10.12 PRECAST CONCRETE MANHOLE

Precast concrete manholes as specified in clause 7.43 shall be supplied and laid generally in accordance with clause 1011 and the drawings.

10.13 GULLY CONNECTIONS

Connections from gullies to sewers and surface water drains or ditches shall consist of concrete pipes and fittings as specified in clause 7.36 jointed with cement mortar 1 to 3 as specified in clause 7.23. All pipes, bends and junctions shall be laid to the lines and levels shown in the drawings or as directed by the Engineer.

10.14 SURFACE BOXES, COVERS ETC.

Surface boxes manhole and other covers lying within the site of the works, shall be raised, and lowered. Altered or removed as directed by the Engineer.

10.15 GULLIES

Gullies completed with gratings end with ridding eyes where necessary all as specified in clause 7.44 shall be supplied and laid in accordance with the drawings. Where directed by the Engineer precast concrete gullies shall be laid on and surrounded with 100mm of concrete of the appropriate grade specified in table 4.2. The concrete surround 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. The rates included in the Bill of Quantities shall include for excavation, provision of all materials, construction, making junctions with connections to main drains, accurate setting of frames to line and level, refilling and disposal of surplus materials. Gullies shall be trapped where leading into foul sewers or into combined foul surface water sewers.

10.16 COMPLETION OF DRAINAGE WORKS.

All sub-soil and surface water drains shall be completed in advance of the construction.

10.17 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 such stakes or training wires properly marked and labeled.

10.18 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 Engineer. The pipes shall be laid and jointed as specified in clause 1005 and during the placing of the concrete they shall be adequately supported.

10.19 SURROUND OR HAUCHING OF PIPE WITH CONCRETE

Surrounding or haunching of pipes shall be carried out using concrete of the appropriate class specified in table 4.2. 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 trowel or template and neatly finished off. The rates shall include for any formwork that the Contractor requires to use under this item.

10.20 INVERT BLOCK AND STONE DRAINS.

Precast concrete invert and side slabs shall be formed of concrete of the appropriate class specified in table 4.2 to the dimensions shown on the drawings. Each course of side slabs rewired in the Bill of Quantities shall be interpreted as one completed row of side slab 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 drained

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 100mm maximum thickness layers of compacted murram. The earth sides to such channels shall be neatly finished to a slope of I to I or such other slopes as the Engineer 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 block or stone, backfilling and disposal of surplus all as specified and all in-situ connections in concrete of the appropriate class specified in table 4.2

10.21 TESTING OF JOINTED PIPES AND MANHOLES.

Sealed jointed drains, up to end including 600mm diameters 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-joined 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 drains to be tested shall be sealed to the satisfaction of the Engineer, 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-joined until there is no further escape of smoke.

Should the Engineer 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 liter per hour per linear meter of nominal internal diameter.

The Contractor shall provide all labour and apparatus for above tests.

All testing will be done in accordance with BSS2005.

10.22 PIPES LAID ON MURRAM BED.

The pipes will be laid on 75mm murram bed. The murram to be laid shall be approved by the Engineer. The murram shall be well rammed after watering it. Proper grooves shall be made in the murram bed so that the socket of the spigot and socket can be received. The backfill shall be properly rammed along the side of the pipes.

10.23 PIPES WITH RUBBER RING JOINTS

Rubber ring complying with BSS2494 will be provided by the Contractor. The jointing of pipes shall be carried out in accordance with manufacturer's instructions and in conformity with any modifications proposed by the Engineer.

11.0 Miscellaneous

11.1 GENERAL

The Contractor is referred to the drawings as to the general character of the works and he shall allow in his rates for any reason of the work being in detached positions, in small quantities, difficulty of access or for any other cause. He should also make due allowance for specialist installations taking place during the currency of this contract.

This section of the specification refers to miscellaneous items. Clauses elsewhere in the specification shall be followed where relevant.

11.2 BONDIES TIES

Bonding ties shall be 75mm wide x 250mm long 184ulfils184184z bitumen – coated expanded metal strip, cast 100mm into concrete surface in contact with block work. The bonding tie used shall be approved by the Engineer.

11.3 PRECAST LINTELS

All precast items shall be marked with the date of casting and shall not be built until they have matured for 28 days. Ends of bar reinforcement shall be hooked. The cover for reinforcement shall be 25mm from internal faces and 38mm from external exposed faces. The top of lintels shall be numbered for identification.

Lintels shall have timber or pre-formed inserts cast in for fixing metal windows where required and shall have fair face finish on all surfaces exposed to view and hacked surfaces where plastered.

11.4 BLOCKWORK

Building blocks shall be dense concrete blocks complying with the requirements of BSS 6398 with faces for plastering and having a compressive strength of 14 N/sq.mm

Blocks shall be obtained from an approved manufacturer and shall be equal to sample blocks previously approved by the Engineer.

Blocks shall be carefully handled and stored on site and protected from the weather at all times.

Surfaces on which blockwork is to be built shall be kept clean. Blocks shall be well wetted before being laid and the tops of walls where block work has been left shall be well wetted before re-commencing. Block work shall be built plumb, true to line and level, with all perpendiculars vertical and in line. Block shall be built in half bond and alternate courses shall be block bonded at all junctions, no cut block shall be less than half block. Joints in concrete block

work shall be well filled with gauged mortar and shall not exceed 10mm in width.

11.5 DAMP – PROOF COURSE (DPC)

Hessian based metal cored bitumen for damp-proof course shall be leaded cored, complying with BSS743 weighing not less than 4.4kg. per square meter. Damp – proof course shall be bedded horizontally in mortar as for block work with 115mm laps in length and full laps at angles.

11.6 HARDWOOD

Hardwood for joinery shall be sound, well-conditioned and seasoned mvuli complying with the requirements of BSS1186. A sample of each representative section for use in the work shall be previously submitted by the contractor for approval by the Engineer. Moisture content shall be 12 (+ or – 2%)

11.7 PLYWOOD

Plywood generally shall comply with BSS6566. That from sources not included in SRN 811 shall be of corresponding grades of veneers and types of bonding. Plywood for flush doors shall be Grade 1 Mvuli veneered.

11.8 DOORS

Internal doors shall be hardwood framed solid cored flush doors constructed in accordance with DIN 68706, faced both sides with 3mm thick Mvuli veneered plywood and lipped all round with matching hardwood lipping. Moisture content at delivery shall be 12% (+ or – 2%).

11.9 FRAMES AND LININGS

Door frames and linings shall be class 1 Mvuli mortise and tenon jointed at angles. Sub-frames for internal doors shall be Class 1 Mvuli tongued at angles.

11.10 ARCHITRAVES AND STOPS

Architraves and stops shall be Class 1 Mvuli matching to the frames and linings.

11.11 IRONMONGERY

All ironmongery shall be obtained from a source approved by the Engineer. Samples shall be submitted before ordering and the articles ordered shall match up with the approved samples. Screws of a like metal shall be used for all fittings.

11.12 JOINERY

All exposed joiner's work shall have wrought faces. The prices of all joiner's work shall include for slightly rounded arises.

Where the term framing or framed is made use of it shall be understood to mean all carvings, dovetails, tenons and hardwood pins and the best known means of putting the work together.

All framed work shall be put together loosely and stacked under cover where a free current of air can circulate and is not to be wedged and glued until it is required for fixing.

All joinery, when brought on the works, shall be stacked under cover.

The Engineer or his representative shall have full right of access to the joinery works and power to condemn any work not approved and any approval expressed or implied is not to relieve the contractor from his responsibility and liability to make good any shrinkage or other defects that may appear after the work is fixed.

All joinery to be painted shall be knotted and primed.

The Contractor shall provide all materials, labour, framing, fixing, etc., nails, screws and anything necessary for the proper execution and completion of the work.

11.13 FIXING JOINERY

Doors shall be hung on one or one and a half pairs of butt hinges to give a maximum even tolerance of 2mm all round.

Sub-frames shall be fixed to block work with three fixing clamps per side and one dowel let 50mm into floor and d50mm into foot of each leg. Linings shall be fixed after completion of other finishing's by means of screwing and 186ulfils186186 to sub-frames with matching hardwood pellates. Architraves and stops shall be pinned on, heads punched and filled with tinted filler.

11.14 FIXING IRONMONGERY

The rates for supplying and fixing ironmongery shall include for all sinking, boring, mortising etc., making good, replacing damaged screws, oiling, adjusting and leaving in good working order and for mastering all keys.

11.15 BOLTS AND NUTS

Bolts and nuts shall comply with the relevant requirements for the Standards as set out below:-

Black Hexagon Bolts,

Screws and Nuts BSS 4190

Metal Washers for General Purpose BSS4320

Black Cup and countersunk

Head Bolts and Screws with nuts BSS4933

The items shall preferably have coarse metric threads but items with B.S.W. or approved equivalent threads may be used. Bolt lengths shall be sufficient to ensure that nuts are full threaded when tightened in their final position.

11.16 STRUCTURAL STEELWORK

The whole of the structural steelwork and testing shall comply with the relevant clauses of BSS449. The Contractor shall include for the preparation of all shop details from the drawings supplied by the Engineer. All such details shall be approved in writing by the Engineer before the work is put in hand. Every drawing shall show the number and sizes of all rivets and bolts compete details of welds, type of electrodes, welding procedure, whether the welds are to be made in the shop or elsewhere and any other relevant information. The Contractor shall be responsible for their accuracy of his shop details and for shop fittings and site connections.

The Contractor shall take the dimensions from the structure and he shall verify all dimensions given on the drawings before the work is put in hand.

Any damage to materials on the site due to inadequate precautions being taken during the erection of the steelwork shall be made good to the satisfaction of the Engineer at the Contractor's expense.

The fabrication and erection of the steelwork shall be carried out in accordance with BSS449

11.17 GALVANISED WORK

Iron and steel, where galvanized, shall comply with BSS729, entirely coated with zinc after fabrication by complete immersion in a zinc bath in one operation and all excess carefully removed. The finished surface shall be clean and uniform.

11.18 ELECTRICAL INSTALLATION

The electrical installations will be carried out by Licensed Electrician and complying with the following:-

a) Regulations for electrical equipment of buildings issued by the institution of electrical engineers.

b) Electric Power Act

c) The K.P. & L. Co.'s Bye-Laws

d) Relevant Current Standards .

e) All the relevant clauses in this specification, particularly the clauses in Section 12 and 13.

PLUMBING INSTALLATION

11.19 WATER AUTHORITIES REGULATIONS

The internal plumbing work shall be carried out to the satisfaction of and in accordance with the regulations of the local water authority.

11.20 RAINWATER INSTALLATIONS

Rainwater installation shall be in grey PVC pipework with '0' ring joints.

11.21 TESTING PLUMBER'S WORK

The plumbing work and sanitary fittings shall be tested at such times as the engineer shall direct and to his entire satisfaction. Gutters and rainwater pipes shall be tested with water to satisfy the engineer that gutters are to correct falls, pipes are unobstructed and joints are sound.

11.22 SETTING OUT

The positions of all pipe runs, including joints and connections, shall be agreed with the engineer before work is commenced.

11.23 COPPER TUBES AND FITTINGS

Light gauge copper shall comply with BSS 2871 Part 1.

Fittings – Fittings and couplings for jointing pipes shall comply with BSS 2871 Part 1 for capillary and compression type A fittings.

Fixing – Tubes shall be fixed clear of walls or soffits with two piece copper spacing clips complying with BSS 1494 part 1 but in metric sizes to horizontally and 1.5 metres vertically for 15mm diameter pipes 2.0m horizontally and 2.5m vertically for 22 and 28mm diameter pipes.

11.24 PLASTIC PIPES, FITTINGS AND ACCESSORIES

uPVC soil and ventilating pipes and fittings shall comply with BSS 4514. Waste pipes and fittings shall be modified unplasticised polyvinyl chloride (MUPVC). Waste traps shall comply with BSS 3943. Ballon gratings shall be plastic coated steel.

11.25 SLEEVES

Where sleeves are required for pipes passing through concrete or block work they shall be of galvanized steel heavy gauge tube of sufficient diameter to give a space of 3mm all round the pipe.

11.26 PIPEWORK GENERALLY

Pipes shall be in the maximum length possible to avoid unnecessary jointing and fixed to sufficient falls to prevent air locks and to enable the system to be drained down.

11.27 BRASSWORK

Ball valves – piston type ball valves shall comply with BSS 1212 part 3 for high or low pressure as described. Floats to break feed cisterns shall be copper type complying with BSS 1968.

Bib – taps shall comply with BSS 1010 part 2 and shall be of brass with fixed jumpers, chromium plated and colour coded for hot and cold.

Stop valves shall comply with BSS 1010 part 2 and shall be of brass with crutch handles

11.28 CISTERNS

Storage cisterns and break cisterns shall be galvanized steel cisterns complying with BSS 417

11.29 SANITARY FITTINGS

Sanitary fittings shall be manufactured from glazed vitreous china complying with the requirements of BSS 3402. They shall be supplied by an approved firm and shall pass the requirements of the Local Water Authority.

PLASTERWQRK AND OTHER FLOOR. WALL AND CEILING FINISHINGS

11.30 GENERAL

All branded materials shall be delivered in the manufacturer's package bearing the manufacturer's name and the name of the material concerned. Cement, lime, plaster etc., shall be stored separately off the ground in dry conditions. All surfaces shall be properly prepared for plastering rendering and screeding and brushed o cleaned from dust and all traces of efflorescence and contamination removed. Concrete surfaces shall be thoroughly cleaned free from all traces of mould, oil or other formwork coatings and hacked to provide a key.

Surface to receive plastering, rendering, screeding etc. shall be wetted sufficiently in advance to ensure the correct conditions for adhesion. Undercoats shall be thoroughly scratched for key and allowed to dry sufficiently before application of further coats. Dubbing out shall be in the same mix as the subsequent coat and shall not exceed 20mm in thickness in one application.

11.31 METAL LATHING

Metal lathing shall be light galvanized expanded metal weighing not less than 1.2kg per square meter and comply in all other respects with BSS 1369.

11.32 CEMENT

Cement shall be ordinary Portland cement and shall comply with BSS 12. White and coloured cements shall comply with BSS 12 and shall be obtain from an approved manufacturer.

11.33 SANDS

Sand for cement and lime shall comply with BSS 1199 for undercoats and for finishing coat Sand for floor screeds shall comply with BSS 1199.

11.34 LIME PUTTY

Lime putty shall be prepared from hydrated lime complying with BSS 890. Hydrated lime shall be added to water, stirred to a creamy consistency and left to mature for at least sixteen hours before use. Alternatively, ready slaked lime may be obtained from an approved manufacturer. The lime putty shall be protected from drying out.

13.35 PLASTICISERS

Plasticisers shall be of the resin type and shall be used only with the approval of the engineer in accordance with the manufacturer's instructions.

11.36 WATERPROOFERS

Waterproofers shall be approved integral water roofers and shall be used in accordance with the manufacturer's instructions.

11.37 ANGLE AND CASING BEADS AND RENDER STOPS

Galvanized steel angle and casing beads and render stops shall be as manufactured by 'Expamet' or other equal and approved.

11.37 TILEWORK

GLAZED CERAMIC WALL TILES

Glazed and eggshell ceramic wall tiles shall comply with BSS 6431 and shall be of the colours described. Samples of tiles shall be submitted to the Engineers for approval.

ADHESIVE

Adhesive for fixing wall tiles shall be an approved adhesive.

FIXING WALL TILES

Tiles shall be wiped clean and fixed dry with the approved adhesive all in accordance with manufacturer's recommendations with straight joints 1.6, wide, pointed in white cement.

CERAMIC FLOOR TILES

Ceramic floor tiles shall be fully vitrified clay tiles complying with BSS 6431 and having a water absorption not exceeding 0.3%.

LAYING FLOOR TILES

For laying of floor tiles the surface of the compacted bedding shall be spread with a 3mm thick cement and sand (1:1) slurry. Floor tiles shall be wiped clean and laid dry, square pattern with 3mm wide joints and tapped into the grout. Pointing shall be in an approved proprietary tile grout, tinted to match floor tiles.

11.38 FIXING METAL LATHING

At junctions of blockwork and concrete where rendering continues over both surfaces a 100mm wide strip of expanded metal lath shall be fixed, centered on the joint.

11.39 FINISH

Cement lime sand undercoats shall be allowed to dry out thoroughly before a further coat is applied and scratched to provide an adequate key for the next coat. The finishing coat shall be finished with a steel float, a neat cut shall be made with the, edge of the 4 trowels through all coats of the wall plaster at junctions with concrete columns and soffits.

11.40 INTERNAL RENDERING

The internal rendering on concrete block panels shall be two coat work, total 20mm finished thickness. The undercoat to be 1:1:5 cement, lime putty, sand by volume, 9 to 12 mm thick and scratched for key. The finishing coat to be 1:1:6 cement, lime putty, sand volume, 6 to 9mm thick, 191ulfils191 smooth. At junctions of panels to concrete columns and beam soffit finish the rendering with a clean trowel cut through both coats of renderine.

11.41 EXTERNAL RENDERING (TYROLEAN)

The external rendering on concrete blockwork and outer face of in-situ concrete frame shall be two coat work, total 15mm finished thickness. Clean and prepare concrete surfaces, shot pin metal lath strip 10mm wide at concrete/blockwork junctions and apply undercoat 10mm finished thickness of 1:1:6 cement, lime putty, sand by volume, floated smooth. The finished coat shall be approximately 6mm thick off white culamix tyrolean open honeycombed texture machine applied to the required thickness by skilled operatives strictly in accordance with the manufacturers recommendations, manufactured and supplied by Blue Circle Industries Ltd., agents in Kenya, Kencem, P.O. Box 14267, Nairobi, Kenya or other approved alternative. The undercoat surface shall be sound and clean and free from any loose material. All window and door frames shall be protected by suitable masking.

11.42 EXPANSION JOINTS

Expansion joints in clay ceramic tile flooring shall be 6mm wide x 50mm deep, unless otherwise described, formed with 6mm wide x 38mm dept butyl rubber or other equal and approved compressible strip pointed with 6mm wide x 12mm deep

polysulphide compound to match colour of tilling. All surfaces of concrete or screed in contact with the butyl rubber shall be primed.

Expansion joints shall be formed at perimeters and at not less than 4.5 metre center
both ways in the tiled areas.

11.43 PREPARATION, PAINTING AND DECORATING

Concrete floors to receive screeds shall be backed where necessary to remove concrete, plaster or mortar dropping and well brushed to remove all loose particles and dirt. Concrete floors shall be well wetted before the screeds are laid.

11.44 PAINTING AND DECORATING

11.44.1 PAINT AND PAINTING

All paint, including primers, undercoats and furnishings, polish, emulsion etc. to be used shall be obtained ready for use from the manufacturer approved by the engineer.

The contractor shall order direct from the manufacturer and only fresh paint will be allowed to be used.

All paints shall be of the qualities, i.e. exterior, interior etc., types and colours scheduled. All coats of paint system shall be obtained from the same manufacturer shall be ordered for use together and as far as practicable, shall be ordered on one order in sufficient quantity for the whole of the work, particularly in the case of the finishing colour. Where more than one of the three systems (gloss, semi-gloss or flat) is in use, these paints shall be used in strict accordance with their instructions.

The contractor shall use only paints delivered to the site in original sealed containers, not exceeding five litre capacity, stamped and bearing the manufacturer's name of mark, the specification number, method of application (e.g. brushing) colour, quantity, batch number and date of manufacture and expiry.

Contractor's stock shall not be accepted unless expressly approved by the engineer.

The paint, which will be subjected to sampling and testing, shall be used exactly as received, after adequate stirring, without the addition of thinners, driers, or
adulterating materials of any kind.

All tints and shades (including colours of undercoats) shall be selected and approved by the engineer and the contractor shall allow in his prices for

executing the paintwork in colour schemes, to be prepared from a wide range of colours.

All paints described, as oil paint shall be alkyd paint.

No painting on exterior work shall be carried out in wet weather or upon surfaces which are not thoroughly dry. Painting shall not proceed in dusty conditions. Each coat of paint shall be thoroughly dry and shall be rubbed down with glass paper before a subsequent coat is applied. Adequate care must be taken to protect surfaces of wet paintwork. Lead based priming paints for steel work shall conform to BSS 2523.

11.44.2 IRONMONGERY FURNITURE

The rate for painting shall include for taking down and refixing ironmongery furniture, kicking plates etc. as necessary.

11.45 ACCESS ROADS AND FOOTPATHS

11.45.1 PREPARATION OF ROAD FORMATION

After excavation of filling has been completed the road formation shall be shaped to the required contour and compacted with an 8 – 10 tonne roller.

If any soft places develop in the formation during compaction they shall be excavated to such depths as the engineer may direct, refilled with hardcore or other approved granular material, leveled and re-compacted before the sub-base is laid.

11.45.2 MURRAM SUB-BASE

The murrain sub-base will be constructed only in poor soil conditions where directed by the engineer. The murrain shall be from an approved source quarried so as to exclude vegetable matter, loan topsoil or clay. The California Bearing Ration of the Murrain, as determined for sample compacted to maximum density as defined under SRN 601 and allowed to soak in water for four days, shall not be less than 30. This C.B.R. is a guide to quality only and the compaction in the work will be judged by density.

The murram sub-base shall be of thickness as shown on drawings or stated in the Bill of Quantities.

The sub-base shall be evenly spread and compacted using 8-10 tonne roller for road construction and contractor will be required to maintain the selected material at its optimum moisture content to achieve maximum compaction. The roads and footpaths shall be finished to the grades and levels shown on the drawings.

11.45.3 WATER-BOUND MACADAM BASE

The base shall consist of crushed building stone mechanically laid in one or more separate layers, so as to give a total compacted thickness as shown on the drawings, or stated in the Bill of Quantities. The first layer shall be laid to produce a thickness of 75mm to 150mm after compaction as specified. Where a greater thickness that 150mm of base is specified the material shall be in separate layers each not less than 75mm or than 150mm in thickness after compaction.

The stone shall have the following grading: -

Standard sieve size	% by weight passing
5in(125mm) ring	100
3 in (75mm)	25-80
1.5in(38mm)	0-20
¾in. (20mm)	0-5

Alternatively a stone base may be placed by hand. In this case the first stones in each layer, which shall be of a cubicle nature, shall be placed to the approximate height of the layer. When an area has been covered in this way a second placing of stones or smaller size shall be positioned by eye in the spaces between these first placed, and wedged home by hammering. A third placing of stone shall follow the second and so on until in the opinion of the engineer the voids are sufficiently filled to permit compaction.

Thoroughly watering shall be carried out at all stages of compaction. Initial compaction shall be with a light roller. The surface shall be blinded with quarry dust so as to fill the interstices complete and gain rolled, this time using a heavy roller. The base shall then be well watered and brushed and permitted to dry. Further rolling with heavy roller, blinding with quarry dust, watering and brushing shall be carried on until the whole presents a homogeneous surface and no movement is visible under the action of the heavy roller. On completion of the base, and before any surfacing is laid the finished surface shall be painted free from potholes, ruts and undulations, irregularities, depressions, loose material or other defects and shall remain true to cross-section, line and level.

11.45.4 ROLLED ASPHALT HOT WEARING COURSE

Rolled asphalt wearing course shall be made and laid in accordance with BSS 594 rolled Asphalt (Hot process) and the thickness after compaction shall be as shown on the drawings or stated in the Bill of Quantities.

Except where impracticable the rolled asphalt shall be laid using an approved paver.

Where a base course has been used as part of the surfacing, the wearing course shall be laid thereon as soon as practicable, care being taken that the latter is thoroughly clean. In any case the wearing course should be laid within 3 days of the laying if the base course, unless the Engineer allows otherwise, and no construction or other traffic shall be allowed on the base course.

11.45.5 BITUMEN MACADAM WEARING COURSE

Bitumen macadam wearing shall be made and laid in accordance with BSS 3690 part 1 and 3 and nominal size of aggregate all as shown on the drawings or stated in the Bill of Quantities except where impracticable the bitumen macadam shall be laid using an approved paver. The maximum mixing temperature for straight run bitumen of penetration 85 – 100 is 155 degrees centigrade. For other penetration bitumen it shall be as determined by the Engineer.

11.45.6 COMPACTION AND SURFACE FINISH

As soon as rolling can be effected without causing undue displacement of the material, and while the material is above the minimum temperature it shall uniformly compacted by an 8 – 10 tonnes roller having a width of toll not less than 18 inches.

11.45.7 PREPARATION OF THE BASE FOR SURFACE OR SURFACE DRESSING

Before any binder or a coating material is applied to a base the latter shall have been freed from all extraneous material by brushing with mechanical sweepers or stiff brooms.

Macadam or murrain bases shall normally receive a priming coat in accordance with the following clause.

Concrete, bitumen bound or rolled asphalt bases shall normally receive a tack coat in accordance with the following clause.

11.45.8 PRIME COAT AND TACK COAT

When a base is to be sealed before surfacing by means of a prime coat, the surface shall first be prepared in accordance with the preceding clause.

Unless otherwise stated in the Bill of Quantities or ordered by the Engineer, the prime coat material shall be bitumen grade M.C.O. at a rate of application of 1.2 – 1.5 lit/s.q.m. It shall be applied with a mechanical bitumen distributor complying with the requirements or BSS 1707 Binder Distributors for Road Surface Dressing.

The prime coat shall be cured for 48 hours. This period may be relaxed at discretion of the engineer who shall be informed and shall give his consent before any surfacing works are commenced.

The contractor shall not permit traffic to run on a prime coat. Where this is ...; unavoidable to the engineer shall order an application of medium sand at a rate of 6kg./sq.m, which item shall be measured and paid for separately.

Unless otherwise stated in the Bill of Quantities or ordered by the engineer, the tack coat material shall be approved bitumen emulsion in accordance with BSS 1707 Bitumen Road. Emulsion containing not less than 55 of the bitumen. It shall be mechanically applied at a rate of 0.38 – 0.43 lit/sq.m.

The tack coat shall be allowed to cure to a tacky condition and the engineer's consent obtained before any surfacing works are commenced. Any ponding which has occurred out to bring the coverage within the limits specified.

The contractor shall not permit traffic under any circumstances to run on a coat.

11.45.9 ROLLING OF SURFACE MATERIALS

The type and weight of the roller to be employed on each courses of surfacing shall be approved beforehand by the engineer. Notwithstanding, the engineer may call for a certified weigh bridge ticker in respect of any roller at any time. Roller wheels shall always be clean and even. An adequate water tank shall be provided together with a fully operating roller sprinkler system. The roller shall be operated by a man fully trained and experienced in rolling technique.

Rolling shall be generally carried out in a longitudinal direction, working from the edge of super elevated carriageway, from the low to the high side. The second pass should be precisely on the path of the first, before the roller shifts transversely. Heavy drive wheels should approach the freshly laid material. Reversing should be carried our slowly and smoothly and the reversing points staggered across the carriageway to avoid any wave effect. Rolling should be continued until all rollmarks are eliminated and there is no perceptible movement under the roller wheels.

Idle standing on freshly laid material is not permitted.

If the total of surfacing to be compacted exceeds 3,330 sq,m. per day, the contractor shall provide a second roller.

In confined areas where normal rolling is not possible, mechanical tamping will be permitted. The tampers must be employed systematically to give a smooth 'as – rolled' finish.

11.45.10 TRAFFIC ON NEWLY CONSTRUCTED ROADS

No traffic will be permitted to use a new carriageway at any stage of construction without the written permission of the engineer.

Notwithstanding any conditions which the engineer may stipulate at the time of giving his permission of the engineer.

Notwithstanding any condition the engineer may stipulate at the time of giving his permission, the contractor will be solely responsible for maintaining the new carriageway, keeping the surface clean and for making good at his own expense any damage or wear so caused.

11.45.11 LAYING KERBS, CHANNELS AND EDGING BLOCKS

Kerbs, channels and edging blocks shall be bedded true to line and level in cement mortar on a concrete foundation class 15/20. The shall be haunched with concrete "class 1520. The foundation and haunch shall be laid before the approved sub-base is laid to the dimensions shown on the drawings.

11.45.12 PREPARATION OF FOOTHPATH FORMATION

After the excavated of filling has been completed as specified the footpath formation
shall be regulated to an even and uniform surface, and compacted with a roller weighing not less than 2.5 tonnes.

If any soft places develop in the formation during compaction they shall be excavated and backfilled with approved granular material, leveled and recompacted.

11.45.13 PRECAST CONCRETE PAVING SLABS

Precast concrete paving slabs shall be to BSS 368 and shall be jointed with 1:3 lime mortar. They shall be laid at a level not exceeding 4mm above the top of the kerb or concrete edging. The joints shall be thoroughly cleaned out and grouted with cement mortar well brushed in and flushed off. No cracked or broken slabs shall be used.

11.46 CHASING

Chasing in load – bearing walling for pipes, etc. is to be kept to a minimum size of cut and positions and runs of chases are to be approved by the engineer before any cutting is commenced.

11.47 DAMP-PROOF COURSE (DPC)

Damp – proof courses shall be 1000 gauge polythene free from tears and holes and be laid with 150mm minimum laps on and including a leveling screed of cement mortar.

11.48 BITUMINOUS FELT ROOFING

Bituminous felt roofing shall be-carried out complete by an approved specialist sub-contractor.

Felt roofing shall be executed in accordance with BSS 747 and strictly in accordance with the manufacturer's instructions, laps shall be 100mm minimum and falls 100mm in 3 metres for flat roofs and minimum specification shall be as follows:-

(a) One layer of asphalt saturated felt (weighing 6.8 kg per 10 square metres) laid loose to screed or random and lap nailed to the boarding ,

(b) One layer of ditto – but weighing 9 kg per 10 square metres and bedded to underlayer with hot bituminous compound

© One layer of white mineral surfaced roofing felt (weighing not less than 23 kg per 10 square metres) bedded to underlayer with compound as last.

11.49 HACKING ETC

The prices for all pavings and plastering, etc., shall include for hacking concrete • surfaces and for raking out joints of walls 12mm deep and for cross scoring undercoats to form a proper key.

Plastering on walls generally shall be taken to include flush faces of lintels, beams, etc in same.

11.50 SURFACES

All surfaces to be paved or plastered must be brushed clean and well wetted before each coat is applied. All cement pavings and plaster shall be kept continually damp in the interval between application of coats and for seven days after the application of the final coat.

11.51 PRICES FOR PAVING

Prices for paving are to include for adequate covering and protection during the progress of the works to ensure that the floors are handled over in perfect condition on completion.

11.52 POLISHED TERRAZO

Polished terrazzo shall be laid by an approved sub-contractor and shall consist of a screed or backing coat and a finishing coat of 'snow Crete' and marble chippings (1:2) mixed with 'cemantone no 1 coloring compound in accordance with the manufacturer's instructions in the proportions of 1 kg. Compound to 10 kg Cement. Overall thicknesses are to be as specified.

The finishing coat shall be a minirnurn of 12mm thick for paving toweled to a smooth and even finish and well rubbed and polished with cabronrundum.

11.53 SITE

Construction site with buildings in progress with restricting space assigned for the drilling and drilling operations. Liaison with other contractors on site scaffolding protections or from main contractor.

12: Specification for Electrical Works

INDEX TO SECTIONS

12.1. Scope of Electrical Works & Definition of Terms

12.2. General Specification for Materials and Works

12.3. Particular Specifications

12.1 SCOPE OF ELECTRICAL WORKS

The Electrical works will comprise the complete lighting, security lighting and 13A switched socket outlet installations as shown on the Electrical layout contract Drawings. The installation of meter boards main switches, PME earthing at meter boards, the sub-main for all buildings. The trenching, filling, sanding and backfilling for K.P.&L.C and Telkom Kenya. The street-lighting installation shall include the supply of lighting columns, lighting fittings, wiring, contactors, cut-outs, consumer units, circuit for timing, control and everything necessary to complete, commission and test the electrical installation to the street-lighting to the satisfaction of the Architect and the Electrical Engineer. The main Contractor shall carry out the digging of all trenches and laying of ducts across the streets under supervision of his approved domestic sub-contractor.

All items shall be priced in the various portions described and the tenders containing lump sums to cover groups of works must be broken down to show prices of each item listed before they will be accepted. Lump sums to cover items of preliminaries and additions shall be likewise broken down if so required. The Engineer reserves the right to ask for further breakdown if necessary.

The main contractor is solely responsible for the accurate ordering of materials in accordance with the Drawings, Specifications and Engineer's instructions and no claims for any loss or expenses will be entertained for errors in ordering, whether based on Drawings or Specifications. He shall be required to submit to the Engineer and Architect evidence of orders placed for materials and equipment especially switch-gear, fittings and any other imported goods for their records.

DEFINITION OF TERMS

01. Sub-Contractor

The term Sub-Contractor or Nominated Sub-Contractor where it occurs shall mean the Main Contractor and/or approved Domestic Sub-Contractor.

Similarly the Sub-Contract Agreement shall mean Main Contract.

02. Sub-Contract Works

The term "Sub-Contract Works" shall mean all or any portion

n of work, materials, articles, whether the same are being manufactured or prepared, which are being used in the execution of the Electrical works and whether the same be on site or not.

36. **Specification**

Shall mean the whole of the Sub-Contract documents including but not

restricted to:

(a) This document comprising General Conditions, General specifications, particular specifications and schedule Quantities and Unit rates.

(b) The Contract Drawings.

36. **Bills of Quantities**

In respect to this Sub-Contract shall mean quantities or schedule of rates contained herein.

05. Contract Drawings

Shall mean those drawings issued to the Sub-Contractor at the time of entering into the Sub-Contract agreement for the purpose of carrying out the works and as such form part of specification.

06. Tender Drawings

Shall mean those drawings enclosed herewith forming part of the Sub-Contract works. The Tenderer shall be deemed to have satisfied himself that the drawings contain sufficient details for a tender to be submitted.

07. Working Drawings

Shall mean those drawings required to be prepared by the Sub-Contractor as specified herein.

08. Record Drawings

Shall mean those drawings required to be prepared by the Sub-Contractor showing the Sub-Contract works as installed and other records of the Sub-Contract Works as hereinafter described.

09. Site

Shall mean the lands and other places on under or in or through which the Works shall be carried out and any other places provided by the Main Contractor for the purpose of the Sub-Contract.

010. Working Space

The area of the site which may be occupied by the Sub-Contractor for use of storage or for the erection of the workshops, etc. shall be defined on site by the Main Contractor.

011. Regulations

Any reference to the I.E.E. Regulations shall mean the Regulations of the Electrical Equipment of the Buildings, Fourteenth Edition, issued by the Institution of Electrical Engineers, LONDON, unless otherwise stated.

012. Engineer

For the purpose of this document the term “Engineer” used on its own shall mean the “Electrical Engineer” for LVWSB.

36.I GENERAL SPECIFICATION OF ELECTRICAL MATERIALS AND WORKS

12.2.1 General

12.2.2 Standard of Materials

12.2.3 Workmanship

12.2.4 Procurement of Materials

12.2.5 Working Drawings

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12.2.7 Regulations and Standards

12.2.8 Setting out Works

12.2.9 Position of Electrical Plan and Apparatus

12.2.10 M.C.B. Distribution Panels and Consumer Units

12.2.11 Fused Switchgear and Isolators

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12.2.28 Sockets and Switched Sockets

12.2.29 Fused Spur boxes

12.2.30 Cooker Outlets

12.2.31 Connectors

12.2.32 Lampholders

12.2.33 Lamps

12.2.34 Lighting fittings-street lighting lanterns

12.2.35 Position of points and switches

12.2.36 Tests

12.2.1 GENERAL

This specification is to be read in conjunction with the drawings which are issued with it. Bills of Quantities shall be the basis of all additions and omissions during the progress of the works.

12.2.2 STANDARD OF MATERIALS

Where the materials and equipment are specifically described and named in the specification followed by approved equal, they are so named or described for the purpose of establishing a standard to which the Sub-Contractor shall adhere.

Should the Sub-Contractor install any material not specified herein before receiving approval from the proper authorities, the Engineer shall direct the Sub-Contractor to remove the material in question immediately. The fact that this material has been installed shall have no bearing or influence on the decision by the Engineer.

All materials condemned by the Engineer as not approved for use, are to be removed from the premises and suitable materials delivered and installed in their place at the expense of the Sub-Contractor. All materials required for the Works shall be new and the best of the respective kind and shall be of a uniform pattern.

12.2.3 WORKMANSHIP

The Workmanship and method of installation shall conform to the best standard practice. All works shall be performed by a skilled tradesman and to the satisfaction of the Engineer. Helpers shall have qualified supervision.

Any work that does not in the opinion of the Engineer conform to the best standard practice will be removed and reinstated at the Sub-Contractor's expense.

Permits, Certificates or Licences must be held by all tradesmen for the type of work, in which they are involved where such permits, certificates or licenses exist under Government Legislation.

12.2.4 PROCUREMENT OF MATERIALS

The Sub-Contractor is advised that no assistance can be given in the procurement or allotment of any materials or products to be used in and necessary for the construction and completion of work. Sub-Contractors are warned that they must make their own arrangements for the supply of materials and/or products specified or required. The Sub-Contractor may be called upon to show evidence that satisfactory arrangements have been made for the procurement of any or all material and products required to complete Works.

Copies of purchase orders to suppliers may be requested.

The Sub-Contractor shall be responsible for all site and/or drawing measurements required for computation of quantities or materials required

for the proper execution of the Works.

No claims for extra payment will be considered on the ground of insufficient knowledge, inaccurate measurements or other errors on the part of the Sub-Contractor.

12.2.5 WORKING DRAWINGS

Before manufacture is begun the Sub-Contractor shall submit six copies of detailed drawings of all pieces of equipment including sizes, capacities, construction details, etc. and as may be required to determine the suitability of the equipment for the approval of the Engineer. Approval of the detail drawings shall not relieve the Sub-Contractor of the full responsibility of errors or the necessity of checking the drawings himself or of furnishing the materials and equipment and performing the work required by the plans and specification.

12.2.6 RECORD DRAWINGS

The Engineer will supply the Sub-Contractor with an extra set of white prints on which he shall clearly mark as the job progresses, all changes and deviations from the proposed installation so that the Architect at the completion of the job, will have a record of the exact location of all piping and equipment.

The Sub-Contractor shall also furnish, within a reasonable time after the completion of the Works and prior to the final payment being sanctioned, drawings and diagrams of the Works completed and relating to the whole installation and plant.

These diagrams and drawings shall show the completed installation including sizes, runs and arrangements of the installation. The drawings shall be to a scale not less than 1-50 and shall include plan view and sections.

The drawings shall include all details which may be useful in the operation, maintenance or subsequent modification or extensions to the installation.

Three sets of diagrams and drawings shall be provided, all to the approval of the Engineer.

One coloured set of line diagrams relating to operating and maintenance instructions shall be framed and rounded in a suitable location.

12.2.7 REGULATIONS AND STANDARDS

All Works executed by the Sub-Contractor shall comply with the current edition of the “Regulations” for the Electrical Equipment of Buildings, issued by the institution of Electrical Engineers, and with the Regulations of the Local Electricity Authority.

Where the two sets of Regulations appear to conflict, they shall be clarified with the Engineers. All materials used shall comply with relevant British Standard Specification.

12.2.8 SETTING OUT WORK

The Sub-Contractor at his own expenses, is to set out works and take all measurements and dimensions required for the erection of his materials on site, making any modifications in details as may be found necessary during the progress of the works, submitting any such modifications or alterations in detail to the Engineer before proceeding and must allow in his Tender for all such modifications and for the provision of any sketches or drawings related thereto.

12.2.9 POSITION OF ELECTRICAL PLANT AND APPARATUS

The routes of cables and appropriate positions of switchboards, etc. as shown on the drawings shall be assumed to be correct for purpose of Tendering, but the exact positions of all Electrical Equipment and routes of cables must be agreed on Site with the Engineer before any work is carried out.

12.2.10 M.C.B. DISTRIBUTION PANELS AND CONSUMER UNITS

All cases of M.C.B panels and Consumer Units shall be constructed in heavy gauge sheet with hinged covers.

Removable undrilled gland plates shall be provided on the top and bottom of the cases. Miniature circuit breakers shall be enclosed in moulded plastic with the tripping mechanism and chambers separated and sealed from the cable terminals.

The operating dolly shall be tripfree with a positive movement in both make and break position. Clear indication of the position of the handle shall be incorporated.

The tripping mechanism shall be on inverse characteristic to prevent tripping in temporary overloads and shall not be affected by normal variation in ambient temperature.

The breakers shall be grouped in distribution panels as specified in part III of this specification, all live metal being shrouded or concealed during normal use.

A locking plate shall be provided for each size of breaker. A complete list of circuit details on typed cartridge paper glued to stiff cardboard and covered with a piece of Perspex, and held in position with four suitable fixings, shall be fitted to the inner face of the lids of each distribution panel. The appropriate M.C.B. ratings shall be stated on the circuit chart against each circuit in use. Ivorine labels shall be secured to the insulation barriers in such a manner to determine the number of the circuit shown on the circuit chart.

Neutral cable shall be connected to the neutral bar in the same sequence as the phase cables are connected to the M.C.B.'s. This shall also apply to earth bars when installed.

12.2.11FUSED SWITCHGEAR AND ISOLATORS

All fused Switchgear and isolators whether mounted on machinery, walls or industrial panels shall conform to the requirements of B.S. 861.1955 and where applicable to B.S. 2510.

Fuse links for fused switches are to be of high rupturing capacity cartridge type, conforming to B.S. 88.1952 category of duty 440V AC

12.2.12 CONDUITS AND CONDUIT RUNS

Conduit systems are to be installed so as to allow the loop-in system of wiring.

All conduits shall be black rigid super high impact heavy gauge class “A” PVC in accordance with B.S. 2782 and I.E.E. Regulations B101-105 tests and as manufactured by Egatube Re: HIP or other approved equal to B.S. 4607: part 1,1970. No conduit less than 20mm in diameter shall be used anywhere in this installation.

Conduit shall be installed buried in plaster work and floor screed except when run on wooden or metal surface when they will be installed surface supported with saddles every 600mm. Conduit run in chases shall be firmly held in position by means of substantial pipe hooks driven into plastic wall plugs.

The Sub-Contractor’s attention is drawn to the necessity of keeping all conduits entirely separate from other piping services such as water and no circuit connections will be permitted between conduits and such pipes.

All conduit systems shall be arranged wherever possible to be self-draining to switch boxes and conduit outlet points for fittings. The systems, when installed and before wiring shall be kept plugged with well fitting plugs and when short conduit pieces are used as plugs, they shall be doubled over and tied firmly together with steel wire. Before wiring, all conduit system shall be carried out until the particular section of the conduit installation is complete in every respect.

The sets and bends in conduit runs are to be formed on Site using appropriate size bending springs and all radii of bends must not be less than 2.5 times the outside diameter of the conduit. No solid inspection bends, tees or elbows will be used.

The conduit connections shall either be by a demountable (screwed up) assembly or adhesive fixed and watertight by solution as Egaweld. The tube and fittings must be clean and free of all grease before applying the adhesive. When connections are made between conduit and switch boxes, circular or non-screwed boxes, care shall be taken that no rough edges of conduit stick into the boxes.

Runs between draw-in boxes are not to have more than two right angle bends or their equivalent. The Sub-Contractor may be required to demonstrate to the Engineers that wiring in any particular run is easily withdrawable and the Sub-Contractor may, at no extra cost to the Contract, be required to install additional draw in boxes required. If conduit is installed in straight runs in excess of 600mm. Expansion couplings as manufactured by Egatube Ref: EEC shall be used at intervals of 600mm.

Where conduit runs are to be concealed in pillars and beams, the approval of the Structural Engineer shall be obtained. The Sub-Contractor shall be responsible for marking the accurate position of all holes, chases etc., on site, or if the Engineers so direct, shall provide the Main Contractor with dimensional drawings to enable him to mark out and form all holes and chases. Should the Sub-Contractor fail to inform the Main Contractor of any inaccuracies in this respect they shall be rectified at the Sub-Contractor's expense.

It will be the Sub-Contractor's responsibility to ascertain from Site, details of reinforced concrete or structural steelwork and check from the builder's drawings the positions of the walls, structural concrete and finishes. No reinforced concrete or steelwork concrete may be drilled without first obtaining the written permission of the Structural Engineer.

The drawings provided with these specifications indicate the appropriate positions only of points and switches, and it shall be the Sub-Contractor's responsibility to mark out and centre on Site the accurate positions where necessary in consultation with the Architect and the Engineer. The Sub-Contractor alone shall be responsible for the accuracy of the final positions.

12.2.13 CONDUIT BOXES AND ACCESSORIES

All conduit outlets and junction boxes are to be either malleable iron and of standard circular pattern to B.S. 31 of the appropriate type of suit saddles being used or super high impact PVC manufactured to B.S. 4607; Part 1, 1970.

Small circular pattern boxes are to be used with conduits upto and including 25mm. Outside diameter. Rectangular pattern adaptable boxes are to be used for conduits of 32mm outside diameter and larger. For drawing in of cables in exposed runs of conduit, standard pattern through boxes are to be used.

Boxes are to be not less than 50mm deep and of such dimensions as will enable the largest appropriate number of cables for the conduit sizes to be drawn in without excessive bending.

Outlet boxes for lighting fittings are to be of the loop-in type where conduit installation is concealed and the Sub-Contractor shall allow one such box per fitting, except where fluorescent fittings are specified when two such boxes per fitting shall be fitted flush with the ceiling and if necessary fitted with break joint rings. Buttresses shall be fitted where required to outlets on surface conduit runs.

Adaptable boxes are to be of PVC or mild steel (of not less than 12 s.w.g) and black 209ulfils209209 or galvanized finish to according to location. They shall be of square or oblong shape complete with lids secured by four 2 BA brass roundhead screws. No adaptable box shall be less than 75mm x 75mm x 50mm or larger than 300mm x 300mm x 75mm and shall be adequate in depth in relation to the size of conduit entering it. Conduits shall only enter boxes by means of conduit bushes.

12.2.14 LABELS

Labels fitted to switches and fuseboard:-

i) Shall be Ivorine engraved black on white

ii) Shall be secured by R.H brass screws of same manufacture throughout.

iii) Shall indicate on switches:-

a) Reference number of switch

b) Specified current rating

c) Item of equipment controlled

iv) Shall indicate on M.C.B. panels:-

a) Reference number

b) Type of board, i.e. lighting, sockets, etc.

c) Size of cable supplying panel

d) Where to isolate feeder cable

v) Shall be generally not less than 75mm x 50mm

12.2.15 EARTHING

The earthing of the installation shall comply with the following requirements:-

i) It shall be carried out in accordance with the appropriate sections of the current edition of the Regulations, for the Electrical Equipment of Buildings issued by the Institution of Electrical Engineers.

ii) At all main distribution panels and main service positions a 25mm x 3mm minimum cross sectional area Copper Tape shall be provided and all equipment including the lead sheath and armouring of cables, distribution boards and metal frames shall be bonded thereto.

iii) The earth tape in Sub-Clause (ii) shall be connected by means of a copper tape or cable of suitable cross sectional area to an earth electrode which shall be a copper earth rod (see later sub-clause).

iv) All tapes to be soft high conductivity copper, untinned except where otherwise specified and where run underground on or through walls, floors, etc., it shall be served with corrosion resisting tape or coated with corrosion compound and braided.

v) Where the earth electrode is located outside the building a removable test link shall be provided inside the building as near as possible to the point of entry of the tape, for isolating the earth electrode for testing purposes.

vi) Earthing of sub-main equipment shall be deemed to be satisfactory where the sub-main cables are M.I.C.S. or conduit with separate earth wire, and the installation is carried out in accordance with the figure stated in the current edition of the I.E.E Regulations.

vii) Where the earth rod is specified (see Sub-Clause (iii) it shall be proprietary manufacture, solid hard drawn copper of 15mm diameter driven into the ground to a minimum depth of 3.6m. It shall be made up to 1.2m sections with internal screw and socket joints and fitted with hardened steel tip and driving cap.

viii) Earth plate will not be permitted.

ix) Where the earth rod is used the earth resistance shall be tested in the manner described in the current edition of the I.E.E Regulations, by the Sub-Contractor in the presence of the Engineer and the Sub-Contractor shall be responsible for the supply of all test equipment.

x) Where copper tape is fixed to the building structure it shall be by means of purpose made non-ferrous saddles which space the conductor away from the structure a minimum distance of 200mm. Fixings, shall be made using purpose made plugs. No fixings requiring holes to be drilled through the tape will be accepted.

xi) Joints in copper tape shall be tinned before assembly riveted with a minimum of two copper rivets and sweated solid.

xii) Where holes are drilled in the earth tape for connection to items of equipment the effective cross sectional area must not be less than required to comply with the regulations.

xiii) Bolts, nuts and washers for any fixing to the earth tape must be of non-ferrous material

xiv) Attention is drawn to the need for the earthing metal parts of lighting fittings and for bonding ball joint suspension in lighting fittings.

12.2.16 CABLES AND FLEXIBLE CORDS

All cables in this Sub-Contract shall be manufactured in accordance with the current appropriate British Standard Specification which are as follows:

Rubber Insulated Cables and Flexible cords - BSS 6500

PVC Insulated Armoured Cables - BSS 6004

Butyl Rubber Insulated Cables - BSS 610V

The successful Sub-Contractor will, at the Engineers discretion be required to submit samples of cables for the Engineer reserves the right to call for the cables of an alternative manufacture without any extra cost being incurred.

PVC insulated cables shall be 500/100 Volt Grade. No cables smaller than 1.5mm² shall be used unless otherwise specified. The installation and the finish of the cables shall be as detailed in later clauses. The colour of cables shall conform with the details stated in the "Cables Braid and insulation Colours" Clause.

12.2.17 ARMOURED PVC INSULATED AND SHEATHED CABLES

Shall be 600/1000 Volt Grade manufactured to BSS 6346: 1969 with copper stranded conductors.

The wire armour of the cable shall be used wholly as an earth continuity conductor and the resistance of the wire armour shall have a resistance not more than twice the largest current carrying conductor of the cable.

P.V.C./S.W.A./P.V.C. Cables shall be terminated using "Telecom" "B" type or approved equal glands and a PVC tapered sleeve shall be provided to shroud each gland.

Where cables rise from floor level to Switchgear etc they shall be protected by PVC Conduit, to a height of 600mm from finished floor level, whether the cable is run on the surface or recessed into the wall.

12.2.18 CABLE SUPPORTS, MARKERS AND TILES

All P.V.C./S.W.A./P.V.C. Cables run inside the building shall be fixed in rising ducts or on ceilings by means of die cast cables hooks or clamps, of appropriate size to suit cables, fixed by studs and back nuts to their channel sections.

Alternatively, fixing shall be by B.I.C.C. claw type cleating system with die cast cleats and galvanised mild steel straps or similar approved equal method. For one or two cables run together the cleats shall be fixed to special channel section supports or backstraps described above which shall in turn be secured to walls or ceilings of ducts by rawbolts.

In excessively damp or corrosive atmospheric conditions special finishes may be required and the Sub-Contractor shall apply to the Engineer for further instructions before ordering cleats and channels for such areas.

The above type of hooks and clamps and channels or cleats and backstraps shall be used for securing cables in vertical ducts.

Cables supports shall be fixed at 600mm maximum intervals, the supports being supplied and erected under this Sub-Contract. Saddles shall not be used for supporting cables nor any other type of fixing other than one of the two methods described above or other system which has received prior approval of the Engineer.

Cables are to be kept clear of all pipe work and the Sub-Contractor shall work in close liaison with other services Sub-Contractors.

The Sub-Contractors shall include for the provision of fixing of approved type

coloured slip on cable end markers to indicate permanently the correct phase and neutral colours on all cable ends.

Provision shall be made for supplying and fixing approved non-corrosive metal cable markers to be attached to the outside of all P.V.C./S.W.A./P.V.C. cables sat 15mm intervals indicating cable size and distinction.

Where P.V.C./S.W.A./P.V.C. cables are run outside the building they shall be laid underground 750mm deep with protecting concrete interlocking cover tiles laid over which shall be provided and laid under this Sub-Contractor. All necessary excavations and Contractor, unless otherwise stated.

12.2.19 PVC INSULATED CABLES

Shall be of non-braided type as C.M.A reference 6491 x 600/1000/1000 Volt Grade cables, or approved.

PVC cables shall conform to the details of the “Cables and Cords” and “Cables Braid and Insulation Colours” clauses.

12.2.20 HEAT RESISTING CABLE

Final connections to cookers, water heaters, etc., shall be made using butyl rubber insulated cable as C.M.A reference 610V butyl (Single core 600/1000 Volt).

This type of cable shall be used in all instances where a temperature in exceeding 43°C but not exceeding 64°C is likely to be experienced.

Final connections to all lighting fittings (and other equipment where a temperature in excess of 64°C is likely to be experienced) shall be made using silicone insulated cable or equal approved.

12.2.21 FLEXIBLE CORDS

Shall be in accordance with the “Cable and Flexible Cords” Clause. No cord shall be less than 24/0.4mm in size unless otherwise specified.

Circular White twin T.R.S. Flex shall be used for plain pendant fittings upto 100 watts. For all other types of lighting fittings the flexible cable shall be silicone rubber insulated.

No polythene insulated flexible cable shall be used in any lighting fitting or other appliance (see “Heat resisting Cables” Clause 30).

12.2.22 CABLE ENDS AND PHASE COLOURS

All cable ends connected up in switchgear, M.C.B. panels etc. shall have the insulation carefully cut back and the ends sealed with Hellerman rubber slip on cable end markers.

The markers shall be of appropriate phase colour for switch and all other live feeds to the details of the “Cable insulation Colours” clause. Black cable with black end markers shall only be used for neutral cables.

12.2.23 CABLE INSULATION COLOURS

Unless otherwise stated in later clauses the insulation colours shall be in accordance with the following table.

Where other systems are installed the cable colours shall be in accordance with the details stated in the appropriate clause.

SYSTEM INSULATION CABLE END MARKER LIGHTING AND POWER

1) Main and Sub-Mains

a)	Phase	Red		Red	
b)	Neutral		black		Black

2) Sub-Circuits Single Phase

a)	Phase	Red		Red	
b)	Neutral		Black		Black

12.2.24 SUB-CIRCUIT WIRING

For all lighting and sockets wiring shall be carried out in the “Looping in” system and there shall be no joints whatsoever. No lighting circuits shall comprise more than 20 points when protected by 10A MCB. Cables with different cross-section area of copper shall not be used in combination.

Lighting circuits PVC Cable.

1.5mm² for a maximum of ten switched 13 Amp sockets wired from a 30A fuseway.

Power circuits PVC Cable.

i) 2.5mm² for one, two or three 5 Amp sockets wired in parallel.

ii) 2.5mm² for one 15 Amp socket.

iii) 2.5mm² for a maximum of ten switched 13amp sockets wired from a 30 Amp fuseway.

The wiring sizes for lighting circuits and sockets are shown on the drawings. In such cases, the sizes shown on the drawing or specified in later clauses of this Specification.

12.2.25 SPACE FACTOR

The maximum number of cables that may be accommodated in a given size of conduit of trunking or duct is not to exceed the number in tables B.5 and B.6 or as stated in Regulation B91, B.117 and B.118 of the I.E.E. Regulations whichever is appropriate.

12.2.26 INSULATION

The insulation resistance to earth and between poles of the whole wiring system, fittings and lamps, shall not be less than the requirements of the latest edition of the I.E.E. regulations. Complex tests shall be made on all circuits by the Sub-Contractor before the installations are handed over.

A report of all tests shall be furnished by the Sub-Contractor to the Engineer. The Engineer will then check test with his own instruments if necessary.

12.2.27 LIGHTING SWITCHES

These shall be mounted flush with the walls, shall be contained in steel or alloy boxes and shall be of gangs and ratings as shown on the drawings, complete with overlapping ivory cover plastic plates and switch dollies. They shall be as manufactured by M.K. Electrical Ltd., or other equal and approved to B.S. 3676.1963.

12.2.28 SOCKETS AND SWITCHED SOCKETS

These shall be flush Pattern in steel box complete with overlapping ivory cover plastic plates.

They shall be 13 Amp, 3 pin, shuttered, switched and as manufactured by M.K. Electrical Co. Ltd., or other approved equal to B.S. 1363.1947.

12.2.29 FUSED SPUR BOXES

These shall flush, D.P. switched as specified as specified in steel box with ivory overlapping plastic cover plates with pilot light as manufactured by M.K. Electrical Co. Ltd., or other approved equal to B.S. 1362.1953.

12.2.30 COOKER OUTLETS

These shall be flush mounted with 13 Amp switched socket outlets and two neon indicator lamps one for the socket outlet and the other for the cooker.

The cooker control units shall be as manufactured by M.K. Electrical Co. Ltd., or other approved equal to B.S. 4177.1967.

12.2.31 CONNECTORS

Shall be of the porcelain normal size 2 brass screws, type of appropriate rating. These shall be fitted at all conduit box lighting point outlet for jointing of looped PVC cables with flexible cables of specified quality.

12.2.32 LAMPHOLDERS

Shall be of the extra heavy H.O skirted pattern and shall be provided for every specified lighting fitting and shall be B.C.E.S or G.E.S as required. All E.S and G.E.S holders shall be heavy brass type (except for plain pendants where reinforced Bakelite type shall be used). The screwed cap of the E.S and G.E.S holders shall be connected to the neutral.

Where lamp holders are supported by the flexible cable, the holders shall have "cord grip" arrangements and in the case of metal shades earthing screws shall be provided on each of the holders.

The Sub-Contractor must order the appropriate type of holder when ordering lighting fittings, to ensure that the correct types of holders are provided irrespective of the type normally supplied by the manufacturers.

12.2.33 LAMP

All lamps shall be suitable for normal stated supply voltage and the number and sizes of lamps detailed on the detailed on the drawings shall be supplied and fixed. The Sub-Contractor must verify the actual supply voltage with the supply authority before ordering the lamps.

Tungsten filament lamps shall be manufactured an accordance with B.S. 161 for general service lamps and BSS 1853.

Pearl lamps shall be used in all fittings unless otherwise specified.

12.2.34 LIGHTING FITTINGS

This Sub-Contract shall include for the provision, handling charges, taking the delivery, safe storage, wiring (including internal wiring) assembling and erecting of all lighting fittings shown on the drawings.

All fittings and pendants shall be fixed to conduit boxes with brass R/H screws. These to be in line with metal finish of fittings. The lighting fittings are detailed for the purpose of establishing a high standard of finish and under no circumstances will inferior fittings be permitted as substitutes.

In case of rectangular shaped ceiling fittings, the extreme ends of the fittings shall be secured to suitable support in addition to the central conduit box fittings. Supports shall be provided and fixed by the Sub-Contractor.

The whole of the metal work of each lighting fittings shall be effectively bonded to earth. In the case of ball and/or knuckle joints short lengths of flexible cable shall be provided, bonded to the metal work on either side of the joints. If the above provisions are not made by the manufacturers, the Sub-Contractor shall include cost of additional work necessary in his Tender. See "Flexible Cords" clause for details of internal wiring of lighting fittings. Minimum size of internal wiring shall be 20.02mm (23/0057). Each lighting fitting shall be provided with number, type and size of lamps as detailed on the drawings. It is to be noted that some fittings are suspended as shown on the drawings.

12.2.35 POSITIONS OF POINTS AND SWITCHES

Although the approximate positions of all points are shown on the drawings enquiry shall be made to the exact positions of all M.C.B panels, lighting points, socket outlet etc., before work is actually commenced. The Sub-Contractor must approach the architect with regard to the final layout of all lights on the ceiling and walls.

Where two or more points are show adjacent to each other on the drawings, e.g., socket outlet and telephone outlet, they shall be lined up vertically or horizontally on the centre line of the units concerned.

Normally the units shall be lined up on vertical centre lines, but where it is necessary to mount units at low level they shall be lined up horizontally.

The Sub-Contractor must consult with the Engineer in liason with the Clerk of Works, or the General Foreman on site regarding the positions of all points before fixing any conduits etc. The Sub-Contractor shall be responsible for all alterations made necessary by the non-compliance with this clause.

36.I.1 TESTS

The tests prescribed in Section E of the 14th Edition of the I.E.E. Regulations for the Electrical Equipment shall be carried out on the complete installation by the Sub-Contractor. In the event of any portion of the installation failing to comply with these tests and which are found to be at fault in any subsequent testing by the Government Inspector, or the Electrical Inspector they may appoint to act on their behalf, the Sub-Contractor shall rectify the faults at his own expense and shall pay all fees involved in re-testing the installation.

In addition to tests carried out by or on behalf of the Government Electrical Inspector or the Supply Authority, the Sub-Contractor shall provide accurate instruments and apparatus and all labour for any further tests called for by the Engineers.

The installation when complete shall pass the following test:

1. Insulation resistance between line and neutral.

2. Insulation resistance between line and earth and resistance between neutral and earth.

3. Earth continuity resistance including all fittings.

4. Earth electrode impedance.

5. Polarity check.

The Contractor shall submit a completion certificate to the Kenya Power and Lighting Company for electricity connection and furnish copies of all the test results mentioned in this section of the Engineer.

12.3. PARTICULARS SPECIFICATION OF WORKS UNDER SUB-CONTRACT

12.3.1 Contract Drawings

12.3.2 Supply

12.3.3 Meterboards

12.3.4 Local Circuit Distribution Boards & Consumer Units

12.3.5 Lighting Installation

12.3.6 Socket Outlet Installation

12.3.7 Cooker and Water Heater Outlets Installation

12.3.8 Telephone Outlets

12.3.9 Schedule of Manufactures.

12.3.1 CONTRACT DRAWINGS

The work to be executed shall be as described in this specification and as set out in the following drawings which are to be read in conjunction with the Specifications.

12.3.2 SUPPLY

The 415 volts, 50Hz and 3 phase supply will be provided, installed and terminated by the Kenya Power & Lighting Company Limited, in the position of the meter board shown in the drawings.

The Sub-Contractor shall be responsible for the supply and installation of the switchgear and all associated cable works in a manner acceptable to the power authority.

The Sub-Contractor shall also liaise with the authority as to the most economical method of connection which is acceptable to them.

12.3.3 METERBOARDS

The meter board shall be fabricated from 16-gauge galvanized sheet metal to a design approved by the Engineer.

The meter board which shall be fixed semi-recessed shall be weather proof and finished in paint as approved by the Architect. The meter board shall be provided with a lockable door complete with a glass window for meter reading.

The Sub-Contractor shall allow in his Tender Price for all the cables required for looping-in to the meters and all equipment installed in the meter board.

12.3.4 CONSUMER UNITS

From the meter board position, the sub-contractor shall provide and install 5 x 100mm2 PVC cable run in 32mm diameter super high impact PVC conduit to the position of the Distribution board.

The distribution board shall be the M.C.B. Type Flush mounted with hinged cover as M.K or other approved equal to B.S.

12.3.5 LIGHTING INSTALLATION

From the Consumer Unit position, the Sub-Contractor shall apply and install 2 x 1.5mm^2 PVC cables in heavy gauge PVC conduit hidden in the building fabric to the lighting points. The various approximate positions of lighting points are indicated on the drawings. The exact positions of these outlets shall be determined on site and it is the responsibility of the Sub-Contractor to confirm these exact positions for each Unit with the Electrical Engineer and the Architect.

The Sub-Contractor shall allow in his price for the supply handling, erection and connection of all lighting fittings complete with lamps, except for pendant outlets to be provided with ceiling rose and lamp holders connected by approximately 0.75m of Butyl rubber installed white two or three-core cables as may be required.

The switches shall be of the number of gangs shown on the drawings and shall be as manufactured by “M.K. Electric Co. Ltd.” Or approved equal. All switches shall be of the same manufacture, design and colour.

All fittings with metal parts shall be earthed as required by I.E.E Regulations.

12.3.6 SOCKET OUTLET INSTALLATION

From the Consumer Units, the Sub-Contractor shall supply and install 2 x 2.5mm2 PVC cables enclosed in heavy gauge PVC conduit hidden in the building fabric.

Generally socket outlets shall be 300mm from finished floor except in the kitchen where they shall be 135mm.

The socket outlets shall be as manufactured by “M.K. Electric Co. Ltd.” Or other approved equal to BSS 1363:1947. All the socket outlets shall be of the same manufacture, design and colour as the lighting switches.

12.3.7 COOKER AND WATER HEATER INSTALLATION

From the final Sub-circuit Consumer Unit, the Sub-Contractor shall provide 2 x6mm^2 PVC cables in heavy gauge super high impact conduit of at least 25mm diameter to all position of cooker control unit as well as 1 x 6mm^2 green cable for earthling.

From the cooker control unit, a short drop of conduit set flush in the wall shall be provided to a suitable cooker connector block at a height of 500mm

finished floor level. No wiring will be provided through this conduit under this sub-contract.

12.3.8 TELEPHONE OUTLETS

From the position shown by the Telkom telephone entry at high level and bent downwards, the sub-contractor shall run 20mm heavy gauge super high impact PVC conduit to link all telephone outlets. The telephone outlets shall terminate in each position at a height of 300mm from finished floor level.

The telephone cord outlet shall be as manufactured by "M.K. Electrical Co. Ltd." Or approved equal. Suitable draw wires shall be left in all conduit accessible at each outlets. The actual wiring of the outlets will be done by the Telkom Kenya

36.I.1 SCHEDULE OF MANUFACTURERS

ITEM	**MANUFACTURERS**
Switchgear	ABB, M.K. Crabtree or approved equal
Distribution Panels, Consumer Units And M.C.B's H.G. PVC Conduits, Accessories	ABB, M.K. Crab Tree or approved equal
PVC/S.W.A/PVC	E.A. Cables Kenya or approved equal
PVC Cables	E.A. Cables Kenya or approved equal
Lighting Fittings	M.K. Crab Tree or approved equal
Lighting Switches	M.K. Crab Tree or approved equal
Socket Outlets	M.K. Crab Tree or approved equal
Fused Spur Boxes	M.K. Crab Tree or approved equal
Fire Alarm System	Gent Chloride or approved equal

14.0 Treatment Works Specification

14.1 GENERAL PROVISIONS

14.1.1 Extent of Work

Work under this section of the Specification comprises the supply, delivery to Site, and construction and erection of the complete treatment works and pump stations, as described in the Specification, including all materials, labour, transport, implements, and other items necessary for the manufacture and installation of the plant and equipment and the construction of the treatment works and pump stations including, but not limited to, testing at the manufacturer's works, protection of the plant and equipment against corrosion, packing and delivery to Site, erection of the plant and provision of all equipment and materials required for the testing, commissioning and supervision of operation of the Works upon completion, as well as training of the Employer's personnel in its operation.

14.1.2 Limits of Construction and Supply and Installation

The expression "Limits of Construction and Supply and Installation" as used in this Sub-section and elsewhere in this Specification, shall mean the limits of the obligations of the Contractor under the Specification in respect of:

i. the supply of all materials and construction of the treatment, hydraulic and associated structures;
ii. the supply of the plant and equipment by the Contractor as specified herein;
iii. installation of the plant and equipment at Site by the Contractor, including all necessary mechanical or electrical work, as required under the Contract.

14.1.3 Works within Limits of Construction and Supply and Installation

The following shall be included within the Limits of Construction and Supply consisting of the following units.

36) **Water Concrete Gravity Intake Weir**

the concrete gravity intake weir is made entirely of concrete as per the drawings and will have (i) ungated overflow spillway with stilling basin (ii) intake tower upstream of weir and grouting foundation treatment as per the specifications for grouting.

The foundation treatment shall allow for (i) exploratory drilling and (ii) grouting to 10-15m depth using primary, secondary tertiary grout holes as exploratory drilling will confirm on site., but the extent is not expected to exceed the provision given in the BOQ.

(36) **Water Treatment Works**

The treatment, hydraulic and associated structures including:

i. Chemical Dosing and Mixing Tank (including flow measurement and chemical dosing), flocculation channel, sedimentation tanks

ii. Filters, treated water detention tank, backwash water tank, chemical store and dosing building.

iii. Access roads, car parks, earthworks, drainage works other related site works.

iv. Complete process and related equipment, within and between process unit structures, such as influent control, sedimentation tanks and filters.
v. Pipework within and between process unit structures, such as tubing and piping of any description and materials, with all fittings, penstocks and valves thereto, external coatings and internal linings of pipework.
vi. Mechanical and other appliances for weighing, proportioning, dissolving and distributing chemical reagents and preparing chlorine solution, including strainers, stirrers, mixers, dispensers, meters, pipework, etc., and pipes for applying chemical reagents and chlorine solutions within and between process unit structures.
vii. Mechanical and other equipment such as trolleys, hoists for handling, storing and lifting of chemicals.

viii. Equipment, including motors, pumps, compressors, blowers, valves and fittings for wash and scour systems, and other systems.

ix. Laboratory equipment and reagents.
x. Regulators, instruments, indicators, gauge plates, flanges, connectors, gaskets, bolts, units, washers, jointing material, materials for building in, jointing and securing, nameplates, identification tags; cable splices, glands, boxes, junctions and ancillary material; fasteners, clips, stands, trays, hangers, and all other auxiliary materials of any description.
xi. Filter bed media.

36) **Pump Stations**

i. Supply and installation of 2 no. pump units and related auxiliary equipment including, but not limited to pumps, electric motors and starters., valves and fittings, cranes, switchboards, complete electric power control and lighting installation, cables and accessories.
ii. All negotiations and payment for the permanent power supplies to be provided by the Kenya Power and Lighting Co. Ltd. And including power distribution throughout the Site.

14.1.4 Plant and Equipment Details

The Contractor shall fill in the Schedule of Particulars attached to the Bill of Quantities and submit same prior to Contract award if required to do so by the Engineer. After approval by the Engineer the particulars so given shall not be departed from without his written consent, provided that any omission from the particulars given shall not relieve the Contractor of any of his obligations under the Contract.

14.1.5 Modifications and Alternatives to Basic Design

The Contractor may propose modifications to the treatment processes which in his opinion are improvements to the Basic Design.

Modifications offered and accepted shall not fall short in any respect of first class installations and of the requirements of the Basic Design, and all details of finish and completion herein specified shall be deemed to be included in the modifications.

14.1.6 **Standards**

For the sake of brevity, in most cases one single standard has been mentioned in the various Sub-sections of the Specification.

However, any other internationally accepted standards, which ensure an equal or higher quality than that mentioned will also be accepted. Only the latest editions of such standards shall apply.

14.1.7 **Calibration of Gauges, etc.**

The scales and dials of all gauges, indicators and similar instruments shall be calibrated in metric units of measurement as follows:

a. Pressure instruments – metres head of water
b. Level – metres and tenths of meters
c. Flow (integrated) – cubic metres
d. Flow rate – litres/second

14.1.8 **Inspection and Testing during Manufacture**

No item of electrical or mechanical plant and equipment or any portion or part thereof shall be shipped or transported until all tests, analyses, and shop inspections of materials and equipment have been completed and accepted, unless certified reports or other evidence of the plant's compliance with the requirements of the Specification have been accepted by the Engineer, or unless inspection has been waived by him.

Tests are to be carried out on all plant as provided for in the Specification and otherwise in accordance with the latest Standard Specification where appropriate to the plant concerned. The Contractor shall carry out such tests and provide the Engineer with duly certified records in triplicate of the results obtained.

The Contractor shall give the Engineer reasonable notice in writing of the date on and the place at which any plant will be ready for testing as provided in the Contract and, unless the Engineer shall attend at the place so named within 10 days of the date which the Contractor has stated in his notice, the Contractor may proceed with the tests, which shall be deemed to have been made in the Engineer's presence. The Engineer shall give the Contractor 24 hours' notice in writing of his intention to attend the tests.

All measuring and testing instruments, indicators and other apparatus-provided by the Contractor shall be calibrated under guarantee of an approved testing laboratory, or otherwise to the satisfaction of the Engineer.

The Contractor shall provide all labour, lubricants and stores required for the purpose of these tests. The costs of carrying out all tests shall be included in the rates tendered.

14.1.9 Packing, Marking and Delivery

After approval by the Engineer and prior to dispatch from the manufacturer's works, all electrical and mechanical plant and equipment shall be thoroughly protected against corrosion and incidental damage, including the effects of vermin, strong sunlight, rain, high temperature and humid and salty atmosphere or sea spray.

The plant shall be packed to withstand rough handling in transit, and packages shall be suitable for export to and storage in the tropics, including possible delays on exposed quaysides. The Contractor shall be held responsible for the plant being packed so that it reaches its destination intact and undamaged. The Contractor shall provide, and include in the Contract Price, the cost of all necessary packing cases and crates. All crates and packages shall be correctly and adequately marked as follows:

a. Name of the Project
b. Contract Number
c. Designation of Plant
d. Item Number.

The Contractor shall keep the Engineer fully informed of the status of deliveries. The Contractor shall be responsible for the delivery of the plant to Site.

14.1.10 Installation and Erection

General

The Contractor shall carry out the complete installation of the plant, including all skilled and unskilled labour, material, transportation, supplies, Contractor's equipment, and appurtenances necessary for the complete and satisfactory erection of the plant.

Work Programme

The Contractor shall submit to the Engineer a work programme for the erection of the plant, within one month from the date of the Engineer's request for such programme. The work programme shall show the order in which the various plant elements will be installed, the Contractor's equipment to be used for installation, and a list of the skilled, semi-skilled and unskilled workers to be employed, and their respective arrival dates on Site.

Erectors

The Contractor's staff shall include at least one approved skilled installation supervisor for the installation of all plant and equipment under the Contract, and sufficient skilled, semi-skilled and unskilled workers to ensure completion of the Contract within the time required. The Contractor's installation staff shall arrive at Site on or before the respective dates set out in the approved programme of work.

Contractor's Equipment, Materials and Appurtenances

The Contractor shall have available on Site sufficient suitable equipment and machinery as well as all other materials and appurtenances required by him of ample capacity to ensure the proper installation of the plant and equipment.

Workmanship

The plant shall be erected and installed in a neat and workmanlike manner on the foundations and at the locations and elevations shown on the approved working drawings. Unless otherwise directed by the Engineer, the Contractor shall adhere strictly to the aforesaid drawings and no departures therefrom will be permitted. All plant shall be correctly aligned, 226ulfils226 and adjusted for satisfactory operation, and shall be installed so that the proper and necessary connections can be made readily between the various units and the piping and equipment installed under the Contract.

Building-in

Before commencing any installation works the Contractor shall check the dimensions of structures where the various items of the plant and equipment are to be installed, and shall bring any discrepancy from the required position, lines or dimensions lo the notice of the Engineer.

The Contractor shall also propose, for the approval of a Resident Engineer, any necessary corrections. The Contractor shall and plug in the holes prepared by him and provide all clips, plugs, screws, nails, sleeves, etc. Required for fixing small bore tubing and piping. The Contractor shall align all pipework, equipment, holding-down bolts, etc.

Commissioning

As soon as the Engineer is satisfied that the installation of the plant and equipment has been completed, the Contractor shall have satisfied himself that the plant and equipment are in good working order and the Engineer is satisfied that the associated civil engineering works have been substantially completed to an extent permitting the proper operation of the treatment units, the Contractor shall himself operate the treatment works (including the pump stations) during the period of lime specified below (hereinafter referred to as the commissioning period). The cost of commissioning shall be borne by the Contractor.

Commissioning shall commence at such date, determined by the Engineer, as the Contractor has successfully put the entire treatment works and both pump stations into operation; however, the Engineer will not delay the commencement of commissioning on account of minor1 deficiencies in the Works which do not materially affect their operation. The commissioning period shall terminate after the Works have been satisfactorily and continuously run by the Contractor (as certified by the Engineer) for one week.

During the commissioning period the Contractor shall supply all fuels, chemicals, electricity, etc. required for the operation of the Works al his own expense.

Site Tests – 'Taking – Over

After the termination of the commissioning period as defined in Subsection above, the Contractor shall prove by site tests that the duties specified in the Schedule of Particulars and Guarantees are being performed continuously by each element of the Works for a period of at least 24 hours under the control of the Contractor's staff and the supervision of the Engineer.

All measuring instruments, indicators, and all other apparatus required for site tests shall be provided by the Contractor at his own cost and shall be included in the prices for the construction of the Works. All measuring instruments shall be attested as having been calibrated by an approved testing institute or otherwise to the satisfaction of the Engineer.
Any deficiencies or deviations from the guaranteed performance of the Works disclosed by the site tests shall be corrected by the Contractor, and site tests repeated as necessary until proper performance of the works-specified above, has been achieved to the satisfaction of the Engineer.

After the site tests have been satisfactorily completed, as certified by the Engineer, and provided that the Contractor has discharged his obligations under the Contract, the Contractor may apply for the Completion Certificate.

The Engineer shall not delay the issue of any Completion Certificate contemplated by this Sub-section on account of minor deficiencies of materials or defects of the Works which do not materially affect the commercial use thereof, provided that the Contractor shall undertake to make good same within 30 days of the issue of the Completion Certificate.

Training of Employer's Personnel

The Contractor shall train personnel assigned by the Employer in accordance with the training programme included by him with his tender and approved by the Engineer. Training of the Employer's personnel shall be aimed at achieving optimum operation of the Works, including minimizing use of chemicals, loss of water and staff required. This shall include training staff in all processes involved, water quality routine tests, control of chemicals, routine and periodic maintenance of every piece of equipment, and in all other subjects as may be required for satisfactory operation of the Works. The Contractor shall train the Employer's staff so that, at the conclusion of the commissioning period and upon the issue by the Engineer of the Completion Certificate, the staff can be entrusted with the operation and maintenance of the Works.

The Contractor shall continue with the training of the Employor's personnel for a period of four weeks after the date of the Completion Certificate.

Instruction Manuals, "As-constructed" Drawings – General

The Contractor's obligations include, as a condition precedent to applying for a Completion Certificate, the provision of 3 complete sets of instruction manuals and 3 sets of "as-constructed" drawings to be submitted within four weeks after the Contractor has received the Completion Certificate.

These manuals and drawings shall form part of the Operating and Maintenance manual referred to in the Specification.

Instruction Manuals

The instruction manuals shall cover the commissioning, testing, operation and maintenance of the entire Works. The greatest importance is attached to completeness and clarity of presentation.

It is emphasized that a collection of standard pamphlets of a general nature unaccompanied by drawings and descriptive matter relating to the Works as constructed, will not be acceptable. In particular, information supplied by subcontractors and manufacturers employed by the Contractor shall be coordinated into a comprehensive manual. Cross referencing of descriptive matter, drawings and spare part lists must be complete. The manuals shall be in English.

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

A separate section of the manual shall be devoted to each size and type of equipment and to each system of the Works.

It shall contain a detailed description of its construction and operation and include all relevant pamphlets, together with a list of parts with procedure for ordering spares. Electrical equipment shall be described in operation step-by-step giving the complete sequence of operation.

As-constructed Drawings

The “as-constructed” drawings shall be submitted within four-weeks after the Contractor has received the Completion Certificate. They shall cover the Works as completed on Site, incorporating all modifications carried out during manufacture or after testing at the Contractor’s or sub-contractor’s and manufacturer’s works and all modifications carried out in the course of the installation and commissioning and testing of the Works. These drawings may be produced by modifying the drawings produced for manufacture and the working drawings.

14.2. PLANT AND EQUIPMENT GENERAL

14.2.1 DESCRIPTION OF WORKS

14.2.1.1 Treatment Works

The purpose of water treatment is to convert water taken from the River Kajulu, the (“raw water”), into a potable water suitable for domestic use. Most important is the removal of pathogenic organisms or other substances causing health hazards. Other substances need to be removed or considerably reduced, including suspended matter causing turbidity, iron and manganese compounds.

The primary factors to be considered in the selection of the treatment process are:

- Treated water specifications
- Raw water quality and its possible variations
- Local constraints (such as availability of major equipment, construction materials and water treatment chemicals)

On the basis of the above considerations and of field and laboratory investigations, the treatment works shall consist of:

- Chemical coagulation, by dosage of alum, and of alkalis (such as soda ash) or pH control
- Pre-chlorination, to avoid algal or bacterial growth within the subsequent treatment processes;
- Chemically-aided settling in horizontal flow sedimentation tanks, in which flocculation takes place at the base of the cone and clear water is decanted from the top surface. Sludge is removed both from the bottom of the tank
- Filtration through rapid gravity filters cleaned with an air/water backwash system;
- Final disinfection by chlorination, utilising calcium hypochlorite or other chlorine based compounds.

Treatment Process	Treatment Unit Type	No.	Surface loading (m3/m2/d)	Surface Area/Unit (m2)	Total Design Flow (m3/d)
Flocculation	Tank with electrically driven paddle mixers	2			48,000
Sedimentation	Horizontal flow tanks	2			48,000
Filtration	Downward vertical flow rapid gravity filters with air/water backwash. Filter media to be 800 mm sand (0.8 to 1.2 mm grain size) on 300 mm gravel bed. Filter Bed Cleaning Water Air	4			48,000
Maximum Losses Sedimentation Constant sludge bleed (0.5 l/s) per unit Bottom Desludge (20m3/unit/day) Filtration Backwash water (8min /unit/day)					

Minimum output					48,000

The treatment plant is structured as shown in the table below:

Weir shall be provided with a float operated instrument for measurement of the rate of flow with local indication. The flow rate indicator shall be mounted in a weatherproof metal box with hinged door and latch at the inflow control valve and shall be supplied with a 150 mm diameter dial gauge with uniformly graduated scale from zero to maximum liters/second.

14.2.1.2 Mixing Tank

A mixing chamber unit shall be constructed to the dimensions shown in the drawings.. The mixed water shall be discharged through a pipeline to the Coagulation chamber. The pipework arrangement shall allow the raw water by-passed directly to the weir when required. The aerator shall be capable of treating 48,000m3/day.

All discharge and isolating valves shall be of the rubber-seated butterfly type.

14.2.1.3 Coagulation Chamber

A channel with electrically driven paddles designed to specifications and installed in the chamber shall ensure uniform dispersion of the coagulant in the raw water entering the treatment works.

14.2.1.4 Sedimentation Tank

The sedimentation tanks shall be of the horizontal flow, sloping bottom type, two in number, all jointly capable of passing a total design flow of 48,000m^3/d.

A t this design rate of flow, the rise rate, when calculated on net surface area, shall not exceed 1.75 m/hr.

The tanks shall be capable of operating at a rated capacity of 2.0 m/hr while one is shut down for maintenance purposes.

Each tank shall be equipped with a sludge concentrator, complete with a draw-off assembly to provide for regulated “bleed-off” of the sludge.

After passing the sludge blanket, the water will be drawn-off by decanting troughs. The troughs shall have notched or drilled sides to provide accurate adjustment for uniform draw-off.

The effluent from the tanks shall be completely stable and no after precipitation shall take place. A pipe work for an overflow shall be provided in the inlet water distribution channel.

All pipes, penstocks, valves, extension spindles headstocks, etc. shall be provided to make the tanks complete in every respect for the distribution and

collection of water and the removal of sludge.

The amount of water lost with the sludge draw-off in the horizontal sedimentation tanks shall in no case exceed five percent of the total treated water produced.

14.3 FILTERS AND APPURTENANCES

14.3.1 Filters General

Filters shall be of the rapid gravity downward flow type, constructed in concrete as shown on the drawings. The Contractor shall supply and install all equipment and pipework required for the six filter units, which shall jointly be capable of filtering the total design flow of 48,000 m^3/d at a rate not exceeding 5.0 m/hr at normal filtration or 6.0 m/hr when one filter unit is shut down for washing or maintenance purposes.

The Contractor shall guarantee that the filtered water turbidity shall never exceed 1 JTU (Jackson Turbidity Unit). The average washwater consumption shall not exceed 5 percent.

The water leaving the fillers shall possess the following Characteristics

Turbidity	less than 5 JTU
Color	less than 5 units (platinum-cobalt scale) unobject ionable
Odour	unobject ionable
Taste	unobjectionable

Filtered water shall be sampled for measure of compliance at any point between the filter outlet valves and the points of application of soda ash for **pH** correction and calcium hypochlorite for disinfection The measure of compliance with the guaranteed limit of water consumption in filter washing, as inserted by the Contractor in the "Schedule of Guarantees", shall be ascertained on the basis of the average consumption of water over a period of one week. The inflow shall be divided equally between the working filters, and shall be shut off at each filter by an isolating valve or penstock. The filtered water from each filter will flow into a common channel or pipe system.

The filters shall be constant flow/rising head type, the increase in filter head loss during a filter run being compensated by the automatic opening of the filter outlet control valve.

The outlet control valve shall be of a butterfly valve type drop-tight construction suitable for mechanical actuation. The outlet control valve shall be actuated by special gear for operating in conjunction with a corrosion resistant float device.

All pipework and fittings embedded in the concrete floor of the filters shall be made of corrosion-resisting materials. The cleaning of the filter beds shall be accomplished by means of air scouring, followed by a water backwash.

The backwash shall be provided by a piped supply, and the waste water shall discharge into two side channels and thence to a waste water drain located under the settled water inlet channel.

All pipe work, fittings and valves necessary for the operation of the filters and for the filter backwash system shall be provided. All valves shall be of the rubber-seated butterfly type.

14.3.2 Filter Base

c)
The filter base shall consist of a platform, laid above the filter floor. The platform shall be made of pre-cast concrete plates, supported and fixed on concrete pillars.

Each plate shall have evenly spaced non-metallic threaded couplings cast in for filter nozzle installation. Nozzles shall be so shaped and proportioned that they will convey filtered water downwards to the filter outlets and, during backwash, compressed air and backwash water upward into the filter bed. The spacing of the nozzles shall be such as to provide an even collection of filtered water and an even distribution of air and backwash water. The size of nozzles shall be designed by the supplier of the filter base to pass the maximum rated daily flow per filter: backwash at a rise rate of 232ulfils. 36 m/h, and air at a rate of 60 cu m/sqm/hour.

The filter base shall be designed and constructed to withstand both normal flow and backwash flow loading conditions.

14.3.3 Filter Media

Filter media consisting of gravel and sand shall be furnished by the Contractor and placed in each of the six filters.

The Contractor shall furnish an additional 25 cu m. of sand filter media, in 50 kg heavy-duty moisture-proof plastic sacks for storage, as directed by the Engineer.

The Contractor may propose single or multi-media, as required, for the filter base arrangement proposed by himself. In either case the Contractor shall guarantee that each filter unit shall deliver not less than the specified daily flow per day at the required filtration rate of flow and that the filters shall not require washing more than once every 24 hours of operation.

d)
14.3.4 Air Scour Blowers

Two electrically driven blowers shall be provided to supply the complete system of air for scouring of filters, each unit delivering the requirement for' scouring one filter unit.

The blowers shall supply air at the related pressure and quantity without

employing any pressure reducing valve and air flow indicator.

A pressure gauge shall be provided and installed in the delivery end of the air main.

The installation shall be provided with all fittings, valves, pipes and controls necessary to render the air scour system complete in all respects.

14.3.5 Washwater Supply System

Water needed for filter washing will be provided from a washwater tank of 200 cubic meters capacity on 15m tower.

The washwater tank, constructed with a central division wall, will be complete with all necessary inlet, outlet, overflow and washout pipework and valves, access hatch, external and internal ladders, air vents, float operated level indicator, chambers and all other associated works.
Head available at the backwash inlet to the filters shall be in the range 7.0 to 11.0 m of water or to lower .pressures as agreed with the Engineer. The Contractor shall state the duration of each filter washing, rate of flow and head required. All piping, fittings and valves on the backwash

14.3.5 Washwater Control System

A manually controlled washwater flow system shall be provided. It shall consist of a "star" regulating valve installed in the backwash inlet main from the wash water tank and located in the filter gallery upstream of the individual backwash valves to each filter.
a) Fill washwater tank.
b) Close regulating valve.
c) Open backwash inlet valve to filter to be backwashed.
d) Close filter inlet valve and drain filter.
e) Open regulating valve slowly and time "be ill water level from lop of sand bed to backwash overflow channel.
f) Repeat until rise rate is correct (233ulfils. 600 mm/minute).
Remove regulating valve handwheel.

14.3.6 Washwater Tank Level Control.

The Contractor shall supply and install high and low level electrodes foI' backwash pump automatic stop/start control. The pump shall be stopped when the water reaches top water level, and be started when the water' level has dropped to 1 m below top water level.

14.4. CHEMICAL STORAGE PREPARATION DOSING AND TESTING EQUIPMENT

14.4.1 Chemical Equipment – General

Equipment shall be provided for the handling and storage of the dry chemicals, solution preparation and storage, chemical solution dosing and for provision of sampling points throughout the treatment works

and laboratory equipment for routine testing of the raw, partially treated and treated waters.

The chemicals to be used are:-

(a) Aluminum Sulphate Alum" – sedimentation process

(b) Soda Ash pH correction at the treatment works inlet

(c) Calcium hypochlorite (HTH) pre-chlorination at the filter inlet channel and post-chlorination at the treated water reservoir

14.4.2 Supply of Chemicals

The Contractor shall supply sufficient chemicals for the testing and commissioning of the treatment works and, in addition, shall supply, and place in the storage to be constructed, sufficient chemicals for the running of the treatment works at the design rate of 14,000 m^3/d for a period of 2 months. The chemicals to be provided and stored are:

(a) Aluminium sulphate 1000 x 50 kg bags
(b) Soda Ash 500 x 50kg bags
© Calcium hypochlorite (70% available chlorine) 200 x 45kg tins

14.4.3 Chemical Storage

Storage shall be constructed of sufficient capacity for the storage of 1 months

a) Alluminium sulphate 1000 x 50 kg bags

The storage area shall be:

Net area 54m2
Gross area 80m2

b) Soda Ash 500 x 50kg bags

The storage area shall be:

Net area 54m2
Gross area 80m2

c) Calcium hypochlorite 200x 50kg bags

The storage area shall be:

Net area 40m2
Gross area 50m2

The storage rooms shall be separate from each other and under no circumstances shall different chemicals be stored in one room.

Floors: reinforced concrete with quarry tile surface finish to be raised 200mm in 1above passageway floors.

Walls: white gloss paint.

Windows: fixed timber louvered windows installed at high level.

Doors: steel panel double doors with bottom panel composed of fixed louvres. All doors open out wards from storage rooms.

Door hinges, locks and latches: doors to be capable of folding back 1800 from closed position against outside walls (provide hook latches for securing in open positions). Door locks to enable instant "panic" opening of both doors from the inside even when locked from the outside.

Trolleys:

No. four-wheeled manually pushed trolley capable of transporting a load of 200 kg.
No. two-wheeled trolleys, each with a load capacity of 100 kg.

g. Step ladders:

- 3 No.2 m high aluminium step ladders

h. Weighing platform:

- 1 No. heavy duty weighing platform suitable – weighing up to 250 kg 100 gram meso

Solution preparation and dosing tanks of the following capacities and sizes shall be constructed

(36) **Aluminium Sulphate solution 2No.**

Capacity	7,000 litres net.
Size	2 m x 2 m x 1. 7 5 m

(36) **Soda Ash solution: 2 No.**

Capacity	7,000 litres net.
Size	2 m x 2 m x 1.75 m

(36) **©Chlorine solution: 2 No.**

Capacity	7,000 litres net.
Size	2 m x 2 m x 1.75 m

Full-bore outlet valve with hose connection for 20rnm flexible tubing (as PCI or similar and approved –suitable for connection to chemical pumping unit dozer);

80mm diameter plug valve c/w pipe work to discharge to waste-water' channel(as Biwater-Ham Maker Cat.no.86 or similar and approved);

Alum tanks only-rock alum perforated rack positioned along inlet side of solution tank made from alum corrosion resistant materials and securely fixed to the tank.

The tanks shall be lined with ceramic tiles or GRPs, fittings and pipe work shall be manufactured from materials which are corrosion resistant to the respective chemicals stored in the tanks.

Chemical pumping units dozers manufactured by reputable firm and approved by the Engineer and complete with all necessary valves, fittings, tubing and outlet collection funnels or troughs shall be installed as follows:

a) Alum tanks	2No.	Chemical pumping units dozers
b) Soda ash tanks	2No	Chemical pumping units dozers
C) Chlorination tanks	2No	Chemical pumping units dozers

The chemical pump dozer outlet shall be connected by suitable tubing to hard rubber chemical solution pipelines leading to various points of application of the chemicals.

A treated water supply from high level tank shall be provided for connection to each of the chemical solution lines for flushing purposes, suitable isolating valves shall be provided.

A treated water supply from a contained in a waterproof carrying case containing plastic tubes or buffer and KCI solutions. The meter should be scaled from 0-14 pH for easy reading and simple adjustment accuracy of 0.1 pH. The instrument and electrode system shall be provided

‘(2) Colorimeter-spectrophotometer – transistor-regulated model.
Range 349-650 mm, with 12 selected test tubes ½” diameter, I” test tube adapter, plastic dust cover and directions. For operation of 50-60 Hz, 220 Volt AC, incl. 21amps replacement – 6 Volt with pre-focused base and pigtail leads.

(3) Turbidity meter-Iiach CR surface furbidimeter, model 1032 or’ equal.

(4) Turbidity meter – Jackson standard complete with one 25 cm tube, one extension tube and 12 standard candles.

(5) Stirrer, multiple, water analysis, 6-unit for alum floc; determination; speeds from 10 rpm to 100 rpm. The entire battery of stirring rods, or any single stirring rod to be able to be used at one time.

With individual 25 mm wide by 75 mm long stainless steel paddles, adjustable for depth, to be able to be removed from the breakers while the stirrer is in operation without disturbing the other paddles. Stirring speeds shall be controlled by a powerstat and indicated by the centrally located tachometer. Aluminium housing, exposed metal parts, nickel-plated 100⁰ m beakers and floc illuminator base. 1’01’ 220 Volt AC, 50 Hz.

(6) Sets of co louvered glass disks, chlorine residual comparator:
For residuals 0.0 to 1.0 ppm
For residuals 0.0 to 2.0 ppm

(7) Water Analyses. Taylor – for determining colour with colour standard 5 slide:

Colour: 0, 5, 10,20,30,40,50,60,70

A field test kit for running the following tests:

- Fluoride
- Sulphates
- Alkalinity Total Hardness
- Iron
- Manganese
- Phosphates
- Chlorides

14.5 PUMPING EQUIPMENTS

14.5.1General

The Drawings are intended to show a general arrangement of pumping equipment, drives, connected piping and valves, all of approximate sizes, shapes and locations required. The Drawings are not intended to show exact dimensions peculiar to any specific pumping equipment.

When the term “pump unit” is used hereinafter, it shall be deemed to mean a pump complete with, but not limited to, electric motor, connecting shafting, bearings, couplings, accessories, appurtenances and all associated equipment. The pump manufacturer shall furnish each pump unit complete with electric motor and all other components, and shall De held entirely responsible for the compatibility in all respects of all components furnished. All external electrical connections shall form part of the Contract, and all electrical equipment for the pump units shall be furnished and installed by the Contractor, Electric motors and all equipment and connections shall comply with the detailed specifications.

14.5.2 Requirements and Qualifications of Manufacturers

Pump units shall be of approved design and make and products or manufacturers who have built equipment of similar type, size and capacity for at least ten years and who have, in the opinion of the Engineer, sufficient experimental and test data to cover the design of the equipment specified. Upon request, or if hereinafter so specified, the.;...Contractor shall submit evidence of the proposed manufacturer’s possession of such data with a list of at least five installations anywhere, of design, capacity and service similar to the equipment proposed to be furnished, with installations shall have been in successful operation for a period of at least five years.

The pump units shall be designed and built for twenty-four hour continuous service at any and all points within the specified range of operation, without over-heating, without cavitations, without excessive vibration or strain, and requiring only that degree of maintenance generally accepted as peculiar to the specific type of pump required.

All parts and components of the pump units shall be designed and built for interchangeability, so that replacement parts may be fitted without any additional fitting or machining.
Upon request, or if hereinafter specified, the Contractor’ shall give evidence that the

tolerances and finishes on the proposed manufacturer's. detail drawings so permit, and that the proposed manufacturer's shop is equipped with the necessary machinery, jigs, fixtures and gauges to assure such interchangeability.

Pump units shall be products of manufacturers who can produce evidence of their ability to promptly furnish any and all interchangeable replacement parts as may be needed at any time within the expected life of the pumps. Upon request, the Contractor shall submit full details of the proposed manufacturer's ability to promptly fill replacement orders.

The pump manufacturer must possess or have readily available access to suitable testing

The Contractor shall submit a description of the proposed manufacturer's testing facilities, including hydraulic, mechanical, electrical and periodic calibration provisions for all instruments. The descriptive matter shall contain illustrative photographs, drawings and such other matter as may be requested.

Approval of manufacturers of suppliers shall not be given until all information required by the preceding has been submitted and found satisfactory.

With the exception of the characteristic curves, all information shall b- submitted by the Contractor at the same time. Partial submission of the information will not be acted upon; such submission will be held without action until the receipt of all required information. No pump unit shall be deemed approved until all specified or requested information is approved.

The pumps offered shall be eminently suitable to operate individually and/or in parallel, according to each specific case, throughout the whole of the operating range required and shown on the specific system head curves sheet.

Materials used in the construction of the pumps shall be of a quality and kind best suited to 238ulfil the required duty under the specified conditions.

Backwash Pumps

Three horizontal end suction pumps to be supplied of which two shall be installed (1 No. duty and 1 No. standby) an done kept as a spare. The pumps shall be connected in parallel and be direct coupled to electric prime movers.

General Description

The pump shall consist basically of a composite cylindrical body clamped between two end-covers with out-hang bearings to carry the rotating element. Suction and delivery branches shall be incorporated in the end-covers: the suction branch at the driving end and the delivery branch at the opposite end. :\ balance valve device shall be fitted.

The pump body shall be made up of the required number of individual stages each comprising an impeller, guideport and chamber. Stages shall be spigoted together and the whole assembly held between end covers by binding bolts. Joint:; seal be sealed by 'o' rings.

End covers

The suction and delivery end-covers shall be of heavy east construction and a balance valve device shall be fitted in the delivery end-cover to control unbalanced hydraulic thrust. Is protection against jet erosion from this balance valve, renewable wearing ring shall be fitted.

Pump Chambers

Chambers shall be cast with integral guide vanes and the first and final chambers shall incorporate feet to support the horizontally mounted pump. The running clearance between the chamber and the impeller boss shall be maintained by replaceable chamber bushes.

Impellers

The impellers shall be produced with automatic machining and grinding tools to precise template contours. Each impeller shall be dynamically balanced to ensure that the complete rotating element is correctly balanced initially, and subsequently if fitted with replacement impellers.

Neck rings

Neck rings fitted into the bore uf the suction covel' and j chambers shall be of a material compatible with the impeller's.

Guide-ports

Guideports shall be machined on all external surfaces and hydraulic passages shall be hand-dressed. They shall be clamped in position and located by dowel pins which can be easily removed during dismantling.

Shaft

The shaft shall be fitted with renewable sleeves but protected by impeller and balance disc hubs.

These shall be individually fixed to the shaft by keys, the keyways being cut on alternating sides of the shaft to eliminate distortion and ensure a rigid rotating.

The complete assembly shall be locked in position by double nuts at each end of the shaft.

Stuffing 130xes and Glands

Stuffing boxes shall be packed with oil-impregnated soft cotton packing, the glands being held in position by studs and nuts for easy adjustment, removal and repacking.

Lantern rings shall be included when sealing of glands against air draw – in is necessary.

Where suction conditions so require, a junk ring shall be fitted in the stuffing boxes to prevent packing extrusion.

Bearings

A grease–Lubricated roller bearing shall be normal within the housing at each end of the pump. The bearing housing shall be flange mounted all the suction cover at tile driving end and from the balance chamber at the opposite end.

Leakage from glands shall be drained through holes provided in the bearing support cones. Lubricant ion shall be by grease through a conveniently located nipple, and the inner bearing cap on each bearing shall incorporate a lip seal.

End Suction Single Stage Centrifugal Pumps

Casing and Cover

The volute casing shall be designed to provide high hydraulic efficiency and maximum suction performance. It shall be heavily ribbed for rigidity, and shall carry a tangential discharge branch in the vertical position between the cover and casing. The delivery branch flange shall have a machined face and slotted holes for the discharge pipe work connecting bolts.

Impeller

The double-shrouded single entry type impeller shall be designed to give good suction performance with minimum power requirement. The combination of equal diameter necks on either side of the impeller and relief holes in the Jack shroud shall ensure hydraulic balance and minimise bearing loads. The impeller shall be keyed to the shaft and secured by a screw and lock-washer, and shall be easily removed without disturbing the driver, casing or discharge pipework.

Shaft and Bearings

The shaft shall be proportioned to withstand all stresses likely to be imposed. Sealed-for-life ball bearings shall support the shaft in the bearing bracket, one at the driving end and one at the inner end.

Bearing Bracket

The bearing bracket shall be of robust construction to provide a rigid support for the pump, and concentric location to the pump casing shall be ensured by matching spigots.

Foundation bolt holes shall be provided and the bottom surface shall be planed to facilitate installation.

Shaft Seal

The standard arrangement shall be a soft-packed gland with lantern ring. Pumped liquid at delivery pressure shall be fed through the lantern ring and stuffing box back to the suction side of the pump.

Provision shall be made to protect the pumping units. The protective circuitry shall allow start of each unit when the following conditions are fulfilled:

- the level in the respective suction pit is above “Low Level” 01’ the inlet pressure in the respective suction pipe is above “Low Pressure” (pressure switch-actuated);
- electrical devices are in correct position for start; protective
- relays are “reset”.

- the level in the respective suction pit drops below “Low Level” (float switch in the pit of reservoir actuated) or the inlet pressure in the respective suction pipe drops below “Low Pressure” (pressure switch actuated);

- the non-return valve fails to reach its “Open” position within pre-determined and adjustable time interval;

- the flow in the discharge pipe is below the “Min” or exceeds the “Max” flow (min. or max. flow contacts of the flow meter or pressure switch-actuated);

- the electrical system fails (short circuit, overload, temperature rise, single phasing and earth leakage).

The Contract includes the supply and installation of all protective devices and instruments necessary to render the protection system of the pumping units complete in all respects.

14.6. PIPES AND VALVES

14.6.1 Pipe work and Fittings

All pipe work and fittings shall be of a class in excess of the maximum. Pressure they will attain in service, including any surge pressure.

K shall be adequately supported with purpose-made fixings and, when passing through a wall, shall incorporate a puddle flange or other suitable purpose-made sealing device or shall otherwise pass through a sleeve inserted in the wall.

Steel pipe work above 80 mm bore shall be externally and internally iin2u at the manufacturer’s works with epoxy-based or similar lining.

All bends made from pipe shall be formed so that at any point along the bend ovality will not reduce the bore by more than 2.5%.

A detachable flexible joint shall be provided on each delivery branch of each pipe. The joint shall be fitted with the bolts to transfer longitudinal thrust along the pipe work.

All the intercepting valves shall be sluice or butterfly valves, and shall be manually operated by suitable wheels complete with indicators to show the amount the valve is open in relation to its full travel.

All valves shall be in compliance with BS 5163 and other appropriate British Standards. Prior to shipment, they shall be tested 1.5 times the working pressure.

Suction and delivery valves shall be provided with limit switches to include pump running under shut-off conditions and to avoid cavitations.

All valves shall be suitable for use with water at all temperatures up to 45°C.
The operating gear of valves shall be such that one man can open and close the valve against an unbalanced head 15% in excess of the maximum to be encountered in

service.

Sluice valves shall be suitable for flow in either direction and shall be clockwise closing. Packed glands shall be arranged for easy replacement of the rubber-'O'-ring, which shall be accessible without removal of the valve and pipe.

All valves shall be located and orientated in readily accessible positions, with hand wheels conveniently arranged for ease of operation.

(36) The shut-off valves shall be of the butterfly rubber seated type or the sluice type.

(36) Non-return valves shall be of the quick-acting, nonslam Venturi type or tilting disk type.

FLOW AND CONTROL EQUIPMENT

Flow measurements and Indicators

Flow meters shall operate either on the differential pressure principle, on level Measurement over a weir or on direct mechanical indication. Venturi tubes shall be inserted into the rising mains of the respective pump stations and installed together, with transmitter" in Chambers adjoining the stations. The differential pressure shall be converted to 4+20 mA electrical output.

The receivers, operated from the Venturi tube transmitters, shall consist of rate-of-flow indicators (indication in lit res/second) and total aggregate flow (totals in cubic metres) instruments.

Flow measurement equipment shall be installed as indicated in the table below:

Location	Equipment		Max. Pressu	Rate of Flow	
	Type	Size	(m)	Min (Iis)	Max (II s)
Aerator outle	Weir	1 m x 0.3 m	Atmospheric		200
Main Supply	Venturi	300	400	40	200
Backwash	Venturi		20	40	8U

Pressure switches shall be of the pressure-controlled electrical type. All parts coming into contact with the water shall be constructed of corrosion-resistant materials. The switch shall allow for adjusting the required head at which the contact shall be actuated.

Level switches be float operated or electrode types, two of which shall be installed in the sumps of each pump station.

Pump Station No.1
One manually operated gantry crane of 2 tonnes lifting capacity shall be installed.

Manually operated Gantry Cranes for pump station

Manually operated gantry cranes shall be of the single girder type with geared crab suitable for the works arrangement.

The lifting capacity of each crane unit shall be sufficient for the heaviest load when erecting or dismantling all items of plant located within range of the crane.

The 243ulfils243243 carriage shall run on bridge rails securely fixed to the gantry. The treads of the 243ulfils243243 carriage wheels shall be machined. The crab hoisting gear shall be such that one man is capable of easily raising the maximum load.

The crane structure shall be designed in accordance with the requirements of Class HI overhead travelling cranes, and also the general requirements of Italian Regulations.

Longitudinal and traverse motions shall be provided to allow speedy operation without impairing safety in working.

The longitudinal and traverse motions shall be operated by means or hand chains which shall extend to within 500 mm of floor level. Ball bearings shall be employed on all motions. All gears shall be machine formed.

The load chain and hook shall be of sufficient length to reach the main access floor level. The crab unit shall include a reliable braking and locking arrangement on the hoist mechanism as well as a load chain collection box.

Manually operated Pully Blocks

Manually operated chain pulley blocks shall be provided complete with geared travelling trolleys arranged to run along the lower flanges of the section universal monorail beam in an arrangement suitable for maintenance of diesel generating sets.

The blocks shall be of the spur geared, close haul type with mould load brake and swivel top hook to allow the block to be easily detached from the trolley without necessity for dismantling. The hoist chain shall extend to within 1.5 m of the operating floor. The load and hook shall be capable of reaching the lowest lift level. The gantry traveling trolley shall be arranged to accept the block hook and the operating chain for the motion of the trolley, and shall extend to within 1.5 m of the operating floor.

Ball bearings shall be employed on all mot ions and the load hook shall revolve on a ball swivel.

A reliable braking and locking arrangement shall be provided and a load chain collection box shall be incorporated on the pulley block unit.

The hoisting gear shall be such that one man is capable of easily raising the maximum load.

The equipment supplied shall respond to the requirements of this Specification, and shall include the supply, installation and connection ready for operation of all electrical equipment for the treatment works and pump stations, the required switchboards, control panels, electric motors, starters, switchgears, power, lighting and control cables, earthing system and underground cables.

The detailed design and ratings of the motors and other electrical and auxiliary equipment shall be the Contractor's responsibility and shall be undertaken at his expense.

Before proceeding with the work, the Contractor shall carefully check and verify all dimensions and sizes, assume all responsibility for the fitting of the materials and equipment to other parts of the equipment and to the structure, carefully check the drawings and ensure that the equipment he contemplates installing will fit into the space provided.

415 V (5%).
Frequency 50 Hz (2 Hz). Totally enclosed fan cooled type (TL: :FC), or 55 protected.
s)

The characteristics of the motors, such as starting torque and starting time, shall match the requirements of the driven pump.

Motors shall be rated to provide about 105% of the power required at the pump shaft under design point conditions of the pump.

Motors shall be effectively cooled by forced air ventilation and able to deliver the required continuous output at site conditions.

Winding insulation shall be class "F" with tropical, moisture and fungus proof finish; temperature rise shall not exceed the temperature rise limits of class "B". Rotating components shall be properly balanced to ensure dynamic balance at operating speeds. Motor bearings shall be grease lubricated. Easily accessible nipples for regreasing shall be provided. ---eating housings shall be of such design as to provide protection of the bearings from deterioration during periods of idleness.

Motors shall be equipped with heaters in order to prevent water condensation in the winding during extended motor shut –down periods. The heaters shall be automatically switched on during shut-down periods. Voltage and wattage shall be marked on a nameplate.

A dust-tight and splash-proof stator terminal box shall be provided with cable gland

for connection of cables.

All Six winding leads shall be brought out of the terminal box on an open terminal strip. Electric motors rated over 75 kW shall be equipped with embedded winding temperature detectors. Motors shall be started through starting panels in a proper manner in order to limit the starting current to 350% of full load current.

Treatment Works Site
Two switchboards shall be installed and located as follows:

t)
- one in the generator house;
- one in Pump Station No. I.

Generator I louse Switchboard
The switchboard shall contain all electrical equipment necessary for three incoming feeders as follows:

- one for the power supply from the Kenya Power and Lighting Co. Ltd.; one for emergency supply from the primary generator set;

- one for emergency supply from the secondary generator set.
- The switchboard shall contain all electrical equipment necessary for outgoing supplies as follows:
- one for the main power supply (whether power is derived from the K.P. & L supply or from the primary standby generator) to Pump Station No.1 switchboard;
    - one for the secondary power supply (from the secondary standby generator) to Pump Station No.1 switchboard);
    - four for supplies to local distribution units feeding:

(36) generator house;
(ii) office and chemical building;
(36) gate house;
(36) part of external lighting. – 3 No. spare outlets.

Pump Station No.1 Switchboard
The switchboard shall contain all electrical equipment necessary for two incoming feeders as follows:

- one for the main power supply from the generator house. Switchboard; - one for the secondary power supply from the generator house switchboard.

u.)

The switchboard shall contain all electrical equipment necessary for outgoing supplies as follows:
four to auto-transformer type motor starters for the main 245ulfi units; - two to star-delta type motor starters for the backwash pump units; two for supplies to local distribution units feeding:
(36) filter gallery (including power for air blowers);
(ii) part of external lighting.
- 3 No. spare outlets.

Starr Housing Site Adjacent to Kirandich Darn
One switchboard shall be installed and located adjacent to the staff housing site (complete with building works).

The switchboard shall contain all electrical equipment necessary for accommodating the incoming power supply from the Kenya Power and Lighting Co. Ltd, and for outgoing" supplies to local distribution units in each of the houses.

Backwash Local pumps
One switchboard shall be installed in the pump station.
The switchboard shall contain all electrical equipment necessary for three incoming feeders as follows:

- one for the power supply from the Kenya Power and Lighting Co. Ltd.; one for emergency supply from the primary standby generator set;
- one for emergency supply from the secondary standby generator set.

The switchboard shall contain all electrical equipment necessary for outgoing supplies as follows:
four to star-delta type motor starters for the main pump units; - three for supplies to local distribution units feeding:

(36) generator house and pump station;
(ii) external lighting;
(36) staff houses.

Distribution switchboards and motor control panels shall consist of a number of enclosures of equal height and depth mounted side by side to form a composite board of uniform and pleasing appearance. The height of the control panel shall not exceed 1600 mm.

All enclosures shall be constructed from a minimum thickness of 2.0 mm thick sheet steel, totally enclosed, bolted 01' for floor fixing with either welded or removable back covers depending upon location with hinged front doors. All doors shall be fitted with door handles. The size and weight of any removable cover shall be such that it can be handled easily

Enclosures mounted indoors shall provide degree of protection to IP 34.

Enclosures mounted externally shall have a degree of protection to IP 55. The design enclosure shall permit adequate ventilation without permitting the entry of vermin. Compartments shall be easily accessible for maintenance purposes. Each panel shall lie provided with a space heater'. 130ards shall be arranged for easy extension at each end.

Incoming Section Protection and Instrumentation

Each incoming section of any switchboard/motor control board shall have a separate compartment in which shall be housed – Instruments, meters, transformers, fuses and relays to provide indication and protection of the system.

Bus Bars

Bus bars and connections shall be adequately supported by suitable insulators, the whole to be mechanically and electrically designed to withstand full fault capacity.

All bus bars and connections shall be rated for continuous operation. The mechanical and dielectric strength of bus bars and supports shall be capable of withstanding the worst conditions of electrical surge which can occur in the installation. [Jus bars shall have a short time rating not less than that of the associated switchgear.

Terminals

All terminals for outgoing connections shall be located all easily accessible compartment.

Panel Earthing

A continuous copper earth bar shall run the length of the switchboard and shall extend to all panel/cubicle sections. A positive earthing conductor and termination shall be provided on all enclosure doors on which electrical equipment is to be mounted.

Small Wiring and Terminal Blocks

All switchboard and instrument panel wiring shall be carried out in PVC insulated cable. The minimum wire size shall be of 1.5 mm2 cross-sectional area.

All terminal blocks for the connection of small wiring shall comprise shrouded anti-tracking mouldings of melamine phenolic or comparable material with provision for securing conductors by high tensile screws and clamps. Identification ferrules or reference numbers shall be fitted on the wires at both ends, and letter and number shall appropriate wiring diagram and colour.

c)

Motor Starters

Low voltage starters shall incorporate air break contactors and be of the fixed pattern. Contactors shall have a minimum mechanical endurance capability of 1 million operations and minimum electrical endurance of 250,000 on-load operations.

Each starter shall be housed in a separate compartment which shall contain the following:

Direct On-line Starters

No. triple pole externally operated, fault-making, breaking isolating switch interlocked with tile compartment door, with provision for using a padlock to lock it in the OFF position. To be provided with auxiliary contacts for electrical interlocks.

3 No. main H. R.C. fuses

No. triple pole contact or for switching direct-an-line

No. triple pole thermal overload relays with single phasing protection

Star-Delta Starters

No. triple pole externally operated fault making, load-breaking isolating switch interlocked with the compartment door, with provision for using a padlock to lock it in the OFF position. To be provided with auxiliary contacts for electrical interlocks. Where a withdraw-able truck or ~hassis type is provided, a mechanical interlock shall be fitted preventing mechanism withdrawal or insertion until the switch is in the fully isolated position.
3 No. main N.R.C. fuses

3 No. triple pole contactor for switching direct-on-line No. adjustable time for delta star commutation

No. triple pole thermal overload relay with single phase protection

Auto-transformer Starters

No. triple pole moulded case circuit breaker mechanically interlocked with front cubicle door.

2 No. triple pole insu1ated contacts for the auto-transporter star connection and for auto-transformer by-pass.

No. auto-transformer with 3 taps and embedded elements thermal protection Set of adjustable timers and auxiliary relays for starting sequence control

No. current transformer of suitable ratio for the motor ammeter circuit

3 No. current transformers of suitable ratio and burden for the operation of motor total protection relay

No. motor total protection relay (46-49-50-SIR- 64) flush mounted on the front door. The following shall be mounted on the front door for starter:

No. ammeter with suppressed scale to read motor and starting current

2 No. pilot lamps to indicate start/stop

1 No. ON/OFF / A UTO selector switch (if required by control scheme)
Set START/STOP push buttons 1 No. hours counter meter

Air break circuit breakers shall be suitable for controlling loads under site climatic conditions, and comply with the standards. Moulded case breakers shall be employed up to 1250L. For higher currents, air circuit breakers shall be used. The circuit breaker shall be horizontally isolated air break type.

The operating mechanism shall have a mechanical ON/OFF indicator and a manual trip device fitted with means for locking.

Closing solenoids or motors shall be suitable for operation at 80% of nominal supply voltage. Incoming circuit breakers shall be fitted with over current tripping.

Low voltage circuit breakers shall trip every time its associated high voltage breaker trips.

All LV fuses shall be of the cartridge pattern suitable for site conditions.

Fuse holders and fittings shall be made of moulded plastic or insulating material. Fuse fittings shall be fully shrouded and fuses shall be capable of being changed without danger from or contact with live metal.

An isolating switch with mechanical ON/OFF indicator shall interrupt all supplies into each compartment to enable safe maintenance to be undertaken. Isolators shall have steel, semi-flush or telescopic operating handles and a fixed post shall be provided to enable the isolator to be padlocked.

All indicating instruments shall be of 900 scale type flush mounted. Instruments shall be 249ulfils249249zed, and have an external zero adjustment and black bezels.

Meters shall be inscribed on the scales to indicate the rating for the associated plant.

Ammeters fitted in a motor circuit shall have a suppressed scale to indicate maxi mum starting current.

d)

Current transformers shall comply with I EC standards, and shall be suitably rated and designed to carry out appropriate function, metering and protection.

For over-current protection, the product of V A rated burden shall be adequate to operate the relevant protection relay

Voltage transformers shall be of the isolatable epoxy resin insulated type with a secondary voltage of 100 Volts, and shall comply with IEC standards. The primary shall be protected by LI RC fuses and be adequately rated to withstand the short circuit rating of the switchgear.

When pump sets are located more than 5 m away from their respective starters, heavy duty push-button starter activators, suitably mounted, shall be installed adjacent to the pump set motor.

The support structure shall be robust, floor- mounted and galvanized by U1C hot-dipped method. The structure shall be designed to locate the pushbutton station at a convenient height and position. Emergency stop pushbutton actuators shall be of the auto latch-turn to release type. The actuator head shall be red, mushroom shaped and clearly 249ulfils249 “STOP”.

Start and stop push buttons shall be of the plain head type equipped with a half-guard protection.

All battery cells shall be lead acid type with a metal or plastic case.

Batteries shall be of adequate ampere-hour capacity equipment concerned.

Battery chargers shall be housed in sheet steel floor-mounted cabinets or on a steel rack. Chargers shall be complete with a self-adjusting constant potential trickle charger suitable for operating off a 240 Volt single phase A.C. supply. The charger shall be rated to continuously energize relay coils and lamps as applicable, and be designed to maintain a constant voltage within irrespective of mains voltage or frequency variation. Voltage control facilities shall be included.

General

A protection system shall be provided to deal with electrical faults such as short-circuits, earth faults, voltage surges, overloads, etc.

System Design

For the system design, the following risk factors shall be taken into account:

- Danger to personnel; material damaged; repair costs;
- Loss of energy.

For the choice of the protective relays, the following requirements shall be considered:

Selectivity:

The protective relay will disconnect only that part of the installation where a fault has occurred and avoid disconnection of other working components,

The protective relay must not trip when there is no fault in the protected object.

e)

Reliability:

In case of a fault the relay must always trip within the guaranteed tripping time.

Tripping times:

The tripping time of the relay, under the given circumstances and the total time required to clear the fault, shall be considered. This means that total tripping time comprises the relay tripping time and the break time of the circuit breaker including the arc duration.

Sensitivity:

This is defined as the lowest input value at which the clay still 250ulfils its required function.

Construction:

Protective relays shall be directly mounted on circuit breaker or secondary relays to be connected with current and transformers. When secondary, the relays shall be supplied ill flush mounted cases with glass windows. Each individual element of the relay shall initiate a flag to indicate that the element has been operated.

Overcurrent and earth fault relays:

Shall be used “dependent time over current relay with two poles over current and one pole earth leakage.

The relay shall be of the either electromagnetic or electronic secondary element type. Current adjustment and setting time regulation shall be provided.

Motor protection:

For all low voltage motors up to 75 k W, one triple pole wound magnetic adjustable overload set for starting and stalling and one triple pole thermal overload element shall be provided.

For all motors over 75 kW, flush-mounted total protection shall be provided.

Motor total protection relays shall include the following elements:

- Thermal protection against motor overheating sensitive to positive and negative sequence currents (49);
- Inverse time negative sequence overcurrent protection (46); inverse time or instantaneous short-circuit protection (50); stalling protection (51 R);
- Earth fault protection (64).

All cables for electrical equipment connection shall be single or multi-core PVC insulated cables.

Regulations concerning the construction and sizing of conductor, insulation system, electrical data, testing requirements and applications, are laid down in the relevant CEI/IEC specification.

Main Characteristics of ryc Cables

The thermoplastic insulating materials (PVC) used for this type of cable shall provide insulation with excellent mechanical characteristics even after ageing.

The cables shall be designed for work in wet conditions at temperatures up to 80°C.

Emergency temperatures up to 120°C due to overloads should be tolerated without damaging the insulation. Furthermore PVC insulated cables show excellent resistance against many chemicals such as acids and base solutions.

Power Cables

The power cables shall be of the 600/1000 V operating and insulating voltage type, complete with copper conductor

f)

Lighting Cables

Non-sheathed cables or wires protected by enclosure in plastic conduit shall be provided.

Instrumentation and Regulating Signals Cables

Shielded type PYC insulated cables shall be provided.

Carrying Current Capacity

Maximum permitted currents in the cables shall be those indicated in the tables and in accordance with CEI/IIEC standards.

Selection of the nominal cross-sectional area shall be based on current ratings, values of voltage drop, short-circuit conditions and laying conditions.

Min. cross-sectional area of conductor – mm2, Power 415 V and below 2.5, Lighting 1.5 or greater Control/alarm/signals 1.5

Installation

Cables inside the building shall be laid in rectangular channels, formed in concrete covered with steel/chequer plates with lifting holes, or in suitable suspended cable trays. Where surface conduits are used, they shall be fixed by means of spacing saddles of standard design in order to give not less than 6 mm clearance between conduits and walls.

General

The metal framework of all electrical and associated equipment included in the scope of supply shall be effectively earthed at all times.

The non-conducting metal work of all electrical equipment shall be effectively earthed. Electric motors rated at 25 kW and above shall be provided with a separate earth conductor of not less than 25 mm connected to the main earthing system; the cable may be used to achieve earth continuity on drives less than 25 kW.

All connections to the earth tape and any joints in the run of the tape shall be tinned, riveted, sweated and electrically continuous.

Earth tapes shall be fixed by means of a non-ferrous spacer saddle.

Earthing Nests

Each nest shall comprise a number of interconnected earth rods, 20 mm in diameter by 1.5 metres long, power driven vertically into the ground, with heads located at a depth to suit the disconnecting chamber position.

Earth rods shall be iron or copper and shall be provided with special hardened tips

and caps to avoid distortion when driven into the ground. Star points of alternators and transformers secondary windings shall be earthed directly to earth rods for this purpose only.

Disconnecting bolts, nuts, locknuts and washers shall be made from phosphor bronze.

Earth rod interconnections shall be an electrically unbroken ring, and interconnections shall be stranded copper conductor.

The conductor size shall be of sufficiently low resistance to carry the maximum fault current for a period equivalent to the clearing time of the protective equipment without undue temperature rise.

Complete external and internal electrical distribution systems for all power, lighting and control requirements shall be provided for:

Treatment works site including:

- generator house;
- office and chemical buildings;
- Pump Station No.
- filter gallery;
- External lighting (note: no local lighting shall be provided in the immediate vicinity of the exposed water surfaces of the sedimentation tanks or filters – a remote lighting source is to be used to illuminate these areas).

Gate house;
Pump Station No.2; All staff houses.

Lighting Intensities

Lighting design shall be carried out taking into account the following lighting intensity.

- External areas 15/20 lux Indoor installations:
- pump houses 150 lux
- Electrical installations: control rooms/sub-stations
- Generator houses 150 lux

Indoor Lighting

For indoor lighting installation, lighting armature shall be provided with the following characteristics:

- Degree of protection: IP 54
- Fittings for humid rooms for two tubular fluorescent lamps; body of fibre stabilized polyester;
- Plate made of steel sheet white-finished;

- Edged controller of metacrylate, clear, stripped, fixed by belt levers, scaled by hollow sect ion rubber gasket;
- Complete with ballast class F 220 V-50 Hz, capacitor, starter, lamp holder and electrical connections.

Outdoor Lighting Luminaries

All outdoor luminaries shall be suitable for steel pole or brackets mounting with the following characteristics:

- Mirror coating of super purity aluminium specially polished, a nodized and secondary compressed best reflection properties. Of polymethyl – metacrylate, special design for high rating of extra heat resistant and shockproof polycarbonate.
- Heat and aging resistant rubber gaskets to prevent penetration of rain, dust and insects. Chrome-plated screws.
- The luminaries shall be equipped with a mercury lamp of 250 W rated power.

Emergency Lighting

Emergency lighting installations shall be provided to guard a minimum level of illumination over the indoor' walkways am1 exit under mains failure conditions.

Emergency lighting fittings shall be self-contained, incorporating lamp, sealed nickel-cadmium battery, charger and mains failure detection relay.

Socket Outlets

Socket outlets for installation throughout the works covered shall be of the waterproof corrosion-resistant type as follows:

- 240 volt 16 amp 2 European round pin switched socket outlets with earthing contacts and with fully recessed switch dolly or raised surround to prevent inadvertent operation.
- 415 volt, 3 phase 16 A, 4 pin plus centre earth industrial fully interlocked switched socket outlets complete with matching interlocking angled plug.

Standby diesel generating sets shall be suitable for 24-hour/day continuous duty under the specific climatic conditions and altitude shown on the drawings, and shall be rated at 1,500 rpm.

Treatment Works Site

The primary generator installed in the generator house shall be rated to provide an electric power supply to two PSI pumps, one backwash pump, one air blower and auxiliary services and treatment works.

The required power demand for the treatment works emergency lighting; external lighting to buildings and auxiliary equipment shall be supplied by a further secondary generator to be located in the generator house. Diesel engine duties and

requirements are detailed below:

Pump Station No.2 Site

The primary generator installed in the generator house shall be rated to provide an electric power supply to two PS2 pumps plus auxiliary services.

The required power demand for the emergency lighting and auxiliary equipment shall be supplied by a further secondary generator to be located in the generator house.

- Machinery driven
- No. of units
- Speed RPM
- Rating 13HP

- Starting systems
- Fuel transfer system
- Cooling system

Alternators shall conform with IEC 34.1, be tropically finished throughout and be insulated with Class "F" insulating materials. They shall provide 3 phases, 415 Volts, 50 Hz supply and be suitable for operating under Iload conditions with a power factor, of 0.8.

Each alternator shall be equipped:-

- With a static voltage regulator and brushless excitation, holding voltage within 2 ~ % from no-load to full load conditions.
- During maximum load conditions of starting (one pump start, whilst two pump units are already running) the maximum instantaneous voltage drop shall not be greater than 2096 of the nominal voltage.
- Each alternator shall be supplied with a compact control panel, including voltage regulator, ammeter, voltmeter with selector switch, frequency meter, P.F. meter, hand-operated main fuse switch and other necessary auxiliary equipment, e.g. control lamps, terminals, glands, etc.
- The panel shall be either board or floor-mounted. The star-point of the alternators shall be connected to a completely separate earth system at the alternator control panel. The resistance of the earth electrode shall be not more than one Ohm.
- The alternators shall be effectively cooled by forced-air ventilation the ventilation openings shall be screened against ingress of large insects and rodents. The mechanical grade of protection shall be to IP 21.
- All rotating components shall be properly balanced to ensure dynamic balance at all operating speeds. The bearings shall be grease lubricated. Easily accessible nipples for regreasing shall be provided.
- Each alternator shaft shall be directly coupled to the diesel via a flexible coupling.

Diesel Engines

The diesel engines shall be suitable for the output of the respective alternators and shall comply with the requirements of ISO 3046 – 8S5514 DIN6271 A/B.

The nominal power output of the diesel engines shall be determined by kW consideration ratings for temperature, humidity

g)
h)

The diesel engines shall be of the cold starting, vertical, 2 or 4-stroke, water-cooled, direct injection type.
Suitable air inlet silencers and dry filters shall be provided on the air inlet manifolds.
The diesel engines shall be of the water-cooled type, equipped with a closed circuit fully pressurized water-cooling system with jacket water by a radiator cooling system. The radiator shall be mounted at the free end of the engine with a fan mechanically driven by the engine or remotely with the fan electrically driven.

The diesel engines shall be equipped with an aspirator of the supercharged type. The diesel engines shall be started either by an air' starting system or by an electrical starting system suitable for cold starting.

Air Starting System

The diesel engine shall be suitable for cold starting by compressed air. A complete compressed air system shall be provided with all necessary pipes, connectors, drain valves, gauges, motors, compressors and air receivers.

Each starting air-receiver shall be of such capacity as to permit at least five consecutive starts. The air-receivers shall be equipped with an over-pressure relief valve vented to the outside of the building and with a mechanical unloader to release the pressure in the pipeline connecting compressor.

Two sets of air compressors shall be provided for each air starting system. One shall be an internal combustion engine compressor, the second an electrically driven compressor set.

Each compressor shall be of such capacity as to be able to fill the air-receiver to the required pressure in not more than 15 minutes.

The engine for the first unit shall be of the air-cooled type, complete with fuel tank and detachable starting handle.

The engine shall be of the diesel type, suitable for operation with the same grade of fuel oil as the main unit.

The 415 Volt AC 3-phase electric motor for the second unit shall be automatically started and stopped through an 11 ir pressure switch.

Both units shall be mounted on fabricated steel plates or skids.

Electric Starting System

The diesel engines shall be suitable for electrical starting from cold. The engines shall each be provided with a separate electric starting system, including starting motors,

storage batteries with automatic recharging system, including charging alternator with automatic cut-out voltage regulator, all required connecting cables, push-button starter and isolating switches.

The electric starter motors shall be suitable for operating at 24 V DC supply from storage battery.

The start push-buttons shall be located on the instrument panel of the engine. The storage battery shall have sufficient capacity, well charged, to permit the consecutive starting the pumps.

15.0 Work Programme And Method Statement Of The Construction Works

1. General

The Contractor shall submit his fully detailed and time related programme showing the order of procedure and the method which he proposes for the construction and completion of the works and for the successful contractor this programme shall be re-submitted to the Engineer for his approval not later than 15 days from the date of award of the Contract. Failure to comply with this requirement will be a breach of the contract.

This approval shall be issued after due Consultation with the Employer for use in the Execution of the Works. The Contractor shall subsequently follow the approved work Programme in the Borehole and associated Works Construction as indicated herein above.

The Contractor shall submit a Statement of his proposed Work Method together with his tender and for the successful Tenderer this will be for the approval by the Engineer in Consultation with the Employer prior to commencement of works.

The program shall be deemed to have taken into account normal climate conditions to provide for the completion of the works in the order and within the times specified therein.

The information to be supplied to the Engineer shall include drawings showing the general arrangement of the temporary offices and any other structures which the Contractor proposes to use, details of the construction plant, temporary works and all of the devices which he proposes to adopt for the construction ads completion of the whole of the works and in addition details of the labour strength, skilled and unskilled, and supervision arrangements.

The contractor shall supply together with his programme and expenditure chart superimposed on it showing monthly anticipated expenditure.

The provision ads maintenance of all temporary works, plant, equipment and appliances required for the works shall be the responsibility of the Contractor in regard to construction, type, sufficiency and safety and approved by the Engineer shall in no way relieve the Contractor of their responsibility.

The order in which it is proposed to execute the permanent works shall be subjected to adjustment and approval by the Engineer, and the Contract Price shall be held to include for any reasonable and necessary adjustments required by the engineer during the course of the works.

Once the proposed program is approved by the engineer the Contractor shall not depart from the program without the written consent of the Engineer. In the event of unforeseen difficulties or disturbances arising which force the Contractor to depart from the approved program works, he shall advice the engineer in writing of such occurrences without delay and submit proposals

for any necessary remedial measures, for which he shall obtain the Engineer's approval before putting such measures into

SECTION III: BILL OF QUANTITIES

Preamble and Notes to Bills of Quantities

36. These Bills of Quantities form part of the Contract Documents and are to be read in conjunction with Conditions of Contract, Standard and Special Specifications and Drawings.

36. The quantities set forth in the Bills of Quantities represent the character of the work to be carried out. There is no guarantee to the Contractor that he will be required to carry out the quantities of work indicated under any one particular item or group of items in the Bills of Quantities, though on the Contract as the whole quantities are intended to represent the overall value of the work to be carried out.

36. The prices and rates inserted in the Bills of Quantities will be used for valuing the work executed and the Engineer will measure the whole of the works executed in accordance with the Contract.

36. The prices and rates inserted in the Bills of Quantities are to be the full inclusive costs of the works described under the items, complete in place and in accordance with specifications and Drawings including costs and expenses which may be required in and for the construction of the works described, together with any temporary works and installations which may be necessary and all general risks, liabilities and obligations set forth or implied in the Documents on which the Contract is based.

36. The brief description of the items given in the Bills of Quantities are purely for the purpose of the identification and in no way modify or supersede the detailed descriptions given in the Conditions of Contract, Specifications or Drawings. When pricing items, reference is to be made to the Conditions of Contract, Standard Specifications, Drawings and Special Specification for the full directions and description of work and materials.

36. A price or rate is to be inserted, in ink, against each item in the Bills of Quantities whether quantities are stated or not, and if the Tenderer includes the cost of a particular item elsewhere in his rates or prices, he shall insert the work teNir against both the rate and extension of that particular item. Should the Tenderer omit to price an item, then it will be assumed that he has included the cost of item elsewhere in his rates or prices.

36. No alteration shall be made to the Bills of Quantities and no extra item shall be inserted. The Tenderer shall satisfy himself that the Contract Sum arrived at by pricing the quantities am items given in sufficient compensation for constructing and maintaining the whole of the works in

accordance with the Contract Documents.

8. For the purpose of payment by Interim Certificate of "Lump Sum" items the Engineer may assess the portion of the work completed of the "Lump Sum" item and allow for payment the portion of the "Lump Sum" he deems fair and reasonable. The total of all portions allowed shall not exceed the "Lump Sum". All interim payment shall be subject to the retention stipulated in the Contract Documents.

9. During construction the unit rate established for an item in one Bills of Quantities may be used as a basis for establishing a unit rate for similar work in another Bill of Quantities, which contains no unit rate for the said item. No additional cost will be considered for such an eventuality

10. The Contractor will be provided by the Employer with all that land occupied by the Permanent Works including the specified working width of pipe laying. The costs of compensation and entry upon land will be paid from the Provisional Sums. All other costs for access to works to be paid by the Contractor.

11. It shall be the responsibility of the Contractor to arrange for the removal of or alteration to existing services where necessitated by the Works. Costs incurred will be paid by the Contractor.

12. Quantities for site clearance, Stripping and spreading shall be based on the horizontal projection of the area cleared or stripped.

13. Disposal of excavated material shall be deemed to be disposed off the site unless otherwise stated in item descriptions.

14. Generally, the excavation items are based on volumes for structures and on linear measurements. The work may be covered by one or more items. The rates shall include as appropriate for:-

a) Breaking through surfaces, handling different classes of material separately, excavation beyond the net plans area of the foundations for working space and for battering or timbering etc.
b) Timbering,
c) Disposal of surplus spoil
d) Back filling as specified
e) Trimming of exposed excavated surfaces

Measurement of volume of excavation for structures shall be calculated from the plan dimensions of the structure without allowance for working space.

Items are included for "Extra for Rock" on a volume basis. The rates shall include for breaking out and any other additional costs and the items shall apply to work encountered within measured excavation. Different classification may be billed separately. Rock shall be measured as a volume calculated from the thickness encountered within the plan area of a mass excavation, within the plan dimensions of a structure, or within the nominal

width of a trench. The decision of the Engineer on the classification of rock encountered shall be final and binding.

Timbering left in excavations shall only be measured for payment where it is specified or ordered by the Engineer. . .

15. When the site of any particular item of the Works has been sufficiently cleared of trees, undergrowth etc. and before any excavation or filling has been carried out, the Contractor shall carry out a survey under the supervision of the Engineer's Representative to take, record and agree upon an adequate number of original ground levels. The data so obtained shall be used as a basis for the computation of excavation and filling.

16. The volume of fill will be measured net to the finished levels as shown on the drawings or amended by the Engineer.

17. All reinforcement will be paid for on the basis of its computed weight except for fabric reinforcement with will be paid on the basis of the net area placed. The unit rates inserted in the Bill of Quantities shall include for all necessary cutting, bending and fixing, all additional bars which may be required as spacer supports, and lacings and also for all soft iron tying wires, fixing clips of approved pattern and manufacture and chairs. The cost of all temporary works etc. shall be included in the rates for the reinforcing steel

18. The rates for concrete shall include for making and testing preliminary test cubes, for making works test cubes and forwarding them to the Testing Engineer, forming the concrete to the slopes and falls shown on the Drawings and any additional concrete used in excess of the net requirements. The rates shall also include for forming construction joints, for protection, for the rubbing down of exposed surfaces of concrete after removal of formwork and for floating or brushing of other exposed surfaces where this is required.

19. The rates for precast concrete paving shall include for all cutting, bedding jointing and laying to falls.

20. The rates for precast concrete edging and kerbs small include for formwork, concrete bed and backing, all cutting, bedding, jointing, hunching and laying to falls.

21. The rates for formwork shall include for fillets and chamfers up to 50mm wide on the splay, coating to prevent adherence of concrete and the provision of temporary openings to facilitate inspection and cleaning. Rates shall also be inclusive of all necessary box outs and cut outs for holes up to 1 square meter.

The rates for forming rebates in concrete walls etc. shall include for forming pockets for the fish tail fixing cleats where required.

Deductions from formwork quantities will be made for openings more than 1 square meter in area.

22. Formwork for upper surfaces inclined at 30 degrees or less to the horizontal is not measured and the cost of any such formwork used will be deemed to be

included in the relevant concrete item rate.

23. Wrought formwork where specified will be measure to 150mm below final ground levels.

24. Items required for Structural Joints and Construction Joints shown on drawings shall be paid for as per the rates in the Bills of Quantities; the rate for providing and fix form work not shown in drawings shall be deemed to be included in the unit rates for concrete works.

25. All rates and sums in the Bills of Quantities shall be in Kenya Shillings and Cents.

26. The Tenderer is reminded that all quantities have been measured in Metric Units.

27. Explanation of abbreviations used in the Bills of Quantities is as follows:

L.S -Lump Sum
P.S. – Provisional SumY
P.C - Prime Cost
E.O. – Extra Over
Avg. – Averange
Max. – Maximum
Min. – Minimum
N. e - Not Exceeding
nr. - Number
mm - Millimeter
m - Linear Meter
m^2 - Square Meter
m^3 - Cubic Meter
Ha. - Hectare
DRG. - Design Drawing
kg- - Kilogramme
Dia - Diameter
C.I. - Cast Iron
uPVC - Unplacticised Polyvinyl
Hr. -Hour
AB - Ablution Block

28. The rates for metalwork shall include for bolts, nuts, nuts, washers and ringbolts, fixing as specified or in accordance with the manufacturer's instructions and rectifying as specified any parts of the painted, coated or galvanized surface that may be damaged either before or after erection.

29. The rates for fixing penstocks and flap valves etc. shall include for bedding and grouting, testing for water tightness, greasing ail working parts and leaving in good working order; where the item includes supply, the rates shall also include for supplying drawings for approval before manufacture is commenced.

Prime Cost Item

30. Attendance on nominated Sub-Contractor shall include for all or any of the following as
appropriate- labour, materials and plant required for taking delivery, carting, storing, hoisting and builder's work entailed in fixing, erecting installing as specified or in accordance with the manufacturer's instructions and all overheads and profits.

32. When, in the opinion of the Engineer, it is reasonable to expect the Contractor to price the attendance item it will be so included in the Bills of Quantities. In all other cases it will form the subject of a Provisional Sum to be expended on a Day works basis.

33. Profit shall include for establishment charges, profit and any other costs not included in the attendance item.

35. Definitions of Terms Used in Bill of Quantities

a) "Provide" – shall mean all costs to cover purchase of materials in good conditions, services for transaction with the supplier, supervision transport to site of works all charges for rental, consumption's overheads and profits throughout the Contract. It shall also include for all maintenance, insurance and handling and storage whenever applicable.

36) "Excavate for" – shall mean handling of any material from its incumbent position intended for specified work shown in the drawings or directed by the Engineer and backfilling and compacting part of material after laying of pipes, and cart away remaining to tips to be provided by the Contract. The cost of this work shall include all survey, supervision, labour, and tools machinery, protection of work, pumping, insurance and overheads and profits.

c) "Laying" – shall cover all work necessary for placing an object or material to true line and level specified in a drawing or as directed by the Engineer.
d) "Jointing" – shall mean process of fixing specified material, pipes, fittings and specials together using appropriate tools, materials labour and machinery. It should cover all work necessary to provide matching of opposite parts in size, shape and position indicated and clamps seating and holders to hold firmly.

36) "Testing" – shall mean provision of all materials apparatus, labour machinery, charges for the media or chemical to be used and their transport, repair or objects to be tested if required, re-testing, excavation of any part for visual inspection, erection of any type at all until the object has been certified as having passed the required test satisfactorily.

f) "Install" – shall include for all work requirements stipulated for "laying and joining"

36. Provisional sums have been included in the BOQ for cost of obtaining intake works
permit from WRMA, organisations as per regulations currently in force

BILL OF QUANTITIES

See attached (Bills of Quantities for the above works Annex 1)

	CONSTRUCTION OF RUGENE WATER PROJECT				
	Description	**Unit**	**Qty**	**Rate**	**Amount**
	PRELIMINARIES				
	Provide For Installation Of Signboards . The sign board dimensions shall be 2400mm high and 1200mm widdth to be installed as directed	No.	1		
	provide for county engineer project management cost	LS	1	250,000.0	250,000.00
	THE FOLLOWING WORKS : SITE CLEARING,EXCAVATION, CONCRETE WORKS,PIPE LAYING AND BACK FILLING ARE ALL PROVISIONAL AND SUBJECT TO RE-MEASUREMENT				
	INTAKE CONSTRUCTION				
	SITE CLEARANCE				
	provide for clearing of site for intake works construction	M2	30		
	provide for river diversion to allow for intake construction work	LS	1		
	EXCAVATION AND EARTHWORKS				
	Exxcavate site for intake chamber and weir key as per attached drawings in hard rock	M3	3.5		
	MASS CONCRETE				
	Provide for plain concrete class X mix 1:4:8 blinding mass in intake chambers , weir key and apront to weir foundation	M3	6		
	VIBRATED REINFORCED CONCRETE CLASS 20/20 mm (1:2:4)				
	Provide for reinforced concrete in intake chambers foundation base,weir and wing wall as in the drawing and directed by the engineer	M3	20		
	Provide for 200 mm thick side walling and roof slab for intake chambers asper the drawing.	M3	6		

	SQUARE TWISTED HIGH TENSILE REINFORCEMENT				
	10 mm Diameter	KG	1000		
	12 mm Diameter	KG	660		
	provide for binding wireto reinforcement bar	KG	15		
	SCREEN				
	Provide and fix standard coarse and fine screens easy to clean 600x1000mm with 30mm and 10mm openings to slide in fixed glooves as directed by the engineer.	ls	1		
	COVER TO INTAKE CHAMBER				
	Provide for heavy duty lockable manhole covers 600mmx450mm to intake chamber insitu fixed	No	3		
	INTAKE PIPE WORK				
	WASH OUT				
	Provide for open wash out to weir and chambers discharging to the water course				
	weir GI pipe 100mm diameter pcs 1m long with welded hoops for fixing in concrete	No	2		
	chambers GI pipe 75mm diameter pcs 1m long with welded hoops for fixing in concrete	No	3		
	OFF TAKE				
	Provide for offtake GI pipe piece 200mm diameter PN10flanged one ends with welded 250mm bell mouth and hoops 1m long as directed by the engineer	No	1		
	Provide for 200 mm diameter PN10 GI piece of pipe 5m long flanged both ends to be fixed to the 200mm diameter sluice valve and upvc 200mm pipe line.	No	1		
	Provide for 200mm sluice valve PN10 intake control valve and fix in place as directed by the engineer.	No	1		
	TOTAL FOR INTAKE STRUCTURE				
3.00	**PIPELINE CONSTRUCTION**				
	SITE CLEARANCE				

	Clear site of all bushes and shrubs and remove debris from site average width 1.2m as directed by the Engineer	LM	2,500		
	EXCAVATION AND EARTHWORKS				
	Excavate in pipe trench for pipe diameter 200mm, average of 1.2m but not exceeding 1.5m deep, minimum pipe cover 1000 mm backfilling trench after pipe fixing.	M	120		
	Ditto for depth exceeding 1.5 m but not more than 3.0m (provisional)	M^3	2		
	E.O for decomposed rock/compacted murram	M^3	10		
	Extra over for excavation in rock as described and defined in the specifications	M^3	2		
	Supply and fix Upvc pipes				
	Diameter 200mm upvc PN 10	M	120		
	Supply and fix 200 mm GI pipes fittings				
	The following pipe laying work is inclusive anhoring of pipes to as directed by the engineer				
	200mm diameter GI pipes class B	M	200		
	Provide for water course anchoring of pipe in reinforce concrete as directe by the engineer	No	34		
	GI fittings				
	200mm x 225 mmdiameter flanged adaptors	No	3		
	200mm diameter flanged bends	No	6		
	WASH OUT				
	Supply and fix 100 mm diametre wash out at CH 500M from intake as directed by the engineer	No	1		
	Provide for stardand valve chamber for washout	No	1		
	AIR VALVE				
	Supply and fix 50 mm diametre air valve at CH 700M from intake as directed by the engineer	No	1		
	Provide for stardand valve chamber for air valve		1		
	BILL SUMMARY				
1.00	**PRELIMINARIES**	No	1		

2	**CONSTRUCTION OF INTAKE**	No	1		
3	**PIPELINE CONSTRUCTION**	No	1		
	add 3% contigencies	%	1		
	TOTAL				

SECTION IX. SECURITY FORMS

Notes on Forms of Securities

Samples of acceptable forms of Bid, Performance, and Advance Payment Securities are annexed.[6] Bidders should not complete the Performance and Advance Payment Security forms at this time. Only the successful Bidder will be required to provide Performance and Advance Payment Securities in accordance with one of the forms or in a similar form acceptable to the Employer.

Annex A Form: Bid Security (Bank Guarantee)

Whereas, ... [name of Bidder] (hereinafter called "the Bidder") has submitted his Bid dated .....[date] for the construction **of intake and pipeline Rugene water project**
(hereinafter called "the Bid").

Know all people by these presents that We ..... [name of Bank] of..... [name of country] having our registered office at..... [address] (hereinafter called "the Bank") are bound unto name of Employer] (hereinafter called "the Employer") in the sum of [amount][7] for which payment well and truly to be 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] day of ..... [month], ...[year].

The conditions of this obligation are:

(1) If, after Bid opening, the Bidder withdraws his Bid during the period of Bid validity specified in the Form of Bid; or

(2) If the Bidder having been notified of the acceptance of his Bid by the Employer during the period of Bid validity:

(a) fails or refuses to execute the Form of Agreement in accordance with the Instructions to Bidders, if required; or

(b) fails or refuses to furnish the Performance Security, in accordance with the Instruction to Bidders; or

(c) does not accept the correction of the Bid Price pursuant to Clause 27,

we undertake to pay to the Employer up to the above amount upon receipt of his first written demand, without the Employer's 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 one or any of the three conditions, specifying the occurred condition or conditions.

This Guarantee will remain in force up to and including the date [number] days[8] after the deadline for submission of bids as such deadline is stated in the Instructions to Bidders or as it may be extended by the Employer, notice of which extension(s) to the Bank is hereby waived. Any demand in respect of this Guarantee should reach the Bank not later than the above date.

Date _____ Signature of the Bank ____

Witness _____ Seal __

_____
[signature, name, and address]

_____

Annex B Form (Alternative 1): Performance Bank Guarantee (Conditional)

This form of Performance Guarantee is conditional[9] in that the required conditions of default are not met until an agreement has been reached on the amount of damages payable, or until an award has been made under the applicable settlement of disputes procedures.

This Agreement is made on the…… … [day] day of…….. [month],……. [year] between…….. [name of Bank] of ……..[address of Bank] (hereinafter called "the Guarantor") of the one part and **county government of meru** (hereinafter called "the Employer") of the other part.

Whereas

(1) This Agreement is supplemental to a contract (hereinafter called the Contract) made between …….. [name of Contractor] of ……..[address of Contractor] (hereinafter called the Contractor) of the one part and the Employer of the other part whereby the Contractor agreed and undertook to execute the Works **Construction of intake and pipeline Rugene water project** for the sum of …….. being the Contract Price; and

(2) The Guarantor has agreed to guarantee the due performance of the Contract in the manner hereinafter appearing.

Now therefore the Guarantor hereby agrees with the Employer that upon receipt of

(1) a written notice to the Guarantor from the Contractor, or

(2) a written notice to the Guarantor from the Adjudicator, or

(3) a binding arbitration or Court award confirming that the amount of the Guarantee is payable to the Employer,

the Guarantor will indemnify and pay the Employer the sum of ……[amount of Guarantee] ……..[amount in words],[10] such sum being payable in the types and proportions of currencies in which the Contract Price is payable, provided that the Employer or his authorized representative has notified the Guarantor to that effect and has made a claim against the Guarantor not later than the date of issue of the Defects Liability Certificate.

The Guarantor shall not be discharged or released from his Guarantee by an arrangement between the Contractor and the Employer, with or without the consent of the Guarantor, or by any alteration in the obligations undertaken by the Contractor, or by any forbearance on the part of the Contractor, whether as to the payment, time,

performance or otherwise, and any notice to the Guarantor of any such arrangement, alteration, or forbearance is hereby expressly waived.

Given under our hand on the date first mentioned above.

Signed by _____
for and on behalf of the Guarantor in the presence of _____

Signed by _____
for and on behalf of the Employer in the presence of _____

Annex B Form (Alternative 2): Performance Bank Guarantee (Unconditional)

The Unconditional (or "On-Demand") Bank Guarantee has the merit of simplicity and of being universally known and accepted by commercial banks.

To:
The county secretary
County government of meru
P.O BOX 120-60200
Meru

Whereas .....[name and address of Contractor] (hereinafter called "the Contractor") has undertaken, in pursuance of Contract No. .....[number] dated .....[date] to execute
Construction of intake and pipeline Rugene water project
(hereinafter called "the Contract");

And whereas it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a recognized bank for the sum specified therein as security for compliance with his obligations in accordance with the Contract;

And whereas we have agreed to give the Contractor such a Bank Guarantee;

Now therefore we hereby affirm that we are the Guarantor and responsible to you, on behalf of the Contractor, up to a total of .....[amount of Guarantee] [amount in words],[11] such sum being payable in the types and proportions of currencies in which the Contract Price is payable, and we undertake to pay you, upon your first written demand and without cavil or argument, any sum or sums within the limits of..... [amount of Guarantee][12] as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein.

We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.

We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed thereunder or of any of the Contract documents which may be made between you and the Contractor shall in any way release us from any liability under this Guarantee, and we hereby waive notice of any such change, addition, or modification.

This Guarantee shall be valid until a date 28 days from the date of issue of the Certificate of Completion.

Signature and seal of the Guarantor _____

Name of Bank _____
Address
Date

Annex B Form (Alternative 3): Performance Bond

This form of Bond corresponds to the U.S. practice, and should not be interpreted in the context of a "Bond" as known in other countries. As with the Conditional Bank Guarantee, the wording of some bonds may be such that an award under legal proceedings is needed to trigger action by the Surety.

By this Bond, ...[name and address of Contractor] as Principal (hereinafter called "the Contractor") and .....[name, legal title, and address of surety, bonding company, or insurance company] as Surety (hereinafter called "the Surety"), are held and firmly bound unto **county government of meru**, [name and address of Employer] as Obligee (hereinafter called "the Employer") in the amount of ..... [amount of Bond] [amount of Bond in words],[13] for the payment of which sum well and truly to be made in the types and proportions of currencies in which the Contract Price is payable, the Contractor and the Surety bind themselves, their heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

Whereas the Contractor has entered into a Contract with the Employer dated[14] the..... day of .....[month], ...[year] execute conin accordance with the documents, plans, specifications, and amendments thereto, which to the extent herein provided for, are by reference made part hereof and are hereinafter referred to as the Contract.

Now, therefore, the Condition of this Obligation is such that, if the Contractor shall promptly and faithfully perform the said Contract (including any amendments thereto), then this obligation shall be null and void; otherwise it shall remain in full force and effect. Whenever the Contractor shall be, and declared by the Employer to be, in default under the Contract, the Employer having performed the Employer's obligations thereunder, the Surety may promptly remedy the default, or shall promptly:

(1) complete the Contract in accordance with its terms and conditions; or

(2) obtain a Bid or bids from qualified bidders for submission to the Employer for completing the Contract in accordance with its terms and conditions, and upon determination by the Employer and the Surety of the lowest responsive Bidder, arrange for a Contract between such Bidder and Employer and make available as work progresses (even though there should be a default or a succession of defaults under the Contract or Contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less the balance of the Contract Price; but not exceeding, including other costs and damages for which the Surety may be liable hereunder, the amount set forth in the first paragraph hereof. The term "Balance of the Contract Price," as used in this paragraph, shall mean the total amount payable by the Employer to the

Contractor under the Contract, less the amount properly paid by the Employer to the Contractor; or

(3) pay the Employer the amount required by the Employer to complete the Contract in accordance with its terms and conditions up to a total not exceeding the amount of this Bond.

The Surety shall not be liable for a greater sum than the specified penalty of this Bond.

Any suit under this Bond must be instituted before the expiration of one year from the date of issuance of the Certificate of Completion.

No right of action shall accrue on this Bond to or for the use of any person or corporation other than the Employer named herein or the heirs, executors, administrators, successors, and assigns of the Employer.

In testimony whereof, the Contractor has hereunto set its hand and affixed its seal, and the Surety has caused these presents to be sealed with its corporate seal duly attested by the signature of its legal representative, this..... day of..... [month],..... [year].

Signed by _____
on behalf of..... [name of Contractor] in the capacity of _____
In the presence of _____
Date _____

Signed by
on behalf of..... [name of Contractor] in the capacity of _____
In the presence of _____
Date _____

Annex C Form: Bank Guarantee for Advance Payment

To:
The county secretary
County government of meru
P.O BOX 120-60200
Meru

Execute
Construction of intake and pipeline Rugene water project

In accordance with the provisions of the Conditions of Contract, Clause 51 ("Advance Payment") of the above-mentioned Contract,..... [name and address of Contractor] (hereinafter called "the Contractor") shall deposit with **county government of meru** a Bank Guarantee to guarantee his proper and faithful performance under the said Clause of the Contract in an amount of..... [amount of Guarantee in words].[15]

We, the ..... has instructed by the Contractor, agree unconditionally and irrevocably to guarantee as primary obligator and not as Surety merely, the payment to **county government of meru** on his first demand without whatsoever right of objection on our part and without his first claim to the Contractor, in the amount not exceeding .....[amount of Guarantee] [amount in words].[16]

We further agree that no change or addition to or other modification of the terms of the Contract or of Works to be performed thereunder or of any of the Contract documents which may be made between **county government of meru** the Contractor, shall in any way release us from any liability under this Guarantee, and we hereby waive notice of any such change, addition, or modification.

This Guarantee shall remain valid and in full effect from the date of the advance payment under the Contract until **county government of meru** receives full repayment of the same amount from the Contractor.

Yours truly,

Signature and seal: _

Name of Bank/Financial Institution: ___
Address: ___
Date: _____

_____

1.0 EVALUATION AND COMPARISON OF TENDERS

Evaluation and comparison of Tenders: the following evaluation criteria shall be applied not withstanding any other requirement in the tender documents.

a) Mandatory requirements(MR)

The following requirements must be met by the renderer

No	Requirements	Requirements	B1	B2	B3	B4	B5
MR1	Must submit a copy of certificate of registration/incorporation	Year Reg./Incorporated					
MR2	Must submit a copy of valid tax compliance certificate	Serial no. Expiry date					
MR3	Must fill the price schedule in the format approved	Dully filled &signed					
MR4	Must fill the form of Tender in the format provided	Dully filled &signed					
MR5	Must fill a form of tender security of 2% of the tender sum	Form (Bank insurance)Amount (2% of tender sum)validity (120 days)					
MR6	Must submit a copy of certificate of registration with the national construction authority (NCA-6 & above)	Registration class					
MR7	Must submit a duly filled up confidential business questionnaire in format provided	Duly filled and signed					
MR8	Audited accounts for the last 3 years	Signed and stamped Auditor					
MR9	Litigation history related to government contracts-fill the litigation form and should be signed by the commissioner of oaths	Form signed by commissioner of oaths					

Key

B1-Bidder 1

B2-Bidder 2

B3-Binder3

B4-Binder4

B5-Binder5

At this stage, the tender s submission will either be responsive or non-responsive. The non -responsive submission will be eliminated from the entire evaluation process and will not be considered further.

b) Technical evaluation scores

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

No	Evaluation Attribute	Weighting score	Max score	B 1	B 2	B 3	B 4	B 5
T.S. 1	Number of years in water systems construction and general civil work	❖ 10 years and above-10 marks ❖ Others prorated at: $\frac{Number\ of\ years \times 10}{10}$	10 marks					
T.S. 2	Provide a list of clients and reference to which the company has done similar works (attach certified copies of reference letters	❖ 10 clients with reference letters from the clients-20 marks ❖ Other prorated at $\frac{No\ of\ clients \times 20}{10}$	20 marks					
T.S. 3	Financial strength of the company =current Asset Current liabilities	❖ 2.1 ratio-10 marks ❖ Others prorated at $\frac{The\ ratio \times 10}{2}$	10 marks					
T.S. 4	Financial strength of the company: Acid Test Ratio=current Asset-Average stock current liabilities	1.1 ratio-10 marks 2.0 others prorated at: $\frac{The\ ratio \times 10}{1}$	10 marks					

T.S.5	Equipment and accessories owned by the company and to be directly assigned to the project during the contract period(Attach certified copies of certificate of ownership purchase receipts sales agreements or lease agreements)	Provide details/list of at least 10 equipment and accessories and explain what they will be used for in the project implementation(2marks for each equipment)	20 marks					
T.S.6	Physical facilities: provide details of physical address and contacts (Attach Evidence)	Details of physical address and contacts with copy of either title, lease documents or latest utility bill	10 marks					
T.S.7	Staffing capacity (Attach certified copies of certificates membership professional bodies	❖ Site Engineer with degree-5 marks ❖ Foreman with diploma -3 marks ❖ Supervisors -2marks	10 marks					
T.S.8	Delivery schedule of works for the period indicated	Provide details	5marks					
T.S.9	Organizational structure	Give structure with details of responsibilities	5 marks					

Only bidders who score 70% and above will be subjected to financial evaluation. Those who score below 70% will be eliminated at this stage from the entire evaluation process and will not be considered further.

c) Financial Evaluation

The evaluation will check the arithmetic errors and confirm the changed prices with the renderer.

Technical score will be weighted at 80%
Financial score will be weighted at 20%

The best responsive evaluated bidder will be awarded the tender