MINISTRY OF TRANSPORT, HIGHWAYS, PORTS AND CIVIL AVIATION

AIRPORT AND AVIATION SERVICES (SRI LANKA) (PRIVATE) LIMITED

NAVIGATIONAL SERVICE COMPLEX AT CIAR, RATMALANA

(BID NO. 067/T/2024)

BIDDING DOCUMENT

COMPRISING:

VOLUME - I

SECTION 1 – INSTRUCTIONS TO BIDDERS – ICTAD/SBD/02

SECTION 3 – CONDITIONS OF CONTRACT– ICTAD/SBD/02

SECTION 5 – STANDARD FORMS (CONTRACT)

VOLUME - II

PART I

INVITATION OF BIDS (IFB)

SECTION 2 – BIDDING DATA – ICTAD/SBD/02

SECTION 4 – CONTRACT DATA– ICTAD/SBD/02

PART II

SECTION 6 – SPECIFICATIONS

PART III

SECTION 7 – FORM OF BID

SECTION 8 – BILL OF QUANTITIES

SECTION 9 – SCHEDULES

SECTION 10 – DRAWINGS

SECTION 11 – STANDARD FORMS (BID)

AIRPORT AND AVIATION SERVICES (SRI LANKA) (PRIVATE) LIMITED

BANDARANAIKE INTERNATIONAL AIRPORT,

KATUNAYAKE.

PROJECT NO. AASL/HCE (P&D)/2024.05.20

MAY 2024

VOLUME I

SECTION 1 – INSTRUCTIONS TO BIDDERS

SECTION 3 – CONDITIONS OF CONTRACT

SECTION 5 – STANDARD FORMS (CONTRACT)

Disclaimer:

Bidding Process of this Tender strictly follows: -

1. ***Standard Bidding Document for Procurement of Works ICTAD/SBD/02***
2. ***Addendum 01 issued in October 2009 to the above***
3. ***Procurement Guidelines 2006 issued by National Procurement Agency***

SECTION 1

INSTRUCTIONS TO BIDDERS

Section - 1

INSTRUCTIONS TO BIDDERS

Notes:

Instructions to Bidders shall be read in conjunction with Bidding Data under Section 2 (Volume 2). Matters governing the performance of the Contractor, payments under the Contract, or matters affecting the risks, rights, and obligations of the parties under the Contract are included under Section 3 - Conditions of Contract (Volume 1) and Contract Data under Section 4 (Volume 2). However, a few such information is reproduced in this section to facilitate the bidders to price their bids.

Instructions to Bidders will not be a part of the Contract and will cease to have effect once the Contract is signed.

Note :

Bidders may consider the information printed in blue colour in the document as a checklist, when preparing their bids. However, it is the responsibility of the bidders to comply with all the requirements given in the bidding document.

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Instructions to Bidders

A. General

1. Scope of Bid

1.1 The Employer, as defined in the Bidding Data and Contract Data hereinafter "the Employer," wishes to receive Bids for the construction of Works, and remedying defects as described in this document hereinafter referred to as "the Works."

1.2 The successful bidder will be expected to complete the Works within the period stated in the Bidding Data and Contract Data from the date of commencement of the Works.

2. Source of Funds

2.1 Works will be financed by the source given in Bidding Data.

3. Ethics, Fraud and Corruption

3.1 The attention of the bidders is drawn to the following guidelines of the Procurement Guidelines published by National Procurement Agency:

- Parties associated with procurement actions, namely, suppliers/contractors and officials shall ensure that they maintain strict confidentiality throughout the process;
- Officials shall refrain from receiving any personal gain from any Procurement Action. No gifts or inducement shall be accepted. Suppliers/contractors are liable to be disqualified from the bidding process if found offering any gift or inducement which may have an effect of influencing a decision or impairing the objectivity of an official.

3.2 The attention of the bidders is also drawn to the Sub-Clause 15.2 (g) of the Conditions of Contract (Section 3) which shall apply to any bidder.

4. Eligibility and Qualification of the Bidders

4.1 All bidders shall include the following information and documents with their Bid in Section 9 - Schedules:

(a) Certified copies of original documents defining the constitution or legal status, place of registration, and principle place of business: written power of attorney authorizing the signatory of the Bid to commit the bidder; and

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(b) In the event that pre-qualification of bidder is a requirement, only Bids from those who satisfy the pre-qualification criteria will be considered for award of Contract. These qualified bidders should submit with their Bids any information updating their original pre-qualification applications or, alternatively, confirm in their Bids that the information submitted with their applications for pre-qualification has not materially changed from the date of Bid submission. The update or confirmation should be provided in Section 9.

As a minimum requirement, bidders shall update the following information:

(i) evidence of access to lines of credit and availability of other financial resources;

(ii) a statement of financial predictions of the bidder for the 12 months, commencing from the closing date of Bids including the effect of known commitments;

iii) work commitments of the other projects under taken since pre-qualification;

iv) availability of equipment that may be required for the project.

(c) In the event that pre-qualification of bidders is not a requirement, unless otherwise stated in the Bidding Data, all bidders shall include the following information and documents as a minimum with their Bids in Section 9 – Schedules:

i) reports on the financial standing of the bidder, such as profit and loss statements and auditor's reports for the past three years;

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

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

iv) 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;

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

vi) qualifications and experience of key Site Management and Technical Personnel proposed for the Contract;

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vii) proposals for subcontracting components of the Works amounting to more than 10 percent of the Contract Amount; and

viii) All bidders shall confirm in Section 7, Form of Bid, a statement that the bidder (including all members of a joint venture and subcontractors) is not associated directly or indirectly in the preparation of the bidding document.

ix) list any other

4.2 To qualify for the award of the Contract, bidder shall meet the following minimum qualifying criteria:

(a) Domestic bidders, shall have been registered and hold a valid registration with Institute for Construction Training and Development (ICTAD), under the grade and specialty given in Bidding Data, Section 2;

(b) average annual volume of construction work performed in last five years shall be not less than the amount specified in Bidding Data;

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

(d) proposals for the timely acquisition (own, lease, hire, etc.) of the essential equipment if any specified in Bidding Data;

(e) a Contract Manager with qualifications and experience as given in Bidding Data;

(f) 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 not less than the amount specified in Bidding Data.

(g) shall not be a blacklisted contractor at the time of bidding and at the time of award of contract.

5. Joint Ventures

5.1 Bids submitted by a joint venture of two or more firms as partners shall comply with the following requirements:

(a) the Bid shall include all the information listed in Clause 4.1 above for each joint venture partner

(b) the bid security, the Bid, and in case of a successful Bid, the Agreement, shall be signed so as to be legally binding on all partners;

(c) one of the partners shall be nominated by others authorizing to act for an on behalf of the joint venture. This authorization shall be evidenced by submitting a power of attorney signed by legally authorized signatories of all the partners;

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

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(e) all partners of the joint venture shall be liable jointly and severally for the execution of the Contract in accordance with the contract terms, and a statement to this effect shall be included in the authorization mentioned under (c) above, as well as in the Bid and in the Agreement (in case of a successful Bid); and

(f) a copy of the joint venture agreement entered into by all partners shall be submitted with the Bid. Alternatively, a memorandum of understanding to execute a joint venture agreement in the event of a successful Bid shall be signed by all partners and submitted with the Bid, together with a copy of the proposed agreement.

5.2 One of the partners shall have the qualification requirements for 4.2 (a) and (c). The qualification 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 4.2(b) and (f); however, for a joint venture to qualify, each of its partners must meet at least 25 percent of minimum criteria 4.2(b), (c) and (f); and the partner in charge must satisfy 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.

6. One Bid per Bidder

6.1 Each bidder shall submit only one Bid, either by himself, or as a partner in a joint venture. A bidder who submits or participates in more than one Bid will be disqualified.

7. Cost of Bidding

7.1 The bidder shall bear all costs associated with the preparation and submission of its Bid, and the Employer will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

8. Site Visit

8.1 The bidder is advised 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.

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

8.3 The Employer may conduct a Site visit concurrently with the pre-bid meeting referred to in Clause 19.

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B. Bidding Documents

9. Content of Bidding Documents

9.1 The bidding documents, consists of two volumes are those stated below and should be read in conjunction with any addenda with Clause 11:

Volume 1

Section 1 - Instructions to Bidders

Section 3 - Conditions of Contract

Section 5 - Standard Forms [Contract]

Volume 2

Invitation for Bids

Section 2 - Bidding Data

Section 4 - Contract Data

Section 6 - Specifications

Section 7 - Form of Bid

Section 8 - Bills of Quantities

Section 9 - Schedules

Section 10 - Drawings

Section 11 - Standard Forms [Bid]

10. Clarification of Bidding Documents

10.1 A prospective bidder requiring any clarification of the bidding documents or any objection to restrictive specifications, may notify the Employer in writing or facsimile at the Employer's address indicated in the Bidding Data. The Employer will respond to any such request for clarification that he receives earlier than 14 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.

11. Amendment of Bidding Documents

11.1 At any time prior to the deadline for submission of Bids, the Employer may amend the bidding documents by issuing addenda.

11.2 Any addendum thus issued shall be part of the bidding documents pursuant to Sub-Clause 9.1 and shall be communicated in writing or by facsimile to all purchasers of the bidding documents. Prospective bidders shall promptly acknowledge receipt of each addendum by facsimile to the Employer.

11.3 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 Clause 22.

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C. Preparation of Bids

12. Language of Bid

12.1 The Bid, and all correspondence and documents related to the Bid exchanged by the bidder and the Employer, shall be written in English Language. Supporting documents and printed literature furnished by the bidder may be in another language provided they are accompanied by an accurate translation of the relevant passages in English language, in which case, for purposes of interpretation of the Bid, the English translation shall prevail.

13. Documents Comprising the Bid

13.1 The Bid submitted by the bidder shall comprise the following:

(A) Enclosed in the envelope marked as "ORIGINAL" ;

(a) Duly filled and signed Form of Bid (in the format indicated in Section 7);

(b) Bid Security

(c) Power of Attorney for the signatory to the Bid

(d) Section 2 - Bidding Data;

(e) Section 4 - Contract Data;

(f) Section 6 - Specifications;

(g) Section 8 – Priced Bills of Quantities;

(h) Section 9 – Duly filled Schedules;

(i) Section 10 – Drawings; and

(j) Any other information required to be completed and submitted by bidders, as specified in the Bidding Data.

and

(B) Enclosed in the envelope marked as "COPY"

(a) Duly filled and signed Form of Bid (in the format indicated in Section 7);

(b) Section 8 – Priced Bills of Quantities;

(c) Section 9 – Duly filled Schedules; and

(d) Any other information required to be completed and submitted by bidders, as specified in the Bidding Data.

14. Bid Prices

14.1 Unless stated otherwise in the bidding documents, the Contract shall be for the whole Works as described in Sub-Clause 1.1, based on the unit rates and prices in the Bills of Quantities submitted by the bidder.

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

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14.3 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 and prices and the total bid price submitted by the bidder. However the VAT component shall be entered separately in the space provided in the

14.4 Unless otherwise provided in the Bidding Data, the rates and prices quoted by the bidder are subject to adjustment during the performance of the Contract in accordance with the provisions of Sub-Clause 13.7 of the Conditions of Contract.

15. Currencies of Bid and Payment

15.1 The rates and prices shall be quoted by the bidder entirely in Sri Lanka Rupees unless otherwise provided in Bidding Data.

16. Bid Validity

16.1 Bids shall remain valid for the period stipulated in the Bidding Data, after the deadline for Bids submission as specified in sub clause 22.1.

16.2 In exceptional circumstances, prior to expiry of the original Bid validity period, the Employer may request that the bidders extend the period of validity for a specified additional period. The request and the responses thereto shall be made in writing. A bidder may refuse the request without forfeiting its bid security. A bidder agreeing to the request will not be required or permitted to modify its Bid, but will be required to extend the validity of its bid security for the period of the extension and in compliance with Clause 17 in all respects.

17. Bid Security

17.1 The bidder shall furnish, as part of its Bid, a bid security in the amount stipulated in the Bidding Data.

17.2 The bid security shall, at the bidder's option, be in the form of a bank draft, letter of credit or a guarantee from a reputed bank or insurance guarantee from a company located in Sri Lanka or from an acceptable bonding organization in Sri Lanka. The format of the bid security should be in accordance with the specimen form of bid security included in the bidding document or another form acceptable to the Employer. bid security shall be valid for the period given in the Bidding Data;

17.3 Any Bid not accompanied by an acceptable bid security shall be rejected by the Employer as non-responsive. The bid security of a joint venture shall be issued so as to commit fully all partners to the proposed joint venture.

17.4 The bid securities of unsuccessful bidders will be returned as promptly as possible, but not later than 28 Days after the expiration of the original period, or any subsequently extended period, of Bid validity.

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17.5 The bid security of the successful bidder will be returned when the bidder has signed the Agreement and furnished the required Performance Security.

17.6 The bid security may be forfeited:

(a) if the bidder withdraws its Bid, after Bid opening during the period of Bid validity;

(b) bidder does not accept the correction of its bid price, pursuant to Clause 29; or

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

(i) sign the Agreement; or
(ii) furnish the required Performance Security

18. Alternative Proposals by Bidders

18.1 Except as provided under Sub-Clause 18.2 below, bidders wishing to offer technical alternatives to the requirements of the bidding documents must first price the Employer's design as described in the bidding documents and shall further provide all information necessary for a complete evaluation of the alternative by the Employer, including drawings, design calculations, technical specifications, breakdown of prices, and proposed construction methodology and other relevant details. Only the technical alternatives, if any, of the lowest evaluated bidder conforming to the basic technical requirements shall be considered by the Employer.

18.2 When bidders are permitted to submit alternative technical solutions for specified parts of the Works, such parts shall be described in Section 6 – Specifications.

19. Pre-Bid Meeting

19.1 The bidder's designated representative is invited to attend a pre-bid meeting, which, if convened, will take place at the venue and time stipulated in the Bidding Data.

19.2 The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.

19.3 The bidder is requested, as far as possible, to submit any questions in writing or by facsimile, to reach the Employer not later than one week before the meeting. It may not be practicable at the meeting to answer questions received late, but questions and responses will be transmitted in accordance with the following sub-clause.

19.4 Minutes of the meeting, including the text of the questions raised and the responses given, together with any responses prepared after the meeting, will be transmitted without delay to all purchasers of the bidding documents. Any modification of the bidding documents listed in Sub-Clause 10.1 that may become necessary as a result of the pre-bid meeting shall be made by the Employer exclusively through the issue of an addendum pursuant to Clause 11 and not through the minutes of the pre-bid meeting.

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

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20. Format and Signing of Bid

20.1 The bidder shall prepare one original of the documents comprising the Bid as described in Clause 13 of these Instructions to bidders clearly marked "ORIGINAL." In addition, the bidder shall submit a copy of the Bid, clearly marked "COPY." In the event of discrepancy between them, the original shall prevail.

20.2 The original and the copy of the Form of 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 Paragraphs 4.1 (a) or 5.1 (c), 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.

20.3 The Bid shall contain no alterations, omissions, or additions, unless such corrections are initialed by the person or persons signing the Bid.

D. Submission of Bids

21. Sealing and Marking of Bids

21.1 The bidder shall seal the original and the copy of the Bid in separate envelopes, duly marking the envelopes as "ORIGINAL" and "COPY." The envelopes shall then be sealed in an outer envelope.

21.2 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 Data; and

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

21.3 In addition to the identification required in Sub-Clause 21.2, 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 23, and for matching purposes under Clause 24.

21.4 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. If the outer envelope discloses the bidder's identity, the Employer will not guarantee the anonymity of the Bid submission, but this shall not constitute grounds for rejection of the Bid.

22. Deadline for Submission of Bids

22.1 Bids must be received by the Employer at the address specified in Sub-Clause 21.2 no later than the time and date stipulated in the Bidding Data.

22.2 The Employer may, in exceptional circumstances and at its discretion, extend the deadline for submission of Bids by issuing an addendum in accordance with Clause 11, in which case all rights and obligations of the Employer and the bidders previously subject to the original deadline will thereafter be subject to the deadline as extended.

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23. Late Bids

23.1 Any Bid received by the Employer after the deadline for submission of Bids prescribed in Clause 22 will be returned unopened to the bidder.

24. Modification and Withdrawal of Bids

24.1 The bidder may modify or withdraw its Bid after Bid submission, provided that written notice of the modification or withdrawal is received by the Employer prior to the deadline for submission of Bids.

24.2 The bidder's modification or withdrawal notice shall be prepared, sealed, marked, and delivered in accordance with the provisions of Clauses 20 & 21, with the outer and inner envelopes additionally marked "Modification" or "Withdrawal," as appropriate.

24.3 No Bid may be modified by the bidder after the deadline for submission of Bids, except in accordance with sub clause 29.2.

24.4 Withdrawal of a Bid during the interval between the deadline for submission of Bids and expiration of the period of Bid validity specified in Clause 16 may result in the forfeiture of the bid security pursuant to Sub-Clause 17.6.

24.5 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

25. Bid Opening

25.1 The Employer will open the Bids, including withdrawals and modifications made pursuant to Clause 24, in the presence of bidders' authorized representatives who choose to attend, at the time, date, and location stipulated in the Bidding Data. The bidders' representatives who are present shall sign a register evidencing their attendance.

25.2 Envelopes marked "WITHDRAWAL" shall be opened first, and the name of the bidder shall be read out. Bids for which an acceptable notice of withdrawal has been submitted pursuant to Clause 24 shall not be opened. Subsequently, all envelopes marked "MODIFICATION" shall be opened and the submissions therein read out in appropriate detail.

25.3 The envelope marked as "Original" will be opened. If no envelope is marked as "Original" the Employer may open one of the envelopes. If the required documents are available in that envelope, Employer may mark it as the "Original" and the unopened envelope as the "Copy". If so the envelope marked as copy will remain unopened. If any of the required document is missing in the envelope opened first, the Employer may open the other envelope to search such missing information and transfer such documents to one envelope and mark it as "Original" and resealed the other envelope and mark as "Copy".

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25.4 The bidders' names, the bid prices, including any alternative bid price or deviation, any discounts, Bid modifications and withdrawals, the presence (or absence) and amount of bid security, and any such other details as the Employer may consider appropriate, will be announced by the Employer at the opening. No Bid shall be rejected at Bid opening except for late Bids pursuant to Clause 23.

25.5 The Employer shall prepare minutes of the Bid opening, including the information disclosed to those present in accordance with Sub-Clause 25.3.

25.6 Bids not opened and read out at Bid opening shall not be considered further for evaluation, irrespective of the circumstances.

26. Process to be Confidential

26.1 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, with respect to processing of Bids or award decisions may result in the rejection of the bidder's Bid.

27. Clarification of Bids

27.1 To assist in the examination, evaluation, and comparison of Bids, the Employer may, at its discretion, ask any bidder for clarification of its Bid, including breakdowns of unit rates. The request for clarification and the response shall be in writing or by 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 29.

27.2 From the time of Bid opening to the time of Contract award, if any bidder wishes to contact the Employer on any matter related to the Bid, it should do so in writing.

28. Examination of Bids and Determination of Responsiveness

28.1 Prior to the detailed evaluation of bids, the Employer will determine whether each Bid (a) meets the eligibility criteria; (b) has been properly signed; (c) is accompanied by the required securities; (d) is substantially responsive to the requirements of the bidding documents; and (e) provides any clarification and/or substantiation that the Employer may require to determine responsiveness pursuant to Sub-Clause 28.2. Furthermore, the bidder shall, if required, provide substantiation that the Employer may require, pursuant to Clause 27.

28.2 A substantially responsive Bid is one that 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) that affects in any substantial way the scope, quality, or performance of the Works; (b) that 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.

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28.3 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.

29. Correction of Errors

29.1 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:

(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

mis-placement 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.

29.2 If the bid price changes by the above procedure, the amount stated in the Form of Bid shall be adjusted with the concurrence of the bidder and shall be considered as binding upon the bidder.

29.3 If the bidder does not accept the corrected amount of Bid, its Bid will be rejected, and the bid security may be forfeited in accordance with paragraph 17.6 (b).

30. Evaluation and Comparison of Bids

30.1 The Employer will evaluate and compare only the Bids determined to be substantially responsive in accordance with Clause 28.

30.2 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 29;

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

(c) making appropriate adjustments as described below to reflect discounts or other price modifications offered in accordance with Sub-Clause 24.5 or otherwise.

i. If discounts are offered to limited items it should be applicable to such items;

ii. If the discount offered is to the total bid price as a percentage it should be applicable to all the items at the percentage discount offered, excluding for contingencies and provisional sum items before the contract award all rates and prices shall be adjusted to suit the discount;

iii. If the discount offered is to the total bid price as a lump sum, such lump sum amount should be considered for evaluation and before the award of contract such lump sum amount shall be uniformly distributed to all the items, excluding for contingencies and provisional sums.

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(d) converting the amount resulting from applying (a) to (c) above, if relevant, to Sri Lanka Rupees in accordance with Bidding Data Clause 15.1; and

(e) making an appropriate adjustment on sound technical and/or financial grounds for any other quantifiable acceptable variations, deviations, or alternative offers.

30.3 The Employer reserves the right to accept or reject any variation, deviation, or alternative offer. Variations, deviations, alternative offers, and other factors that are in excess of the requirements of the bidding documents shall not be taken into account in Bid evaluation.

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

30.5 If the Bid, which results in the lowest evaluated bid price, is seriously unbalanced or front loaded in relation to the Engineer's estimate of the items of work to be performed under the Contract, the Employer may require the bidder to produce detailed price analyses for any or all items of the Bills of Quantities, to demonstrate the internal consistency of those prices with the construction methods and schedule proposed. After evaluation of the price analyses, taking into consideration the schedule of estimated Contract payments, the Employer may require that the amount of the Performance Security set forth in Clause 35 be increased at the expense of the bidder to a level sufficient to protect the Employer against financial loss in the event of default of the successful bidder under the Contract.

31. Preference for Domestic Bidders

31.1 Not used unless specified in Bidding Data.

F. Award of Contract

32. Award

32.1 Subject to procedures if provided under Sub-Clause 32 under Bidding Data and Subject to Clause 33, 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 pursuant to Clauses 30 and 31 (if applicable), provided that such bidder has been determined to be (a) eligible in accordance with the provisions of Sub-Clause 3, and (b) qualified in accordance with the provisions of Clause 4 & 5.

32.2 Even though the bidders meet the eligibility and qualification criteria specified they are subjected to disqualify if they have:

(a) made misleading or false representation in the forms, statement and attachments submitted in proof of the eligibility and qualification requirements ; or

(b) record of poor performance in previous contracts, such as abandoning the works, inordinate delays resulted in payment of liquidated damages up to the maximum limit specified in the contract etc.

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

33.1 The Employer reserves the right to accept or reject any Bid, and to annul the bidding process and reject all Bids, at any time prior to 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.

34. Notification of Award and signing of Agreement

34.1 Prior to expiration of the period of Bid validity prescribed by the Employer, the Employer will notify the successful bidder that its Bid has been accepted. This letter (hereinafter and in the Conditions of Contract called the "Letter of Acceptance") shall specify the sum that the Employer will pay the Contractor in consideration of the execution and completion of the Works and the remedying of any defects therein by the Contractor as prescribed by the Contract (hereinafter and in the Conditions of Contract called "the Initial Contract Price").

34.2 The notification of award will constitute the formation of the Contract.

34.3 Upon the successful bidder's furnishing of the Performance Security pursuant to ITB Clause 35, the Employer will promptly notify the name of the winning bidder to each unsuccessful bidder and will discharge the bid security of the unsuccessful bidders, pursuant to ITB Clause 17.

34.4 At the same time that the Employer notifies the successful bidder that its Bid has been accepted, the Employer will send the bidder the Agreement in the form provided in the bidding documents, incorporating all Agreements between Parties.

34.5 The Agreement will incorporate the Memorandum of Understanding (if any) between the Employer and the successful bidder, and shall be signed by the Employer and the successful bidder.

34.6 The Employer shall notify the successful bidder the date, time and venue for the signing of the Agreement. The Agreement shall be signed within 28 Days of Letter of Acceptance.

35. Performance Security

35.1 Within 14 Days of receipt of the Letter of Acceptance, the successful Bidder shall furnish to the Employer a Performance Security in the amount specified in the Bidding Data in the form given in the Bidding Data or some other form acceptable to the Employer.

35.2 Failure of the successful bidder to comply with the requirements of Clauses 34 or 35 shall constitute a breach of Contract, cause for annulment of the award, forfeiture of the bid security, and any such other remedy the Employer may take under the Contract, and the Employer may resort to awarding the Contract to the next ranked bidder.

35.3 During the bid evaluation if the Employer found that the rate/s or amount/s quoted by the bidder is/ are unreasonably low and could not furnish rational justification to the Employer, the Employer may request the bidder to furnish a Performance Security to an increased amount than that specified in the Contract Data.

36. Advance Payment & Security

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36.1 The Employer will provide an advance payment as stipulated in the Conditions of Contract, subject to a maximum amount of 20% of the Initial Contract Price, within 14 Days of the Contractor submitting an acceptable guarantee and upon submission of Performance Security.

37. Adjudicator

37.1 The Employer and the Contractor shall mutually agree on the appointment of an Adjudicator within 28 Days from the Commencement Date.

If mutual consent is not reached or resorted to or the Adjudicator was not proposed then the Adjudicator shall be appointed by the Institute for Construction Training and Development (ICTAD) at the request of either Party after the expiry of 28 Days.

The Adjudicator shall be a person not associated with the project directly or indirectly and who could demonstrate impartiality and independence in his functions.

SECTION 3

CONDITIONS OF CONTRACT

Section - 3

CONDITIONS OF CONTRACT

Conditions of Contract shall be read in conjunction with the Section 4 - Contract Data in Volume 2, which shall take precedence over the Conditions of Contract

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Conditions of Contract

1.0 General Provisions

1.1 Definitions

In the Conditions of Contract ("these Conditions"), and Contract Data, the following words and expressions shall have the meanings stated.

1.1.1 The Contract

1.1.1.1 **"Contract"** means the Contract Agreement, the Letter of Acceptance, Memorandum of Understanding (if any), the Form of Bid, these Conditions, the Contract Data, the Specifications, the Drawings, the Bills of Quantities, the Schedules and further documents (if any) which are listed in the Contract Agreement or in the Letter of Acceptance.

1.1.1.2 **"Contract Agreement"** means the contract agreement (if any) referred to Sub-Clause 1.6 *(Contract Agreement)*

1.1.1.3 **"Letter of Acceptance"** means the letter issued by the Employer indicating the acceptance of the Bid.

1.1.1.4 **"Contract Data"** means the completed pages entitled contract data and given in Section 4 which forms part of the conditions of contract.

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

1.1.1.6 **"Schedules"** means the document(s) entitled schedules and given in Section 9 completed by the Contractor and submitted with the Bid, as included in the Contract.

1.1.1.7 **"Form of Bid"** means the document entitled form of bid, which is completed by the Contractor and includes the signed offer to the Employer for the Works.

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1.1.1.8 **"Bid"** means the Form of Bid and all other documents, which the Contractor submitted with the Bid, as included in the Contract.

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

1.1.1.10 **"Bills of Quantities"** and **"Dayworks Schedule"** means the documents so named (if any) which are comprised in the Contract.

1.1.2 Parties and Persons

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

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

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

1.1.2.4 **"Engineer"** is the person named in the Contract Data (or any other competent person appointed by the Employer and notified to the Contractor) who is responsible for administering and supervising the execution of the work. Such person may be an engineer, architect or any other technical person. In the absence of such appointment the Employer himself.

1.1.2.5 **"Contractor's Representative"** means the person appointed from time to time by the Contractor and notified to the Engineer, under Sub-Clause 4.3 *(Contractor's Representative)*, who acts on behalf of the Contractor.

1.1.2.6 **"Employer's Personnel"** means staff, labour and other employees of the Employer; and any other personnel notified to the Contractor, by the Employer, as Employer's Personnel.

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

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

1.1.2.9 The "**Adjudicator**" is the person appointed jointly by the Employer and the Contractor or by the Institute for Construction Training and Development (ICTAD) as the case may be, in accordance with Sub-Clause 19.3 *(Procedure for Adjudication)* or Sub-Clause 19.4 *(Replacement of Adjudicator)* for determination of the disputes in the first instance, as provided for in Clause 19.0 *(Claims, Disputes and Arbitration)* hereunder.

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1.1.3 Dates, Tests, Periods and Completion

1.1.3.1 **"Base Date"** means the date 28 Days prior to the latest date for submission of the Bid.

1.1.3.2 **"Commencement Date"** means the date notified under Sub-Clause 8.1 *(Commencement of Works)*

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

1.1.3.4 **"Tests on Completion"** means the tests which are specified in the Contract or agreed by both Parties or instructed as a variation, and which are carried out under Clause 9.0 *(Tests on Completion)* before the Works or a Section (as the case may be) are taken over by the Employer.

1.1.3.5 **"Taking-Over Certificate"** means a certificate issued under Clause 10.0 *(Employer's Taking Over).*

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

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

1.1.3.8 **"Performance Certificate"** means the certificate issued under Sub-Clause 11.8 *(Performance Certificate)*

1.1.3.9 **"Day"** means a calendar day and "**Year**" means 365 Days.

1.1.4 Money and Payments

1.1.4.1 **"Initial Contract Price"** means the amount stated in the Letter of Acceptance for the execution and completion of the Works and remedying of any defects.

1.1.4.2 **"Contract Price"** means the amount stated in the Letter of Acceptance, subjected to adjustments in accordance with the Contract.

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

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1.1.4.4 **"Final Payment Certificate"** means the payment certificate issued under Sub-Clause 14.12 *(Issue of Final Payment Certificate).*

1.1.4.5 **"Final Statement"** means the statement defined in Sub-Clause 14.10 *(Application for Final Payment Certificate).*

1.1.4.6 **"Interim Payment Certificate"** means a payment certificate issued under Clause 14.0 (Contract Price and Payment) other than the Final Payment Certificate.

1.1.4.7 **"Payment Certificate"** means a payment certificate issued under Clause 14.0 (Contract Price and Payment)

1.1.4.8 **"Provisional Sum"** means a sum (if any), which is specified in the Contract as a provisional sum, for the execution of any part

of the Works or for the supply of Plant, Materials or services under Sub-Clause 13.4 *(Provisional Sums)*

1.1.4.9 **"Retention Money"** means the accumulated retention moneys, which the Employer retains under Sub-Clause 14.3 *(Application for Interim Payment Certificates)* and pays under Sub-Clause 14.8 *(Payment of Retention)*.

1.1.4.10 **"Statement"** means a statement submitted by the Contractor as part of an application, under Clause 14.0 *(Contract Price and Payment)* for a payment certificate.

1.1.5 Works and Goods

1.1.5.1 **"Contractor's Equipment'** means all apparatus, machinery, vehicles and other things required for the execution and completion of the Works and the remedying of any defects.

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

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

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

1.1.5.5 **"Plant"** means the apparatus, machinery and vehicles intended to form or forming part of the Permanent Works.

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

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

1.1.5.8 **"Works"** mean the Permanent Works, Contractor's Documents and the Temporary Works, or either of them as appropriate.

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1.1.6 Other Definitions

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

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

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

1.1.6.4 **'Laws"** means all legislation. statutes, ordinances and other laws, and regulations and by-laws of any legally constituted public authority.

1.1.6.5 **"Performance Security"** means the security (or securities, if any) under Sub-Clause 4.2 *(Performance Security).*

1.1.6.6 **"Variation"** means any change to the Works, which is instructed or approved as a variation under Clause 13.0 *(Variations and Adjustments).*

1.1.6.7 **"Unforeseeable"** means not reasonably foreseen by an experienced Contractor.

1.2 Interpretation

In the Contract, except where the context requires otherwise:

(a) words indicating one gender include all genders;

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

(c) provisions including the word "agree", "agreed" or "agreement" require the agreement to be recorded in writing; and

(d) "written" or "in writing' means hand-written, type-written, printed or electronically made, and resulting in a permanent record.

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

1.3 Communications

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

(a) In writing and delivered by hand, sent by mail or courier (against receipt); and

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

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

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

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

1.4 Law and Language

The Contract shall be governed by the laws of Democratic Socialist Republic of Sri Lanka and the language for all purposes for the Contract shall be English.

1.5 Priority of Documents

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

(a) the Contract Agreement (if any);

(b) the Letter of Acceptance;

(c) Memorandum of Understanding (if any);

(d) the Form of Bid;

(e) the Contract Data;

(f) these Conditions of Contract;

(g) the Specifications;

(h) the Drawings; and

(i) the Bills of Quantities, and any other schedules or documents forming part of the Contract.

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

1.6 Contract Agreement

The Parties shall enter into a Contract Agreement within 28 Days, unless they otherwise agreed, after the date on which the Contractor receives the Letter of Acceptance. The Contract Agreement shall be prepared and completed by the Employer. The Contractor shall pay the cost of stamp duties and similar charges (if any) imposed by law in connection with the execution of the Contract Agreement.

1.7 Assignment

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

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

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

1.8 Care and Supply of Documents

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

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

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

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

1.9 Delayed Drawings or Instructions

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

If the Contractor suffers delay and/or incurs Cost as a result of a failure of the Engineer to issue the notified drawing or instruction within a time which is reasonable and is specified in the notice with supporting details, the Contractor shall give a further notice to the Engineer and shall be entitled subject to Sub-Clause 19.1 *(Contractor's Claims) to:*

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

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

After receiving this further notice, the Engineer shall proceed in accordance with Sub-Clause 3.4*(Determinations)* to agree or determine these matters.

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

1.10 Employer's use of Contractor's Documents

As between the Parties, the Contractor shall retain the copyright and other intellectual property rights in the Contractor's Documents and other design documents made by (or on behalf of) the Contractor.

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

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

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

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

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

1.11 Contractor's use of Employer's Documents

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

1.12 Confidential Details

The Contractor shall disclose all such confidential and other information as the Engineer may reasonably require in order to verifying the Contractor's compliance with the Contract.

1.13 Compliance with Laws

The Contractor shall in performing the Contract, comply with applicable Laws. The Contractor shall give all notices, pay all taxes, duties and fees, and obtain all permits, licenses and approvals, as required by the Laws in relation to the execution and completion of the Works and the remedying of any defects; and the Contractor shall indemnify and hold the Employer harmless against and from the consequences of any failure to do so.

1.14 Joint and Several Liability

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

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

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

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

2.0 The Employer

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2.1 Right of Access to the Site

The Employer shall give the Contractor right of access to, and possession of, all parts of the Site within 14 Days from Letter of Acceptance unless otherwise specified in Contract Data. The right and possession may not be exclusive to the Contractor. If, under the Contract, the Employer is required to give (to the Contractor) possession of any foundation, structure, plant or means of access, the Employer shall do so in the time and manner stated in the Contract. However, the Employer may withhold any such right or possession until the Performance Security has been received.

If the Contractor suffers delay and/or incurs Cost as a result of a failure by the Employer to give any such right or possession within such time, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 19.1 *(Contractor's Claims)* to:

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

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

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.4 *(Determinations) to* agree or determine these matters.

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

2.2 Permits, Licenses or Approvals

The Employer shall (where he is in a position to do so) provide reasonable assistance to the Contractor at the request of the Contractor, in obtaining permits, licenses and approvals referred to in section 1.13.

2.3 Employer's Personnel

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

(a) co-operate with the Contractor's efforts under Sub-Clause *4.6 (Co-operation);* and

(b) take actions similar to those which the Contractor is required to take under sub-paragraphs (a), (b) and (c) of Sub-Clause 4.8 *(Safety Procedures)*and under Sub-Clause 4.13 *(Protection of the Environment).*

2.4 Employer's Claims

If the Employer considers himself to be entitled to any payment under any Clause of these Conditions or otherwise in connection with the Contract, and/or to any extension of the Defects Notification Period, the Employer or the Engineer shall give notice and particulars to the Contractor.

The notice shall be given as soon as practicable after the Employer became aware of the event or circumstances giving rise to the claim. A notice relating to any extension of the Defects Notification Period shall be given before the expiry of such period.

The particulars shall specify the Clause or other basis of the claim, and shall include substantiation of the amount and/or extension to which the Employer considers him to be entitled in connection with the Contract. The Engineer shall then proceed in accordance with Sub-Clause 3.4 *(Determinations) to* agree or determine (i) the amount (if any) which the Employer is entitled to be paid by the Contractor; and/or (ii) the extension (if any) of the Defects Notification Period in accordance with Sub-Clause 11.3 *(Extension of Defects Notification Period).*

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

3.0 The Engineer

3.1 Engineer's Duties and Authority

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

The Engineer shall have no authority to amend the Contract.

The Engineer may exercise the authority attributable to the Engineer as specified in or necessarily to be implied from the Contract. If the Engineer is required to obtain the approval of the Employer before exercising a specified authority, the requirements shall be as stated in the Contract Data. The Employer undertakes not to impose further constraints on the Engineer's authority, except as agreed with the Contractor.

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

Except as otherwise stated in these Conditions:

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

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

3.2 Delegation by the Engineer

The Engineer may from time to time assign duties and delegate authority to assistants, and may also revoke such assignment or delegation. These assistants may include a resident engineer, and/or independent inspectors appointed to inspect and/or test items of Plant and / or Materials. The assignment, delegation or revocation shall be in writing and shall not take effect until copies have been received by both Parties. However, unless otherwise agreed by both Parties, the Engineer shall not delegate the authority to determine any matter in accordance with Sub-Clause 3.4 *(Determinations)*.

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

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

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

3.3 Instructions of the Engineer

The Engineer may issue to the Contractor (at any time) instructions, which may be necessary for the execution of the Works and the remedying of any defects, all in accordance with the Contract. The Contractor shall only take instructions from the Engineer, or from an assistant to whom the appropriate authority has been delegated under this Clause. If an instruction constitutes a Variation, Clause 13.0 *(Variations and Adjustments)* shall apply.

The Contractor shall comply with the instructions given by the Engineer or delegated assistant, on any matter related to the Contract. These instructions shall be given in writing.

3.4 Determinations

Whenever these Conditions provide that the Engineer shall proceed in accordance with this Sub-Clause 3.4 to agree or determine any matter, the Engineer shall consult with each Party in an endeavor to reach agreement. If agreement is not achieved, the Engineer shall make a fair determination in accordance with the Contract, taking due regard of all relevant circumstances.

The Engineer shall give notice to both Parties of each agreement or determination, with supporting particulars. Each Party shall give effect to each agreement or determination unless and until revised under Clause 19.0 *(Claims, Disputes and Arbitration).*

3.5 Engineer's Impartiality

Wherever, under the Contract, the Engineer is required to exercise his discretion by:

(a) giving his decision, opinion or consent,

(b) expressing his satisfaction or approval,

(c) determining value, or

(d) otherwise taking action which may affect the rights and obligations of the Employer or the Contractor

He shall exercise such discretion impartially within the terms of the Contract and having regard to all the circumstances. Any such decision, opinion, consent, expression of satisfaction, or approval, determination of value or action may be opened up, reviewed or revised as provided in Clause 19.0 *(Claims, Disputes and Arbitration).*

4.0 The Contractor

4.1 Contractor's General Obligations

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

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

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

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

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

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

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

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

(d) prior to the commencement of the Tests on Completion, the Contractor shall submit to the Engineer the "as-built" documents and operation and maintenance manuals in accordance with the Specification and in sufficient detail for the Employer to operate, maintain, dismantle, reassemble, adjust and repair this part of the Works. Such part shall not be considered as completed for the purposes of taking-over under Sub-Clause 10.1 *(Taking Over of the Works and Sections)* until these documents and manuals have been submitted to the Engineer.

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4.2 Performance Security

The Contractor shall obtain (at his cost) a Performance Security for his proper performance of the Contract, in the amount stated in the Contract Data. The Contractor shall deliver the Performance Security to the Employer within 14 Days after the receipt of the Letter of Acceptance. The Performance Security shall be in the form acceptable to the Employer as stipulated in Contract Data.

Without limitation to the provision of the preceding paragraph and subject to Section 13.0 whenever the Engineer determines an addition to the Contract Price as a result of a change in cost and/or Change in Law and/or as a result of a variation amounting to more than 25 (twenty five) percent of the Initial Contract Price, the Contractor, at the Engineer's written request, shall promptly increase the value of the Performance Security by an equal percentage and thereafter in thresholds of fifteen percent of the

Initial Contract Price. The Performance Security of a joint venture shall be in the name of the joint venture.

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

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

4.3 Contractor's Representative

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

Unless the Contractor's Representative is named in the Contract, the Contractor shall, prior to the Commencement Date, submit to the Engineer for consent the name and particulars of the person the Contractor proposes to appoint as Contractor's Representative. If consent is withheld or subsequently revoked, or if the appointed person fails to act as Contractor's Representative, the Contractor shall similarly submit the name and particulars of another suitable person for such appointment.

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

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

4.4 Subcontractors

The Contractor shall not subcontract the whole of the Works.

The Contractor shall be responsible for the acts or defaults of any Subcontractor, his agents or employees, as if they were the acts or defaults of the Contractor.

Unless otherwise stated in the Contract Data:

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

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

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

4.5 Assignment of Benefit of Subcontract

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

4.6 Co-operation

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

(a) the Employer's Personnel;

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

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

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

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

The Contractor shall be responsible for his construction activities on the Site, and shall co-ordinate his own activities with those of other contractors to the extent (if any) specified in the Contract.

4.7 Setting Out

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

The Employer shall be responsible for any errors in these specified or notified items of reference, but the Contractor shall use reasonable efforts to verify their accuracy before they are used.

If the Contractor suffers delay and/or incurs Cost from executing work which was necessitated by an error in these items of reference, and an experienced Contractor could not reasonably have discovered such error and avoided this delay and/or Cost, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub Clause 19.1 *(Contractor's Claims)* to:

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

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

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.4 *(Determinations)* to agree or determine: (i) whether and (if so) to what extent the error could not reasonably have been discovered; and (ii) the matters described in sub-paragraphs (a) and (b) above related to this extent.

4.8 Safety Procedures

The Contractor shall:

(a) comply with all applicable safety regulations;

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

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

(d) provide fencing, lighting, guarding and watching of the Works until completion and taking over under Clause 10.0 (Employer's Taking Over); and

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

4.9 Site data

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

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

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

(b) the hydrological and climatic conditions;

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

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

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

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4.10 Sufficiency of the Initial Contract Price

The Contractor shall be deemed to:

(a) have satisfied himself as to the correctness and sufficiency of the bid price; and

(b) have based the bid price on the data, interpretations necessary Information, inspections, examinations and satisfaction as to all relevant matters referred to in Sub-Clause 4.9 *(Site Data).*

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

4.11 Unforeseeable Physical Conditions

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

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

This notice shall describe the physical conditions, so that they can be inspected by the Engineer, and shall set out the reasons why the Contractor considers them to be Unforeseeable. The Contractor shall continue executing the Works, using such proper and reasonable measures as are appropriate for the physical conditions, and shall comply with any instructions, which the Engineer may give, if an instruction constitutes a Variation, Clause 13.0 (Variations and Adjustments) shall apply.

If and to the extent that the Contractor encounters physical conditions, which are Unforeseeable, gives such a notice, and suffers delay and/or incurs Cost due to these conditions, the Contractor shall be entitled subject to Sub-Clause 19.1 *(Contractor's Claims)* to:

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

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

Alter receiving such notice and inspecting and/or investigating these physical conditions, the Engineer shall proceed in accordance with Sub-Clause 3.4 *(Determinations)* to agree or determine (i) whether and (if so) to what extent these conditions were Unforeseeable; and (ii) the matters described in sub-paragraphs (a) and (b) above related to this extent.

However, before additional Cost is finally agreed or determined under sub-paragraph (ii), the Engineer may also review whether other physical conditions in similar parts of the Works (if any) were more favorable than could reasonably have been foreseen when the Contractor submitted the Bid. If and to the extent that these more favorable conditions were encountered, the Engineer may proceed in accordance with Sub-Clause 3.4 *(Determinations)* to agree or determine the reductions in Cost which were due to these conditions, which may be included (as deductions) in the Contract Price and Payment Certificates.

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

4.12 Contractor's Equipment

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

Contractor's Equipment which is owned by the Contractor (either directly or indirectly) shall be deemed to be the property of the Employer with effect from its arrival on the Site. This vesting of property shall not:

(a) affect the responsibility or liability of the Employer;

(b) prejudice the right of the Contractor to the sole use of the vested Contractors Equipment for the purpose of the Works; or

(c) affect the Contractors responsibility to operate and maintain Contractor's Equipment.

The property in each item shall be deemed to revest in the Contractor when he is entitled either to remove it from the Site or to receive the Taking-Over Certificate for the Works, whichever occurs first.

4.13 Protection of the Environment

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

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

4.14 Progress Reports

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

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

Each report shall include:

(a) charts and detailed descriptions of progress, including each stage of design (if any), Contractor's Documents, procurement, manufacture, delivery to Site, construction, erection and testing; and including these stages for work by each nominated Subcontractor (as defined in Clause 5.0 *(Nominated Subcontractors))*;

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

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

(i) commencement of manufacture;

(ii) Contractor's inspections;

(iii) tests; and

(iv) shipment and arrival at the Site:

(d) the details described in Sub-Clause 6.9 *(Records of Contractor's Personnel and Equipment);*

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

(f) list of notices given under Sub-Clause 2.4*(Employer's Claims)* and notices given under Sub-Clause 19.1 *(Contractor's Claims);*

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

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

4.15 Contractor's Operations on Site

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

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

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

4.16 Fossils

All fossils, coins, articles of value or antiquity, and structures and other remains or items of geological or archaeological interest found on the Site shall be placed under the care and authority of the Employer. The Contractor shall take reasonable precautions to prevent Contractor's Personnel or other persons from removing or damaging any of these findings.

The Contractor shall, upon discovery of any such finding, promptly give notice to the Engineer, who shall issue instructions for dealing with it. If the Contractor suffers delay and/or incurs Cost from complying with the instructions, the Contractor shall give a further notice to the Engineer and shall be entitled subject to Sub-Clause 19.1 *(Contractor's Claims)* to:

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

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

After receiving this further notice, the Engineer shall proceed in accordance with Sub Clause 3.4*(Determinations)* to agree or determine these matters.

4.17 Quality Assurance

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

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

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

4.18 Rights of Way and Facilities

The Contractor shall bear all costs and charges for special and/or temporary rights of-way which he may require, including those for access to the Site. The Contractor shall also obtain, at his risk and cost, any additional facilities outside the Site which he may require for the purposes of the Works.

4.19 Avoidance of Interference

The Contractor shall not interfere unnecessarily or improperly with:

(a) the convenience of the public, or

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

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

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4.20 Access Route

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

Except as otherwise stated in these Conditions:

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

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

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

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

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

4.21 Transport of Goods

(a) the Contractor shall give the Engineer not less than 7 Days notice of the date on which any Plant or a major item of other Goods will be delivered to the Site;

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

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

4.22 Security of the Site

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

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

5.0 Nominated Subcontractors

5.1 Definition of "nominated Subcontractor"

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

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

(b) whom the Engineer, under Clause 13.0 *(Variations and Adjustments)*, instructs the Contractor to employ as a Subcontractor.

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5.2 Objection to Nomination

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

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

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

(c) the subcontract does not specify that, for the subcontracted work (including design, if any), the nominated Subcontractor shall:

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

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

5.3 Payments to nominated Subcontractors

The Contractor shall pay to the nominated Subcontractor the amounts, which the Engineer certifies to be due in accordance with the subcontract. These amounts plus other charges shall be included in the Contract Price in accordance with subparagraph (b) of Sub-Clause 13.4 *(Provisional Sums)*, except as stated in Sub-Clause 5.4 *(Evidence of Payments)*.

5.4 Evidence of Payments

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

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

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

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

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

6.0 Staff and Labour

6.1 Rates of Wages and Conditions of Labour

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

6.2 Persons in the Service of Employer

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

6.3 Labour Laws

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

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

6.4 Working Hours

No work shall be carried out on the Site on locally recognized Days of rest, or outside the normal working hours, unless:

(a) otherwise stated in the Contract;

(b) the Engineer gives consent; or

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

6.5 Facilities for Staff and Labour

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

6.6 Health and Safety

The Contractor shall at all times take all reasonable precautions to maintain the health and safety of the Contractor's Personnel. In collaboration with local health authorities, the Contractor shall ensure that first aid facilities are available at all times at the Site and at any accommodation for Contractor's and Employer's Personnel, and that suitable arrangements are made for all necessary welfare and hygiene requirements and for the prevention of epidemics.

The Contractor shall designate a separate person to deal with safety and protection against accidents. The Contractor shall send, to the Engineer, details of any accident as soon as practicable after its occurrence. The Contractor shall maintain records and make reports concerning health, safety and welfare of persons, and damage to property, as the Engineer may reasonably require.

6.7 Contractor's Superintendence

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

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

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6.8 Contractor's Personnel

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

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

(b) carries out duties incompetently or negligently;

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

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

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

6.9 Records of Contractor's Personnel and Equipment

The Contractor shall submit, to the Engineer, details showing the number of each class of Contractor's Personnel and of each type of Contractor's Equipment on the Site.

Details shall be submitted each calendar month in a form approved by the Engineer, until the Contractor has completed all work which is known to be outstanding at the completion date stated in the Taking-Over Certificate for the Works.

6.10 Disorderly Conduct

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

7.0 Plant, Materials and Workmanship

7.1 Samples

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

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

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

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

7.2 Inspection

The Employer's Personnel shall at all reasonable times:

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

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

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

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

7.3 Testing

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

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

The Engineer may, under Clause 13.0*(Variations and Adjustments)* vary the location or details of specified tests, or instruct the Contractor to carry out additional tests. If these varied or additional tests show that the tested Plant, Materials or workmanship is not in accordance with the Contract, the cost of carrying out this Variation shall be borne by the Contractor, notwithstanding other provisions of the Contract.

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

If the Contractor suffers delay and or incurs Cost from complying with these instructions or as a result of a delay for which the Employer is responsible, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 19.1 *(Contractor's Claims)*

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

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

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.4 *(Determinations)* to agree or determine these matters.

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

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7.4 Rejection

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

If the Engineer requires this Plant, Materials or workmanship to be retested, the tests shall be repeated under the same terms and conditions. If the rejection and retesting cause the Employer to incur additional costs, the Contractor shall subject to Sub-Clause 2.4 *(Employer's Claims)* pay these costs to the Employer.

7.5 Remedial Work

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

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

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

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

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

If the Contractor fails to comply with the instruction, the Employer shall be entitled to employ and pay other persons to carry out the work. Except to the extent that the Contractor would have been entitled to payment for the work, the Contractor shall subject to Sub-Clause 2.4 *(Employer's Claims)* pay to the Employer all costs arising from this failure.

7.6 Ownership of Plant and Materials

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

(a) when it is delivered to the Site;

(b) when the Contractor is entitled to payment of the value of the Plant and Materials under Sub-Clause 8.10 *(Payment for Plant and Materials in Event of Suspension).*

7.7 Royalties

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

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

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

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8.0 Commencement, Delays and Suspension

8.1 Commencement of Works

The Engineer shall give the Contractor not less than 7 Days' notice of the Commencement Date. Unless otherwise stated in the Contract Data, the Commencement Date shall be within 14 Days after the Contractor receives the Letter of Acceptance.

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

8.2 Time for Completion

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

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

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

8.3 Programme

The Contractor shall submit a detailed time programme to the Engineer within 14 Days after receiving the notice under Sub-Clause 8.1 *(Commencement of Works)*. The Contractor shall also submit a revised programme whenever the previous programme is inconsistent with actual progress or with the Contractor's obligations. Each programme shall include:

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

(b) each of these stages for work by each nominated Subcontractor as defined in Clause 5.0 *(Nominated Subcontractors);*

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

(d) a supporting report which includes:

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

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

Unless the Engineer, within 14 Days after receiving a programme, gives notice to the Contractor stating the extent to which it does not comply with the Contract, the Contractor shall proceed in accordance with the programme, subject to his other obligations under the Contract. The Employer's Personnel shall be entitled to rely upon the programme when planning their activities.

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

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

8.4 Extension of Time for Completion

The Contractor shall be entitled subject to Sub-Clause 19.1 *(Contractor's Claims)* to an extension of the Time for Completion if and to the extent that completion for the purposes of Sub-Clause 10.1 *(Taking Over of the Works and Sections)* is or will be delayed by any of the following causes:

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

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

(c) exceptionally adverse climatic conditions;

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

(e) any delay, impediment or prevention caused by or attributable to the Employer, the Employer's Personnel, or the Employer's other contractors on the Site.

If the Contractor considers himself to be entitled to an extension of the Time for Completion, the Contractor shall give notice to the Engineer in accordance with Sub Clause 19.1 *(Contractor's Claims)* When determining each extension of time under Sub-Clause 19.1, the Engineer shall review previous determinations and may increase, but shall not decrease, the total extension of time.

8.5 Delays Caused by Authorities

If the following conditions apply, namely:

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

(b) these authorities delay or disrupt the Contractors work; and

(c) the delay or disruption was Unforeseeable.

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

8.6 Rate of Progress

If at any time:

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

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

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

Unless the Engineer notifies otherwise, the Contractor shall adopt these revised methods, which may require increases in the working hours and/or

in the numbers of Contractor's Personnel and/or Goods, at the risk and cost of the Contractor. If these revised methods cause the Employer to incur additional costs, the Contractor shall subject to Sub-Clause 2.4 *(Employer's Claims)* pay these costs to the Employer, in addition to liquidated damages (if any) under Sub-Clause 8.7 below.

8.7 Liquidated Damages

If the Contractor fails to comply with Sub-Clause *8.2 (Time for Completion) the* Contractor shall subject to Sub-Clause *2.4 (Employer's Claims)* pay liquidated damages to the Employer for this default. These liquidated damages shall be the sum stated in the Contract Data, which shall be paid for every day, which shall elapse between the relevant Time for Completion and the date stated in the Taking-Over Certificate. However, the total amount due under this Sub-Clause shall not exceed the maximum amount of liquidated damages (if any) stated in the Contract Data.

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

8.8 Suspension of Work

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

The Engineer may also notify the cause for the suspension. If and to the extent that the cause is notified and is the responsibility of the Contractor, the following Sub-Clauses 8.9, 8.10 and 8.11 shall not apply.

8.9 Consequences of Suspension

If the Contractor suffers delay and/or incurs Cost from complying with the Engineers instructions under Sub-Clause 8.8 *(Suspension of Work)* and/or from resuming the Suspension work, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 19.1 *(Contractor's Claims)* to:

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

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

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.4 (*Determinations*) to agree or determine these matters.

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

8.10 Payment for Plant and Materials in Event of Suspension

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

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

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

8.11 Prolonged Suspension

If the suspension under Sub-Clause 8.8 *(Suspension of Work)* has continued for more than 84 Days, the Contractor may request the Engineer's permission to proceed. If the Engineer does not give permission within 28 Days after being requested to do so, the Contractor may, by giving notice to the Engineer, treat the suspension as an omission under Clause 13.0 (*Variations and Adjustments*) of the affected part of the Works. If the suspension affects the whole of the Works, the Contractor may give notice of termination under Sub-Clause 16.2 (*Termination by Contractor*).

8.12 Resumption of Work

After the permission or instruction to proceed is given, the Contractor and the Engineer shall jointly examine the Works and the Plant and Materials affected by the suspension. The Contractor shall make good any deterioration or defect in or loss of the Works or Plant or Materials, which has occurred during the suspension.

8.13 Management Meetings

The Engineer or the Contractor's Representative may require the other to attend a management meeting in order to review the arrangements for future work. The Engineer shall record the business of such meetings and supply copies of the record to those attending the meeting and to the Employer.

9.0 Tests on Completion

9.1 Contractor's Obligations

The Contractor shall carry out the Tests on Completion in accordance with this Clause and Sub-Clause 7.3 (*Testing*), after providing the documents in accordance with sub-paragraph (d) of Sub-Clause 4.1 (*Contractor's General Obligations*).

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

In considering the results of the Tests on Completion, the Engineer shall make allowances for the effect of any use of the Works by the Employer on the performance or other characteristics of the Works.

As soon as the Works, or a Section, have passed any Tests on Completion, the Contractor shall submit a certified report of the results of these Tests to the Engineer.

9.2 Delayed Tests

If the Tests on Completion are being unduly delayed by the Employer, Sub- Clause 7.3 *(Testing) (fifth paragraph)* and/or Sub-Clause 10.3 *(Interference with Tests on Completion)*, shall be applicable.

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

If the Contractor fails to carry out the Tests on Completion within the period of 21 Days, the Employer's Personnel may proceed with the Tests at the risk and cost of the Contractor. The Tests on Completion shall then be deemed to have been carried out in the presence of the Contractor and the results of the Tests shall be accepted as accurate.

9.3 Retesting

If the Works, or a Section. fail to pass the Tests on Completion, Sub-Clause 7.4 *(Rejection)* shall apply, and the Engineer or the Contractor may require the failed Tests, and Tests on Completion on any related work, to be repeated under the same terms and conditions.

9.4 Failure to Pass Tests on Completion

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

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

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

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

In the event of sub-paragraph (c), the Contractor shall proceed in accordance with all other obligations under the Contract, and the Contract Price shall be reduced by such amount as shall be appropriate to cover the reduced value to the Employer as a result of this failure. Unless the relevant reduction for this failure is stated (or its method of calculation is defined) in the Contract, the Employer may require the reduction to be (i) agreed by both Parties (in full satisfaction of this failure only) and paid before this Taking-Over Certificate is issued, or (ii) determined and paid under Sub-Clause 2.4 *(Employer's Claims)* and Sub-Clause 3.4 *(Determinations)*

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10.0 Employer's Taking Over

10.1 Taking Over of the Works and Sections

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

The Contractor may apply by notice to the Engineer for a Taking-Over Certificate not earlier than 14 Days before the Works will, in the Contractor's opinion, be complete and ready for taking over. If the Works

are divided into Sections, the Contractor may similarly apply for a Taking-Over Certificate for each Section.

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

(a) issue the Taking-Over Certificate to the Contractor, stating the date on which the Works or Section were completed in accordance with the Contract, except for any minor outstanding work and defects which will not substantially affect the use of the Works or Section for their intended purpose (either until or whilst this work is completed and these defects are remedied); or

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

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

10.2 Taking Over of Parts of the Works

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

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

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

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

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

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

If the Contractor incurs Cost as a result of the Employer taking over and/or using a part of the Works, other than such use as is specified in the Contract or agreed by the Contractor, the Contractor shall (i) give notice to the Engineer and (ii) be entitled subject to Sub-Clause 19.1 *(Contractor's Claims) to* payment of any such Cost plus reasonable profit, which shall be included in the Contract Price. After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.4 *(Determinations)* to agree or determine this Cost and profit.

If a Taking-Over Certificate has been issued for a part of the Works (other than a Section), the liquidated damages thereafter for completion of the remainder of the Works shall be reduced. Similarly, the liquidated damages for the remainder of the Section (if any) in which this part is included shall also be reduced. For any period of delay after the date stated in this Taking-Over Certificate, the proportional reduction in these liquidated damages shall be calculated as the proportion which the value of the part so certified bears to the value of the Works or Section (as the case may be) as a whole. The Engineer shall proceed in accordance with Sub-Clause 3.4 *(Determinations)* to agree or determine these proportions. The provisions of this paragraph shall only apply to the daily rate of liquidated damages under Sub-Clause 8.7 *(Liquidated Damages.)* and shall not affect the maximum amount of these damages.

10.3 Interference with Tests on Completion

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

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

If the Contractor suffers delay and/or incurs Cost as a result of this delay in carrying out the Tests on Completion, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 19 *(Contractor's Claims)* to:

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

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

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.4 *(Determinations)* to agree or determine these matters.

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11.0 Defects Liability

11.1 Completion of Outstanding Work and Remedying Defects

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

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

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

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

11.2 Cost of Remedying Defects

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

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

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

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

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

11.3 Extension of Defects Notification Period

The Employer shall be entitled subject to Sub-Clause 2.4 *(Employer's Claims)* to an extension of the Defects Notification Period for the Works or a Section if and to the extent that the Works, Section or a major item of Plant (as the case may be, and after taking over) cannot be used for the purposes for which they are intended by reason of a defect or damage. However, a Defects Notification Period shall not be extended by more than one year.

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

11.4 Failure to Remedy Defects

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

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

(a) carry out the work himself or by others, in a reasonable manner and at the Contractor's cost, but the Contractor shall have no responsibility for this work; and the Contractor shall subject to Sub-Clause 2.4 *(Employer's Claims)* pay to the Employer the costs reasonably incurred by the Employer in remedying the defect or damage;

(b) require the Engineer to agree or determine a reasonable reduction in the Contract Price in accordance with Sub-Clause 3.4 *(Determinations)*; or

(c) if the defect or damage deprives the Employer of substantially the whole benefit of the Works or any major part of the Works,

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

11.5 Removal of Defective Works

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

11.6 Further Tests

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

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

11.7 Contractor to Search

The Contractor shall, if required by the Engineer search for the cause of any defect, under the direction of the Engineer. Unless the defect is to be remedied at the cost of the Contractor under Sub-Clause 11.2 *(Cost of Remedying Defects)* the Cost of the search plus reasonable profit shall be agreed or determined by the Engineer in accordance with Sub-Clause 3.4 *(Determinations)* and shall be included in the Contract Price.

11.8 Performance Certificate

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

The Engineer shall issue the Performance Certificate within 28 Days after the latest of the expiry dates of the Defects Notification Periods, or as soon thereafter as the Contractor has supplied all the Contractor's Documents and completed and tested all the Works, including remedying any defects. A copy of the Performance Certificate shall be issued to the Employer.

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

11.9 Unfulfilled Obligations

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

11.10 Clearance of Site

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

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

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

12.0 Measurement and Evaluation

12.1 Works to be Measured

The Works shall be measured, and valued for payment in accordance with this Clause Whenever the Engineer requires any part of the Works to be measured, reasonable notice shall be given to the Contractor's Representative who shall:

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

(b) supply any particulars requested by the Engineer.

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

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

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

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12.2 Method of Measurement

Except as otherwise stated in the Contract:

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

(b) the method of measurement shall be the Standard Method of Measurement stated in the Contract Data according to which the Bills of Quantities and other applicable schedules have been prepared.

12.3 Evaluation

Except as otherwise stated in the Contract, the Engineer shall proceed in accordance with Sub-Clause 3.4 *(Determinations)* to agree or determine the Contract Price by evaluating each item of work, applying the measurement agreed or determined in accordance with the above Sub-Clauses 12.1 and 12.2 and the appropriate rate or price for the item.

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

such item, the rate or price specified for similar work. However, a new rate or price shall be appropriate for an item of work if:

(a) (i) the measured quantity of the item is changed by more than 25% from the quantity of this item in the Bills of Quantities or other Schedule; and

(ii) this change in quantity multiplied by such specified rate for this item exceeds 1 % of the Initial Contract Price; or

(b) (i) the work is instructed under Clause 13.0 (Variations and Adjustments);

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

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

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

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

12.4 Omissions

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

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

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

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

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then the Contractor shall give notice to the Engineer accordingly, with supporting particulars. Upon receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.4 *(Determinations)* to agree or determine this cost, which shall be included in the Contract Price.

13.0 Variations and Adjustments

13.1 Right to Vary

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

The Contractor shall execute and be bound by each Variation, unless the Contractor promptly gives notice to the Engineer stating (with supporting particulars) that the Contractor cannot readily obtain the Goods required

for the Variation. Upon receiving this notice, the Engineer shall cancel, confirm or vary the instruction.

Each Variation may include:

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

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

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

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

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

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

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

13.2 Value Engineering

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

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

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

(a) the Contractor shall design this part;

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

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(c) if this change results in a reduction in the contract value of this part, the Engineer shall proceed in accordance with Sub-Clause 3.4 *(Determinations)* to agree or determine a fee, which shall be included in the Contract Price. This fee shall be half (50%) of the difference between the following amounts:

(i) such reduction in contract value, resulting from the change, excluding adjustments under Sub-Clause 13.6 *(Adjustments for Changes in Legislation)* and Sub-Clause 13.7 *(Adjustments for Changes in Cost)*; and

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

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

13.3 Variation Procedure

If the Engineer requests a proposal, prior to instructing a Variation, the Contractor shall respond in writing as soon as practicable, either by giving reasons why he cannot comply (if this is the case) or by submitting:

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

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

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

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

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

Each Variation shall be evaluated in accordance with Clause 12.0 (Measurement and Evaluation), unless the Engineer instructs or approves otherwise in accordance with this Clause.

13.4 Provisional Sums

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

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

(b) Plant, Materials or services to be purchased by the Contractor, from a nominated Subcontractor {as defined in Clause 5.0 (Nominated Subcontractors)} or otherwise; and for which there shall be included in the Contract Price:

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

(ii) a sum for overhead charges and profit, calculated as a percentage of these actual amounts by applying the relevant percentage rate (if any) stated in the appropriate Schedule. If there is no such rate, the percentage rate stated in the Contract Data shall be applied.

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

13.5 Dayworks

For work of a minor or incidental nature, the Engineer may instruct that a Variation shall be executed on a Dayworks Schedule included in the Contract, and the following procedure shall apply. If a Dayworks Schedule

is not included in the Contract, this Sub-Clause shall not apply. Before ordering Goods for the work, the Contractor shall submit quotations to the Engineer. When applying for payment, the Contractor shall submit invoices, vouchers and accounts or receipts for any Goods.

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

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

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

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

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

13.6 Adjustments for Changes in Legislation

The Contract Price shall be adjusted taking into account any increase or decrease in Cost resulting from Change in Law in Sri Lanka, during the period commencing 28 Days prior to the closing date of Bids and ending on the date of issuance of the Certification of Completion or termination pursuant to clause 15 and 16 and which affect the Contractor's performance of contractual obligations.

For purposes of this sub clause, Change in Law means the enactment of any new Law or a change to existing legislation and the repeal of , or modification of existing laws of the country, including any regulations made, and/or directives issued thereunder, or a change in the judicial interpretation and the application of any Law by a competent Court as compared to such interpretation or application by a Court prior to the date of this Agreement, and which relates to taxation or imposes rationing proscribing any activity or relates to duties and other import/export levies which in each case is beyond the control of the Contractor and materially affects the performance of the Contractor's responsibilities under the Contract.

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If the Contractor suffers delay and or incurs additional cost attributable to a Change in Law during the period commencing 28 Days prior to the Closing date of Bids and ending on the date of issuance of the Certificate of Completion or termination pursuant to Section 15 and 16, the Contractor shall give notice to the Engineer and shall be entitled subject to sub clause 19.1: (Contractor's Claims:) to;

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

(b) Payment of any such Cost, which shall be included in The Contract Price. Notwithstanding the foregoing, such additional or reduced cost shall not be separately paid or credited if the same shall already have been taken into account in the indexing of any inputs to the Price Adjustment Formula in accordance with the provisions of Clause 13.7.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.4 *(Determinations)* to agree or determine these matters.

13.7 Adjustments for changes in Cost

The amounts computed from the formula given under this sub-clause in respect of the rise or fall in the cost of labour, Materials, Plant and other inputs to the Works, shall be added to or deducted from the payment to the Contractor if the Contract Price is subjected to adjustments due to fluctuation of prices and stated in Contract Data.

(a) The adjustment to the Contract Price in respect of Changes in Cost and Legislation shall be determined from following formula :

$$F = \frac{0.966\,(V - V_{na})}{100} \sum_{\text{All inputs}} P_x \frac{(I_{xc} - I_{xb})}{I_{xb}}$$

Where:

F = Price adjustment for the period concerned
V = Current valuation of work done for the period.
V_{na} = Value of non adjustable element. or value of work not considered for price variation.
P_x = Input percentage of input named X.
I_{xc} = Current indices of input X.
I_{xb} = Base indices of input X.

No other adjustment of the Contract Price on account of fluctuations of inputs shall be made, notwithstanding the fact that the Contractor has to pay additional amount under special circumstances.

(b) The "Input Percentage" means the percentage proportionate contribution of any input in terms of cost of the construction based on the prices prevailing for the Month, one Month prior to the Month on which the last date for submission of the Bids falls and listed under Clause numbered 13.7 in Contract Data.

(c) The "Non adjustable elements" means,

(i) The work done under the BOQ items that shall not be considered for valuation of price adjustment which are listed under Clause 13.7 in Contract Data

(ii) Variations carried out by the Contractor on instructions of the Engineer under Clause 13.3 and are valued under Clause 12, based on new rates.

(iii) Works done under Daywork rates and Provisional Sum items

(d) The "current valuation" means the certified gross value of work executed during the current valuation period and will include the 80% of the invoiced value of materials the contractor has delivered to site but were not consumed for the physical work done;

(e) The "Indices" means the monthly indices published by Institute for Construction Training and Development for different Inputs;

(f) For the purpose of determining the applicable indices the Month is defined as the time period between the first and the last day of any month in the Gregorian calendar inclusive of the first and the last day.

(g) "Base Indices" means the indices for the inputs, prevailing for the Month, one Month prior to the Month on which the last date for submission of Bids falls.

(h) In the case of first monthly statement the current indices shall be taken as the indices prevailing on the Month where the Commencement Date falls. For any other monthly statement or for the statement at completion the current indices shall be taken as the indices prevailing for the Month where the first date of the current valuation period falls

(i) If the Contractor fails to complete the Works within the time for completion prescribed under Clause 17 or 28 the price adjustment for the work performed after the due date of completion as described above shall be made using the current indices prevailed at the due date for completion.

(j) The weightings for each of the Inputs of cost given in this Clause shall be adjusted if, in the opinion of the Engineer, they have been rendered unreasonable, unbalanced or inapplicable as a result of varied or additional work already executed or instructed under Clause 39 or for any other reason.

14.0 Contract Price and Payment

14.1 The Contract Price

Unless otherwise stated in the Contract Data:

(a) the Contract Price shall be agreed or determined under Sub-Clause 12.3 *(Evaluation)* and be subject to adjustments in accordance with the Contract;

(b) the Contractor shall pay all taxes, duties and fees required to be paid by him under the Contract, and the Contract Price shall not be adjusted for any of these costs except as stated in Sub-Clause 13.6 *(Adjustments for Changes in Legislation);*

(c) any quantities which may be set out in the Bills of Quantities or other Schedule are estimated quantities and are not to be taken as the actual and correct quantities:

(i) of the Works which the Contractor is required to execute; or

(ii) for the purposes of Clause 12.0 *(Measurement and Evaluation);* and

(a) the Contractor shall submit to the Engineer, within 28 Days after the Commencement Date, a proposed breakdown of each lump sum price in the Schedules. The Engineer may take account of the breakdown when preparing Payment Certificates, but shall not be bound by it.

14.2 Advance Payment

The Employer shall make an advance payment excluding provisional sums and contingencies, as an interest-free loan for mobilization, when the Contractor submits a guarantee in accordance with this Sub-Clause. The total advance payment and the number and timing of installments (if more than one), shall be as stated in the Contract Data.

The Engineer shall issue an Interim Payment Certificate for the first installment after receiving a Statement {under Sub-Clause 14.3 *(Application for Interim Payment Certificates)*} and after the Employer

receives (i) the Performance Security in accordance with Sub-Clause 4.2 *(Performance Security);* and (ii) a guarantee in amounts equal to the advance payment. This guarantee shall be issued by an entity approved by the Employer.

The Contractor shall ensure that the guarantee is valid and enforceable until the advance payment has been repaid, but its amount may be progressively reduced by the amount repaid by the Contractor as indicated in the Payment Certificates. If the terms of the guarantee specify its expiry date, and the advance payment has not been repaid by the date 28 Days prior to the expiry date, the Contractor shall extend the validity of the guarantee until the advance payment has been repaid.

The advance payment shall be repaid through percentage deductions in Payment Certificates as follows:

(a) deductions shall commence from the Interim Payment Certificate issued after the payment of the advance payment;

(b) advance payment shall be repaid by deducting proportionate amounts from the Interim Certificates. Advance payment shall be repaid in full when the total certified value of Works reaches 90% of the Initial Contract Price less provisional sums.

If the advance payment has not been repaid prior to the issue of the Taking-Over Certificate for the Works or prior to termination under Clause 15.0 (*Termination by Employer),* Clause 16.0 *(Suspension and Termination by Contractor)* or Clause 20.0 (Force *Majeure)* (as the case may be), the whole of the balance then outstanding shall immediately become due and payable by the Contractor to the Employer.

14.3 Application for Interim Payment Certificates

The Contractor shall submit a Statement in three copies to the Engineer after the end of each month, in a form approved by the Engineer, showing in detail the amounts to which the Contractor considers himself to be entitled, together with supporting documents which shall include the report on the progress during this month in accordance with Sub-Clause 4.14 *(Progress Reports).*

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The Statement shall include the following items, as applicable, which shall be expressed in the various currencies in which the Contract Price is payable, in the sequence listed:

(a) the estimated contract value of the Works executed and the Contractor's Documents produced up to the end of the month [including Variations but excluding items described in sub-paragraphs (b) to (g) below];

(b) any amounts to be added and deducted for changes in legislation and changes in cost, in accordance with Sub-Clause 13.6 *(Adjustments for Changes in Legislation)* and Sub-Clause 13.7 *(Adjustments for Changes in Cost);*

(c) any amount to be deducted for retention, calculated by applying the percentage of retention stated in the Contract data to the total of the above amounts, until the amount so retained by the Employer reaches the limit of Retention Money (if any) stated in the Contract data;

(d) any amounts to be added and deducted for the advance payment and repayments in accordance with Sub-Clause 14.2 *(Advance Payment);*

(e) any amounts to be added and deducted for Plant and Materials in accordance with Sub-Clause 14.4 *(Plant and Materials intended for the Works);*

(f) any other additions or deductions which may have become due under the Contract or otherwise, including those under Clause 19.0 *(Claims, Disputes and Arbitration);* and

(g) the deduction of amounts certified in all previous Payment Certificates.

14.4 Plant and Materials intended for the Works

Interim Payment Certificates shall include, under sub-paragraph (e) of Sub-Clause 14.3 (*Application for Interim Payment Certificate*), an amount equivalent to 80% of the invoiced value of Plant and Materials which have been delivered to the Site for incorporation in the Permanent Works.

14.5 Issue of Interim Payment Certificates

No amount will be certified or paid until the Employer has received and approved the Performance Security. Thereafter, the Engineer shall, within 21 Days after receiving a Statement and supporting documents, issue to the Employer an Interim Payment Certificate, which shall state the amount which the Engineer fairly determines to be due, with supporting particulars.

However, prior to issuing the Taking-Over Certificate for the Works, the Engineer shall not be bound to issue an Interim Payment Certificate in an amount which would (after retention and other deductions) be less than the minimum amount of Interim Payment Certificates (if any) stated in the Contract Data. In this event, the Engineer shall give notice to the Contractor accordingly.

An Interim Payment Certificate shall not be withheld for any other reason, although:

(a) if any thing supplied or work done by the Contractor is not in accordance with the Contract, the cost of rectification or replacement may be withheld until rectification or replacement has been completed; and/or

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(b) if the Contractor was or is failing to perform any work or obligation in accordance with the Contract, and had been so notified by the Engineer, the value of this work or obligation may be withheld until the work or obligation has been performed.

The Engineer may in any Payment Certificate make any correction or modification that should properly be made to any previous Payment Certificate.

A Payment Certificate shall not be deemed to indicate the Engineer's acceptance, approval, consent or satisfaction.

14.6 Payment

The Employer shall pay to the Contractor:

(a) the first installment of the advance payment within 14 Days after issuing the Letter of Acceptance and after receiving the documents

in accordance with Sub-Clause 4.2 *(Performance* Security) and Sub-Clause 14.2 *(Advance Payment).*

(b) the amount certified in each Interim Payment Certificate within 14 Days after the Employer receives the Interim Certificate from the Engineer: and

(c) the amount certified in the Final Payment Certificate within 56 Days after the Employer receives this Payment Certificate.

14.7 Delayed Payment

If the Contractor does not receive payment in accordance with Sub-Clause 14.6 *(Payment)* the Contractor shall be entitled to receive financing charges compounded monthly on the amount unpaid during the period of delay. This period shall be deemed to commence on the date for payment specified in Sub-Clause 14.6 *(Payment)* irrespective (in the case of its sub-paragraph (b)) of the date on which any Interim Payment Certificate is issued.

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 of 1% over the lending rate of the Central Bank to Commercial Banks.

14.8 Payment of Retention

When the Taking-Over Certificate has been issued for the Works, one half of the total amount retained shall be repaid to the Contractor and the second half when the Defects Notification Period has passed and the Engineer has certified that all Defects notified by the Engineer to the Contractor before the end of this period have been corrected.

However, if any work remains to be executed under Clause 11.0 *(Defects Liability)* the Engineer shall be entitled to withhold certificate of the estimated cost of this work until it has been executed.

When calculating these proportions, no account shall be taken of any adjustments under Sub-Clause 13.6 *(Adjustments for Changes in Legislation)* and Sub-Clause 13.7 *(Adjustments for Changes in Cost).*

14.9 Statement at Completion

Within 84 Days after receiving the Taking-Over Certificate for the Works, the Contractor shall submit to the Engineer three copies of a Statement at completion with supporting documents, in accordance with Sub-Clause 14.3 *(Application for Interim Payment Certificates)* showing:

(a) the value of all work done in accordance with the Contract up to date stated in the Taking Over Certificate for the Works;

(b) any further sums which the Contractor considers to be due; and

(c) any estimate of any other amounts which the Contractor considers will become due to him under the Contract Estimated amounts shall be shown separately in this Statement at completion.

The Engineer shall then certify in accordance with Sub-Clause 14.5 *(Issue of Interim Payment Certificates).*

14.10 Application for Final Payment Certificate

Within 56 Days after receiving the Performance Certificate, the Contractor shall submit, to the Engineer, six copies of a draft final statement with supporting documents showing in detail in a form approved by the Engineer:

(a) the value of all work done in accordance with the Contract; and

(b) any further sums which the Contractor considers to be due to him under the Contract or otherwise.

If the Engineer disagrees with or cannot verify any part of the draft final statement, the Contractor shall submit such further information as the Engineer may reasonably require and shall make such changes in the draft as may be agreed between them. The Contractor shall then prepare and submit to the Engineer the final statement as agreed. This agreed statement is referred to in these Conditions as the "Final Statement".

However if, following discussions between the Engineer and the Contractor and any changes to the draft final statement which are agreed, it becomes evident that a dispute exists, the Engineer shall deliver to the Employer (with a copy to the Contractor) an Interim Payment Certificate or the agreed parts of the draft final statement. Thereafter, if the dispute is finally resolved under Sub-Clause 19.3 *(Procedure for Adjudication)* , or Sub-Clause 19.5 (*Arbitration)* the Contractor shall then prepare and submit to the Employer (with a copy to the Engineer) a Final Statement.

14.11 Discharge

When submitting the Final Statement, the Contractor shall submit a written discharge, which confirms that the total of the Final Statement represents full and final settlement of all moneys due to the Contractor under or in connection with the Contract. This discharge may state that it becomes effective when the Contractor has received the Performance Security and the outstanding balance of this total, in which event the discharge shall be effective on such date.

14.12 Issue of Final Payment Certificate

Within 28 Days after receiving the Final Statement and written discharge in accordance with Sub-Clause 14.10 *(Application for Final Payment Certificate)* and Sub-Clause 14.11 *(Discharge)* the Engineer shall issue, to the Employer, the Final Payment Certificate, which shall state:

(a) the amount which is finally due; and

(b) after giving credit to the Employer to all amounts previously paid by the Employer and for all sums to which the Employer is entitled, the balance (if any) due from the Employer to the Contractor or from the Contractor to the Employer, as the case may be.

If the Contractor has not applied for a Final Payment Certificate in accordance with Sub-Clause 14.10 *(Application for Final Payment Certificate)* and Sub-Clause 14.11 *(Discharge)* the Engineer shall request the Contractor to do so. If the Contractor fails to submit an application within a period of 28 Days the Engineer shall issue the Final Payment Certificate for such amount as he determines to be due.

14.13 Cessation of Employer's Liability

The Employer shall not be liable to the Contractor for any matter or thing under or in connection with the Contract or execution of the Works, except to the extent that the Contractor shall have included an amount expressly for it:

(a) in the Final Statement and also;

(b) (except for matters or things arising after the issue of the Taking-Over Certificate for the Works) in the Statement at completion described in Sub-Clause 14.9 *(Statement at Completion)*

However, this Sub-Clause shall not limit the Employer's liability under his indemnification obligations, or the Employer's liability in any case of fraud, deliberate default or reckless misconduct by the Employer.

15.0 Termination by Employer

15.1 Notice to Correct

If the Contractor fails to carry out any obligation under the Contract, the Engineer may by notice require the Contractor to make good the failure and to remedy it within a specified reasonable time.

15.2 Termination by Employer

The Employer shall he entitled to terminate the Contract if the Contractor:

(a) fails to comply with Sub-Clause 4.2 (*Performance Security*) or with a notice under Sub-Clause 15.1 (*Notice to Correct*);

(b) abandons the Works or otherwise plainly demonstrates the intention not to continue performance of his obligations under the Contract;

(c) without reasonable excuse fails:

(i) to proceed with the Works in accordance with Clause 8.0 (*Commencement, Delays and Suspension*); or

(ii) to comply with a notice issued under Sub-Clause 7.4 (*Rejection*) or Sub-Clause 7.5 (*Remedial Work*), within 28 Days after receiving it;

(d) subcontracts the whole of the Works or part of the works without prior consent of the Engineer or assigns the Contract without the required agreement;

(e) becomes bankrupt or insolvent, goes into liquidation, has a receiving or administration order made against him, compounds with his creditors, or carries on business under a receiver, trustee or manager for the benefit of his creditors, or if any act is done or event occurs which (under applicable Laws) has a similar effect to any of these acts or events; or

(f) gives or offers to give (directly or indirectly) to any person any bribe, gift, gratuity, commission or other thing of value, as an inducement or reward:

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(i) for doing or forbearing to do any action in relation to the Contract; or

(ii) for showing or forbearing to show favour or disfavour to any person in relation to the Contract,

or if any of the Contractor's Personnel, agents or Subcontractors gives or offers to give (directly or indirectly) to any person any such inducement or reward as is described in this sub-paragraph. However, lawful inducements and rewards to Contractor's Personnel shall not entitle termination.

(g) The Contractor has engaged in corrupt or fraudulent practices, in competing for or in executing the Contract.

For the purpose of this Sub-Clause:

"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.

In any of these events or circumstances, the Employer may, upon giving 14 Days' notice to the Contractor, terminate the Contract and expel the Contractor from the Site. However, in the case of sub-paragraph (e) or (f), the Employer may by notice terminate the Contract immediately.

The Employer's election to terminate the Contract shall not prejudice any other rights of the Employer, under the Contract or otherwise.

The Contractor shall then leave the Site and deliver any required Goods, all Contractor's Documents, and other design documents made by or for him, to the Engineer. However, the Contractor shall use his best efforts to comply immediately with any reasonable instructions included in the notice (i) for the assignment of any subcontract; and (ii) for the protection of life or property or for the safety of the Works.

After termination, the Employer may complete the Works and/or arrange for any other entities to do so. The Employer and these entities may then use any Goods, Contractor's Documents and other design documents made by or on behalf of the Contractor.

The Employer shall then give notice that the Contractor's Equipment and Temporary Works will be released to the Contractor at or near the Site. The Contractor shall promptly arrange their removal, at the risk and cost of the Contractor. However, if by this time the Contractor has failed to make a payment due to the Employer, these items may be sold by the Employer in order to recover this payment. Any balance of the proceeds shall then be paid to the Contractor.

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15.3 Valuation at Date of Termination

As soon as practicable after a notice of termination under Sub-Clause of Termination by Employer has taken effect the Engineer shall proceed in accordance with Sub-Clause 3.4 *(Determinations)* to agree or determine the value of the Works, Goods and Contractor's Documents, and any other sums due to the Contractor for work executed in accordance with the Contract.

15.4 Payment after Termination

After a notice of termination under Sub-Clause 15.2 (*Termination by Employer)* has taken effect, the Employer may:

(a) proceed in accordance with Sub-Cause 2.4 *(Employer's Claims);*

(b) withhold further payments to the Contractor until the costs of execution, completion and remedying of any defects, damages for delay in completion (if any), and all other costs incurred by the Employer, have been established; and/or

(c) recover from the Contractor any losses and damages incurred by the Employer and any extra costs of completing the Works, as determined by the Engineer after allowing for any sum due to the Contractor under Sub-Clause 15.3 *(Valuation at Date of Termination)* After recovering any such losses, damages and extra costs, the Employer shall pay, any balance to the Contractor.

15.5 Employer's Entitlement to Termination

The Employer shall be entitled to terminate the Contract, at any time for the Employer's convenience, by giving notice of such termination to the Contractor. The termination shall take effect 28 Days after the later of the dates on which the Contractor receives this notice or the Employer returns the Performance Security. The Employer shall not terminate the Contract under this Sub-Clause in order to execute the Works himself or to arrange for the Works to be executed by another contractor.

After this termination, the Contractor shall proceed in accordance with Sub-Clause 16.3 *(Cessation of Work and Removal of Contractor's Equipment)* and shall be paid in accordance with Sub-Clause 20.6 *(Optional Termination, Payment and Release).*

Provided however, the Employer shall not be precluded from executing the Contract himself or by another Contactor, after a period of one year has lapsed from the date on which the termination has taken effect pursuant to this Section and subject to the satisfaction of the Employer's payment obligations to the Contractor under the Contract.

16.0 Suspension and Termination by Contractor

16.1 Contractor's Entitlement to Suspend Work

If the Engineer fails to certify in accordance with Sub-Clause 14.5 *(Issue of Interim Payment Certificates)* or the Employer fails to comply with Sub-Clause 14.6 *(Payment)* the Contractor may, after giving not less than 56 Days' notice to the Employer, suspend work (or reduce the rate of work) unless and until the Contractor has received the Payment Certificate, reasonable evidence or payment. as the case may be and as described in the notice.

The Contractor's action shall not prejudice his entitlements to financing charges under Sub-Clause 14.7 (Delayed *Payment)* and to termination under Sub-Clause 16.2 *(Termination by Contractor).*

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If the Contractor subsequently receives such Payment Certificate, evidence or payment (as described in the relevant Sub-Clause and in the above notice) before giving a notice of termination, the Contractor shall resume normal working as soon as is reasonably practicable.

If the Contractor suffers delay and or incurs Cost as a result of suspending work (or reducing the rate of work) in accordance with this Sub-Clause, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 19.1 (*Contractor's Claims)* to:

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

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

After receiving this notice, the Engineer shall proceed in accordance with Sub Clause 3.4 *(Determinations)* to agree or determine these matters.

16.2 Termination by Contractor

The Contractor shall be entitled to terminate the Contract if:

(a) the Engineer fails. within 56 Days after receiving a Statement and supporting documents, to issue the relevant Payment Certificate;

(b) the Contractor does not receive the amount due under an Interim Payment Certificate within 56 Days after the expiry of the time stated in Sub-Clause 14.6*(Payment)* within which payment is to be made (except for deductions in accordance with Sub-Clause 2.4 *(Employer's Claims)*;

(c) the Employer substantially fails to perform his obligations under the Contract;

(d) the Employer fails to comply with Sub-Clause 1.6 *(Contract Agreement) or* Sub-Clause 1.7 *(Assignment);*

(e) a prolonged suspension affects the whole of the Works as described in Sub-Clause 8.11 *(Prolonged Suspension);* or

(f) the Employer becomes bankrupt or insolvent, goes into liquidation, has a receiving or administration order made against him, compounds with his creditors, or carries on business under a receiver, trustee or manager for the benefit of his creditors, or if any act is done or event occurs which (under applicable Laws) has a similar effect to any of these acts or events.

In any of these events or circumstances, the Contractor may, upon giving 14 Days notice to the Employer, terminate the Contact. However, in the case of subparagraph (e) or (f), the Contractor may by notice terminate the Contract immediately.

The Contractor's election to terminate the Contract shall not prejudice any other rights of the Contractor, under the Contract or otherwise.

16.3 Cessation of Work and Removal of Contractor's Equipment

After a notice of termination under Sub-Clause 15.5 *(Employer's Entitlement to Termination)* Sub-Clause 16.2 *(Termination by Contractor)* or Sub-Clause 20.6 *(Optional Termination, Payment and Release)* has taken effect, the Contractor shall promptly:

(a) cease all further work, except for such work as may have been instructed by the Engineer for the protection of life or property or for the safety of the Works;

(b) hand over Contractor's Documents, Plant, Materials and other work, for which the Contractor has received payment; and

(c) remove all other Goods from the Site, except as necessary for safety, and leave the Site.

16.4 Payment on Termination

After a notice of termination under Sub-Clause 16.2 *(Termination by Contractor)* has taken effect, the Employer shall promptly:

(a) return the Performance Security to the Contractor;

(b) pay the Contractor in accordance with Sub-Clause 20.6 (Optional *Termination, Payment and Release);* and

(c) pay to the Contractor the amount of any, loss of profit or other loss or damage sustained by the Contractor as a result of this termination.

17.0 Risk and Responsibility

17.1 Indemnities

The Contractor shall indemnify and hold harmless the Employer, the Employer's Personnel, and their respective agents, against and from all claims, damages, losses and expenses (including legal fees and expenses) in respect of:

(a) bodily injury, sickness, disease or death, of any person whatsoever arising out of or in the course of or by reason the Contractor's design (if any), the execution and completion of the Works and the remedying of any defects, unless attributable to any negligence, willful act or breach of the Contract by the Employer, the Employer's Personnel, or any of their respective agents; and

(b) damage to or loss of any property, real or personal (other than the Works), to the extent that such damage or loss:

(i) arises out of or in the course of or by reason of the Contractor's design (if any), the execution and completion of the Works and the remedying of any defects; and

(ii) is attributable to any negligence, willful act or breach of the Contract by the Contractor, the Contractor's Personnel, their respective agents, or anyone directly or indirectly employed by any of them.

17.2 Contractor's Care of the Works

The Contractor shall take full responsibility for the care of the Works and Goods from the Commencement Date until the Taking-Over Certificate is issued {or is deemed to be issued under Sub-Clause 10.1 (*Taking Over of the Works and Sections)*} for the Works, when responsibility for the care of the Works shall pass to the Employer. If a Taking-Over Certificate is issued (or is so deemed to be issued) for any Section or part of the Works, responsibility for the care of the Section or part shall then pass to the Employer.

After responsibility has accordingly passed to the Employer, the Contractor shall take responsibility for the care of any work, which is outstanding on the date stated in a Taking-Over Certificate, until this outstanding work has been completed.

If any loss or damage happens to the Works, Goods or Contractor's Documents during the period when the Contractor is responsible for their care, from any cause not listed in Sub-Clause 17.3 *(Employer's Risks)* the Contractor shall rectify the loss or damage at the Contractor's risk and cost, so that the Works, Goods and Contractor's Documents conform with the Contract.

The Contractor shall be liable for any loss or damage caused by any actions performed by the Contractor after a Taking-Over Certificate has been issued. The Contractor shall also be liable for any loss or damage which occurs after a Taking-Over Certificate has been issued and which arose from a previous event for which the Contractor was liable.

17.3 Employer's Risks

The risks referred to in Sub-Clause 17.4 below are:

(a) war, hostilities (whether war be declared or not), invasion, act of foreign enemies;

(b) rebellion, terrorism, revolution, insurrection, military or usurped power or civil war, within the Country;

(c) riot, commotion or disorder within the Country by persons other than the Contractor's Personnel and other employees of the Contractor and Subcontractors;

(d) munitions of war, explosive materials, ionizing, radiation or contamination by radio-activity, within the Country, except as may be attributable to the Contractor's use of such munitions, explosives, radiation or radio-activity;

(e) pressure waves caused by aircraft or other aerial devices travelling at sonic or supersonic speeds;

(f) use or occupation by the Employer of any part of the Permanent Works, except as may be specified in the Contract;

(g) design of any part of the Works by the Employer's Personnel or by others for whom the Employer is responsible; and

(h) any operation of the forces of nature which is Unforeseeable or against which an experienced Contractor could not reasonably have been expected to have taken adequate preventative precautions.

17.4 Consequences of Employer's Risks

If and to the extent that any of the risks listed in Sub-Clause 17.3 above results in loss or damage to the Works, Goods or Contractor's Documents, the Contractor shall promptly give notice to the Engineer and shall rectify this loss or damage to the extent required by the Engineer.

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If the Contractor suffers delay and/or incurs Cost from rectifying this loss or damage, the Contractor shall give a further notice to the Engineer and shall be entitled subject to Sub-Clause 19.1 (*Contractor's Claims*) to:

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

(b) payment of any such Cost, which shall be included in the Contract Price in the case of sub-paragraphs (f) and (g) of Sub-Clause 17.3 (*Employer's Risks*) reasonable profit on the Cost shall also be included.

After receiving this further notice, the Engineer shall proceed in accordance with Sub Clause 3.4 (*Determinations*) agree or determine these matters.

18.0 Insurance

18.1 Insurance for Works and Contractor's Equipment

Without limiting his obligations and responsibilities under the Contract, the Contractor within 14 Days from the Letter of Acceptance, shall insure up to the amounts given below, in the joint names of the Employer and the Contractor against all loss or damage from whatever cause arising, other than employer's risks, for which he is responsible under the terms of the Contract and in such manner that the Employer and Contractor are covered for the period stipulated in Sub-Clause 17.2 and are also covered during the period of Defects Notification for loss or damage arising from a cause, occurring prior to the commencement of the Defects Notification Period, and for any loss or damage occasioned by the Contractor in the course of any operations carried out by him for the purpose of complying with his obligations under Clause 11.0:

(a) Works for an amount not less than 115% of Initial Contract Price; and

(b) The Contractor's Equipment for the replacement value.

18.2 Third Party Insurance (including Employer's Property)

The Contractor within 14 Days from the Letter of Acceptance, shall insure against each Party's liability for any loss, damage, death or bodily injury which may occur to any physical property {except things insured under Sub-Clause 18.1 *(Insurance for Works and Contractor's Equipment)}* or to any person, which may arise out of the Contractor's performance of the Contract and occurring before the issue of the Performance Certificate.

This insurance shall be for a limit per occurrence of not less than the amount stated in Contract Data, with no limit on the number of occurrences.

The insurances specified in this Sub-Clause:

(a) shall be in the joint names of the Parties; and

(b) shall be extended to cover liability for all loss and damage to the Employer's property (except things insured under Sub-Clause 18.1 arising out of the Contractor's performance of the Contract);

18.3 Insurance for Contractor's Personnel

The Contractor within 14 Days from the Letter of Acceptance, shall effect and maintain insurance against liability for claims, damages, losses and expenses (including legal fees and expenses) arising from injury, sickness, disease or death of any person employed by the Contractor or any other of the Contractor's Personnel.

The Employer and the Engineer shall also be indemnified under the policy of insurance, except that this insurance may exclude losses and claims to the extent that they arise from any act or neglect of the Employer or of the Employer's Personnel.

The insurance shall be maintained in full force and effect during the whole time that these personnel are assisting in the execution of the Works. For a Subcontractor's employees, whether the insurance has been effected by the Subcontractor or not, the Contractor shall be responsible for compliance with this Clause.

18.4 Remedy on Contractor's Failure to Insure

If the Contractor shall fail to effect and keep in force the insurances referred to in Clause 18.1, 18.2 and 18.3 hereof, or any other insurance which he may be required to effect under the terms of the Contract, then and in any such case the Employer may effect and keep in force any such insurance and pay such premium or premiums as may be necessary for that purpose and from time to time deduct the amount together with the service charge of 5% of the amount so paid by the Employer as aforesaid from any monies due or which may become due to the Contractor, or recover the same as a debt due from the Contractor.

19.0 Claims, Disputes and Arbitration

19.1 Contractor's Claims

If the Contractor considers himself to be entitled to any extension of the Time for Completion and/or any additional payment, under any Clause of these Conditions or otherwise in connection with the Contract. the Contractor shall give notice to the Engineer, describing the event or circumstance giving rise to the claim. The notice shall be given as soon as practicable, and not later than 28 Days after the Contractor became aware, or should have become aware, of the event or circumstance.

The Contractor shall also submit any other notices which are required by the Contract, and supporting particulars for the claim, all as relevant to such event or circumstance.

The Contractor shall keep such contemporary records as may be necessary to substantiate any claim, either on the Site or at another location acceptable to the Engineer. Without admitting the Employers liability, the Engineer may, after receiving any notice under this Sub-Clause, monitor the record-keeping and/or instruct the Contractor to keep further contemporary records. The Contractor shall permit the Engineer to inspect all these records, and shall (if instructed) submit copies to the Engineer.

Within 84 Days after the Contractor became aware (or should have become aware) of the event or circumstance giving rise to the claim, or within such other period as may be proposed by the Contractor and approved by the Engineer, the Contractor shall send to the Engineer a fully detailed claim which includes full supporting particulars of the basis of the claim and of the extension of time and/or additional payment claimed. If the event or circumstance giving rise to the claim has a continuing effect:

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(a) this fully detailed claim may be considered as interim;

(b) the Contractor may send further interim claims at monthly intervals, giving the accumulated delay and/or amount claimed, and such further particulars as the Engineer may reasonably require; and

(c) the Contractor shall send a final claim within 28 Days after the end of the effects resulting from the event or circumstance, or within such other period as may be proposed by the Contractor and approved by the Engineer.

Within 42 Days after receiving a claim or any further particulars supporting a previous claim, or within such other period as may be proposed by the Engineer and approved by the Contractor, the Engineer shall respond with approval, or with disapproval and detailed comments.

He may also request any necessary further particulars, but shall nevertheless give his response on the principles of the claim within such time.

Each Payment Certificate shall include such amounts for any claim as have been reasonably substantiated as due under the relevant provision of the Contract. Unless and until the particulars supplied are sufficient to substantiate the whole of the claim, the Contractor shall only be entitled to payment for such part of the claim as he has been able to substantiate.

The Engineer shall proceed in accordance with Sub-Clause 3.4 *(Determinations)* to agree or determine (i) the extension (if any) of the Time for Completion (before or after its expiry) in accordance with Sub-Clause 8.4 *(Extension of Time for Completion)* and/or (ii) the additional payment (if any) to which the Contractor is entitled under the Contract.

The requirements of this Sub-Clause are in addition to those of any other Sub-Clause which may apply to a claim, If the Contractor fails to comply with this or another Sub-Clause in relation to any claim, any extension of time and/or additional payment shall take account of the extent (if any) to which the failure has prevented or prejudiced proper investigation of the claim, unless the claim is excluded under the second paragraph of this Sub-Clause.

19.2 Dispute Resolution

Any dispute of whatever nature arising out of or in relation to this agreement shall in the first instance be attempted to be resolved by way of adjudication in accordance with the adjudication procedure set forth in Clause 19.3.

19.3 Procedure for Adjudication

Either Party may initiate the reference of a dispute to the Adjudicator by giving 07 Days notice to the other Party.

The Adjudicator shall be appointed by agreement between the Parties. In the event the Parties are unable to reach agreement on the appointment of the Adjudicator within fourteen (14) Days from the date of such request, either Party may make an application to the Institute for Construction Training and Development (ICTAD) to appoint an Adjudicator.

The Adjudicator shall be a professional with experience relevant to the Works and in the interpretation of contractual documents. Such Adjudicator shall have no interest financial or otherwise in the Employer, the Contractor or the Engineer nor any financial interest in the Contract, except in respect of his professional fees.

The Adjudicator's fee shall be agreed by both Parties and shall be borne by both Parties in equal amounts.

The Adjudicator shall give the determination in writing within 28 Days or such other period of receipt of a notification of a dispute. The Adjudicator shall determine procedures as he sees fit ensuring that each Party is given a reasonable opportunity to make representations including written submissions and/or hearing of witnesses in person.

With the prior concurrence of both Parties the Adjudicator may take advice and assistance from independent professional advisor/s or other person/s to enable him to reach a determination on the dispute. Such costs shall be borne by both Parties in equal amounts.

Each of the Parties shall upon and in accordance with a request by the Adjudicator supply him free of charge such information and documents as he shall require for the purposes of the reference to him. That information and those documents shall be kept confidential by him and by the Parties.

The Adjudicator shall not act as an Arbitrator. The decision of the Adjudicator shall be deemed final and binding on the Parties if neither Party refers the dispute to arbitration in accordance with Sub-Clause 19.5 within twenty eight (28) Days of the Adjudicator's determination.

19.4 Replacement of Adjudicator

Should the Adjudicator resign or die or is removed by agreement of the Parties on the basis of his unsatisfactory performance, the Parties may jointly appoint another Adjudicator and such an appointment shall be made within fourteen (14) Days after the resignation or death or removal of the Adjudicator. If the Parties are unable to reach agreement on the appointment of a new Adjudicator then the Adjudicator shall be appointed by the Institute for Construction Training and Development (ICTAD) at the request of either Party within fourteen (14) Days of receipt of such request.

19.5 Arbitration

(a) Any dispute of whatever nature arising from, out of or in connection with this agreement, on the interpretation thereof, or the rights, duties, obligations or liabilities of any Party, or the operation, breach, termination, abandonment, foreclosure or invalidity thereof, shall be referred to by either Party to arbitration for final settlement, in accordance with the Arbitration Act No. 11 of 1995, or any amendment thereof,

(b) Pending the award in any arbitration proceedings hereunder,

(i) this Contract and the rights and obligations of the Parties shall remain in full force and effect and

(ii) each of the Parties shall continue to perform their respective obligations under this Contract. The termination of this Contract shall not result in the termination of any arbitration proceedings pending at the time of such termination nor otherwise affect the rights and obligations of the Parties under or with respect to such pending arbitration.

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(c) Any award rendered by the arbitral tribunal shall determine the extent to which the cost of arbitration is to be borne by each Party. The arbitration centre charges (if any) and the compensation to the arbitrator shall be equally shared by the Parties initially.

Composition of the Arbitral Tribunal :

The arbitral tribunal shall consist of a sole arbitrator who shall be appointed in the manner provided in the Selection Procedure as given below.

Selection Procedure :

The Party desiring arbitration shall nominate three arbitrators out of which one to be selected by the other Party within 21 Days of the receipt of such nomination. If the other Party does not select one to serve as Arbitrator

within the stipulated period then the Arbitrator shall be appointed in accordance with the Arbitration Act No. 11 of 1995, or any amendments thereof.

Venue & Language :

The venue of arbitration shall be in Sri Lanka.

Unless otherwise agreed to by the Parties the proceedings shall be conducted and the award shall be rendered in the English language.

20.0 Force Majeure

20.1 Definition of Force Majeure

In this Clause, "Force Majeure means an exceptional event or circumstance

(a) which is beyond a Party's control;

(b) which such Party could not reasonably have provided against before entering into the Contract;

(c) which, having arisen, such Party could not reasonably have avoided or overcome, and

(d) which is not substantially attributable to the other Party.

Force Majeure may include, but is not limited to exceptional events or circumstances of the kind listed below, so long as conditions (a) to (d) above are satisfied:

(i) war, hostilities (whether war be declared or not), invasion, act of foreign enemies.

(ii) rebellion, terrorism, revolution, insurrection, military or usurped power, or civil war;

(iii) riot, commotion, disorder, strike or lockout by persons other than the Contractor's Personnel and other employees of the Contractor and Sub-contractors,

(iv) munitions of war, explosive materials, ionising radiation or contamination by radio-activity, except as may be attributable to the Contractor's use of such munitions, explosives, radiation or radio-activity, and

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(v) natural catastrophes such as earthquake hurricane, typhoon or volcanic activity.

20.2 Notice of Force Majeure

If a Party is or will be prevented from performing any of its obligations under the Contract by Force Majeure. then it shall give notice to the other Party of the event or circumstances constituting the Force Majeure and shall specify the obligations, the performance of which is or will be prevented. The notice shall be given within 14 Days after the Party became aware, or should have become aware, of the relevant event or circumstance constituting Force Majeure.

The Party shall, having given notice, be excused performance of such obligations for so long as such Force Majeure prevents it from performing them.

Notwithstanding any other provision of this Clause, Force Majeure shall not apply to obligations of either Party to make payments to the other Party under the Contract.

20.3 Duty to Minimise Delay

Each Party shall at all times use all reasonable endeavours to minimise any delay in the performance of the Contract as a result of Force Majeure.

A Party shall give notice to the other Party when it ceases to be affected by the Force Majeure.

20.4 Consequence of Force Majeure

If the Contractor is prevented from performing any of his obligations under the Contract by Force Majeure of which notice has been given under Sub-Clause 20.2 *(Notice of Force Majeure)* and suffers delay and/or incurs Cost by reason of such Force Majeure, the Contractor shall be entitled to such Costs subject to Sub-Clause 19.1 *(Contractor's Claims)* to:

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

(b) if the event or circumstance is of the kind described in sub-paragraphs (i) to (iv) of Sub-Clause 20.1 *(Definition of Force Majeure)* and, in the case of sub-paragraphs (ii) to (iv), occurs in the Country, payment of any such Cost.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.4 *(Determinations)* to agree or determine these matters.

20.5 Force Majeure Affecting Sub-Contractor

If any Subcontractor is entitled under any contract or agreement relating to the Works to relief from force majeure on terms additional to or broader than those specified in this Clause, such additional or broader force majeure events or circumstances shall not excuse the Contractor's non-performance or entitle him to relief under this Clause.

20.6 Optional Termination, Payment and Release

If the execution of substantially all the Works in progress is prevented for a continuous period of 84 Days by reason of Force Majeure of which notice has been given under Sub-Clause 20.2 *(Notice of Force Majeure)* or for multiple periods which total more than 140 Days due to the same notified Force Majeure, then either Party may give to the other Party a notice of termination of the Contract. In this event, the termination shall take effect 7 Days after the notice is given, and the Contractor shall proceed in accordance with Sub-Clause 16.3 *(Cessation of Work and Removal of Contractor's Equipment)*.

Upon such termination, the Engineer shall determine the value of the work done and issue a Payment Certificate which shall include:

(a) the amounts payable for any work carried out for which a price is stated in the Contract;

(b) the Cost of Plant and Materials ordered for the Works which have been delivered to the Contractor, or of which the Contractor is liable to accept delivery: this Plant and Materials shall become the property of (and be at the risk of) the Employer when paid for by the Employer, and the Contractor shall place the same at the Employer's disposal;

(c) any other Cost or liability which in the circumstances was reasonably incurred by the Contractor in the expectation of completing the Works;

(d) the Cost of removal of Temporary Works and Contractor's Equipment from the Site and the return of these items to the Contractor's works in his country (or to any other destination at no greater cost); and

(e) the Cost of repatriation of the Contractor's staff and labour employed wholly in connection with the Works at the date of termination.

20.7 Release from Performance under the Law

Notwithstanding any other provision of this Clause, if any event or circumstance outside the control of the Parties (including, but not limited to, Force Majeure) arises which makes it impossible or unlawful for either or both Parties to fulfill its or their contractual obligations or which, under the law governing the Contract, entitles the Parties to be released from further performance of the Contract, then upon notice by either Party to the other Party of such event or circumstance:

(a) the Parties shall be discharged from further performance, without prejudice to the rights of either Party in respect of any previous breach of the Contract; and

(b) the sum payable by the Employer to the Contractor shall be the same as would have been payable under Sub-Clause 20.6 *(Optional Termination. Payment and Release)* if the Contract had been terminated under Sub-Clause 20.6.

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SECTION 5

STANDARD FORMS

- Letter of Acceptance
- Agreement (Issued herewith)
- Performance Security (Issued herewith)
- Advance Payment Security (Issued herewith)
- Retention Money Guarantee (Issued herewith)

Notes on Standard Forms:

Bidders shall submit the completed Form of Bid Security in compliance with the requirements of the bidding documents.

Bidders should not complete the Form of Agreement at the time of preparation of bids. The successful Bidder will be required to sign the Form of Agreement, after the award of contract. Any corrections or modifications to the accepted bid resulting from arithmetic corrections, acceptable deviations, or quantity variations in accordance with the requirements of the bidding documents should be incorporated into the Agreement.

The Form of Performance Security, Form of Advance Payment Security and Form of Retention Money Guarantee should not be completed by the bidders at the time of preparation of bids. The successful Bidder will be required to provide these securities in compliance with the requirements herein or as acceptable to the Employer.

Notes on Form of Letter of Acceptance

The Letter of Acceptance will be the basis for formation of the Contract as described in Clause 34 of the Instructions to Bidders. This Form of Letter of Acceptance should be filled in and sent to the successful bidder only after evaluation of Bids and after obtaining approval from the relevant authority.

FORM OF LETTER OF ACCEPTANCE

[letter head paper of the Employer]

..... *[date]*

[LETTER HEADING PAPER OF THE PROCURING ENTITY]

To: ---------- *[name and address of the Contractor]* ---------

This is to notify you that your bid dated ---------- *[insert date]* for the construction and remedying defects of the ---------- *[name of the Contract and identification number]* for the Contract price of ----------*[name of currency*[49]*]*----------*[amount in figures and words]* as corrected in accordance with Instructions to Bidders and/ or modified by a Memorandum of Understanding[50], is hereby accepted.

You are hereby instructed to proceed with the execution of the said Works in accordance with the Contract documents.

The Commencement Date shall be: ..... *(fill the date as per Clause 8.1 of Conditions of Contract).*

The amount of Performance Security is *:* ..... *(fill the amount as per Clause 4.2 of Conditions of Contract).*

The Performance Security shall be submitted on or before ..... *(fill the date as per Clause 4.2 of Conditions of Contract).*

Authorized Signature : .....

Name and title of Signatory : .....

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[49] *If multiple currencies are involved indicate amounts under each currency separated with the word 'and' between them*

[50] *Delete "corrected in accordance with ITB and/or " or "and/or modified by a Memorandum of Understanding", if not applicable*

AGREEMENT

This Agreement made at Katunayake the …… of ……., between **AIRPORT AND AVIATION SERVICES (SRI LANKA) (PRIVATE) LIMITED** a Company duly incorporated under the Companies Act no. 07 of 2007 and having it's registered office at the Bandaranaike International Airport, Katunayake (hereinafter called and referred to as "the Employer"), of the ONE PART, and **……**
……
(name and address of Contractor) (hereinafter called and referred to as "the Contractor"), of the OTHER PART:

Whereas the Employer desires that the Contractor execute the **NAVIGATIONAL SERVICE COMPLEX AT CIAR, RATMALANA - 067/T/2024** (hereinafter called and referred to as "the Works") and the Employer has accepted the Bid by the Contractor for the execution and completion of such Works and remedying of any defects therein.

The Employer and the Contractor agree as follows:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Contract.
2. In consideration of the payments to be made by the Employer to the Contractor as indicated in this Agreement, the Contractor hereby covenants with the Employer to execute 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 remedying any defects therein, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

In Witness whereof the parties hereto have caused this Agreement to be executed the day and year aforementioned in accordance with laws of Sri Lanka.

Authorized signatories of Employer

Name: - ……

Designation: - ……

Signature: - ……

Name: - ……

Designation: - …… COMMON SEAL

Signature: - ……

Authorized signatories of Contractor

Name: - ……

Designation: - ……

Signature: - ……

Name: - ……

Designation: - …… COMMON SEAL

Signature: - ……

In the presence of:

Witnesses:

Name: - ……

NIC No: - ……

Signature: - ……

Address: - ……

Witnesses:

Name: -……

NIC No: - ……

Signature: - ……

Address: - ……

Name: - ……

NIC No: - ……

Signature: - ……

Address: - ……

Name: -……

NIC No: - ……

Signature: - ……

Address: - ……

FORM OF PERFORMANCE GURANTEE
(Unconditional)

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

Beneficiary: ----------
[Name and Address of Employer]

Date:----------

PERFORMANCE GUARANTEE No.:----------

We have been informed that ----------[*name of Contractor*] (hereinafter called "the Contractor") has entered into a Contract dated----------with you, for the ----------[*insert "construction"]* of---------- [*name of Contract and brief description of Works*] (hereinafter called "the Contract").

Furthermore, we understand that, according to the Conditions of the Contract, a Performance Guarantee is required.

At the request of the Contractor, we ----------[*name of Agency]* hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of ----------[*amount in figures]*(----------)*[amount in words],* upon receipt by us of your first demand in writing.

This guarantee shall expire, no later than the ----------day of ---------, 20--------[*insert date, 28 days after the end of the Defects Liability Period]* and any demand for payment under it must be received by us at this office on or before that date.

[signature (s)]

FORM OF ADVANCE PAYMENT GUARANTEE

[*name and address of Agency, and Address of Issuing Branch or Office]*

Beneficiary : ……*[Name and Address of Employer]*

Date : ……

ADVANCE PAYMENT GUARANTEE No.:----------

We have been informed that ----------*[name of Contractor]* (hereinafter called "the Contractor") has entered into a Contract dated---------- ----------with you, for the Construction of---------- ------- *[name of Contract and brief description of works]* (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, an advance payment in the sum----------*[amount in figures]* (----------) [*amount in words]* is to be made against an advance payment guarantee.

At the request of the Contractor, we ----------[*name of issuing Agency]* hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of------- ----------*[amount in figures]*[51] (----------) [*amount in words*] upon receipt by us of yours first demand in writing.

The maximum amount of this guarantee shall be progressively reduced by the amount of the advance payment repaid by the Contractor.

This guarantee shall expire on ----------[*Insert the date, 28 days beyond the Time for Completion]*

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

[signature (s)]

[51] *The Guarantor shall insert an amount representing the amount of the advance payment and denominated either in the currency(ies) of the advance payment as specified in the Contract.*

FORM OF RETENTION MONEY GUARANTEE

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

Beneficiary :----------[*Name and Address of Employer]*

Date:----------

RETENTION MONEY GUARANTEE No.: ----------

We have been informed that ----------[*name of Contractor*] (hereinafter called "the Contractor") has entered into a Contract dated---------- with you, for the execution of ----------[*name of Contract and brief description of Works]* (hereinafter called "the Contract").

Furthermore, we understand that, according to the Conditions of the Contract, when the works have being taken over and the first half of the Retention Money has been certified for payment, payment of the second half of the Retention Money may be made against a Retention Money guarantee.

At the request of the Contractor, we ----------[*name of agency]* hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of----------[*amount in figures]* (----------) [*amount in words*][52] upon receipt by us of your first demand in writing.

This guarantee shall expire, at the latest, ----------[*insert 28 Days after the end of the Defects Liability Period].* Consequently, any demand for payment under this guarantee must be received by us at this office on or before that date.

[signature (s)]

52
The Guarantor shall insert an amount representing the amount of the second half of the Retention Money

VOLUME II

INVITATION FOR BID

Note:-

Bidders are advised to consider the information printed in blue colour in the document as a check list, when preparing their bids. However, it is responsibility of the bidders to comply with all the requirements given in the bidding document.

Invitation for Bids (IFB)

AIRPORT AND AVIATION SERVICES (SRI LANKA) (PRIVATE) LIMITED

NAVIGATIONAL SERVICE COMPLEX AT CIAR, RATMALANA

(BID NO. 067/T/2024)

1. The Chairman, on behalf of the Airport and Aviation Services (Sri Lanka) (Private) Limited (AASL) now invites sealed bids from eligible and qualified bidders for "Navigational Service Complex at CIAR, Ratmalana" as described below and estimated to cost of **Rupees 3979 Million** (Including 10% physical Contingencies, 10% Price Contingencies) excluding VAT.

   The scope of work consists of a construction of six storied building with control tower on top level (total floor area – 5,090.0 sq.m. approximately) including a power house (floor area – 118.0 sq.m. approximately) and other associated works with Mechanical, Electrical and IT related works providing all materials and labour in accordance with the Specifications, Drawings and the Bill of Quantities.

   Project is located at Colombo International Airport, Ratmalana (CIAR).

   The construction period is **540 Days**.

2. Bidding will be conducted through National Competitive Bidding Procedure.

3. To be eligible for contract award, the successful bidder shall not have been blacklisted and shall be registered for **Grade CS2 - (Building Construction)**, with the Construction Industry Development Authority (CIDA) – former ICATD with experience in similar works.

4. Qualification requirements to qualify for contract award include: key technical, financial, legal and other requirements specified in the bidding document.

5. Interested bidders may obtain further information from Head of Civil Engineering (P&D), Civil Engineering (P&D) Division, Airport & Aviation Services (SL) (Pvt) Ltd., Bandaranaike International Airport, Katunayake on Telephone No. 011-2263500/011-2263502, facsimile No. 011-2251356 and e-mail – pd@airport.lk and inspect the bidding documents at Supply Chain

Management Division - Airport & Aviation Services (SL) (Pvt) Ltd., Bandaranaike International Airport, Katunayake, from …… 2024 until …… 2024 from 09.00 hrs to 15.00 hrs.

6. A complete set of Bidding Documents in English language may be purchased by interested bidders on the submission of a written application to the Head of Supply Chain Management, Supply Chain Management Division - Airport & Aviation Services (SL) (Pvt) Ltd., Bandaranaike International Airport, Katunayake, from …… 2024 until …… 2024 from 09.00 hrs to 15.00 hrs. upon payment of a non refundable fee of **Rupees 300,000/=**. The method of payment will be in cash.

7. Bids shall be delivered in duplicate either by registered post or hand delivered addressed below at: Chairman, Standing Cabinet Appointed Procurement Committee (SCAPC), Aviation Procurement Division, Ministry of Transport, Highways, Ports, and Civil Aviation, 30th Floor, West Tower, World Trade Centre, Colombo 01 on or before **14.00hrs. on** …… **2024**. **Late bids will be rejected.** Bids will be opened soon after closing in the presence of the bidders or their authorized representatives.

8. Bids shall remain valid for a period of **190** days from the date of closing of Bids.

9. All bids shall be accompanied by a Bid Security (on demand bid bond) in the amount of **Rupees Sixty Two Million (Rs.62,000,000.00.)** issued by the institutions listed in Section 02 – Bidding Data of this document or in cash. Bid Security shall be valid up to **3rd August 2025**.

10. All bidders or their authorized representatives are invited to attend the Pre - Bid meeting, on …… at 10.00 a.m. at the Conference Room at Admin Building, Airport & Aviation Services (SL) (Pvt) Ltd, Colombo International Airport, Ratmalana.

    The purpose of the meeting is to clarify issues and to answer questions on any matter relating to Contract. Bidders are encouraged to attend the pre-bid meeting and the Bidders are requested, as far as possible, to submit any questions (in writing) to reach AASL (Fax No. 011-2251356, email – pd@airport.lk) not later than one week before the meeting.

SECTION – 2
BIDDING DATA

Note: -

This section shall be read in conjunction with Section I – Instruction to Bidders, and is intended to provide specific information in relation to corresponding clauses in Section I. Whenever there is a discrepancy, the provisions in Section 2 – Bidding Data shall supersede these provided in the Section I - Instruction to Bidders.

Bidding Data

Instructions to Bidders Clause Reference		Entry
1.1	**Employer's Name and Address**	Name : **Chairman, Airport and Aviation Services (Sri Lanka)(Private) Limited.** Address: **Bandaranaike International Airport, Katunayake.**
1.1	Scope of Works: The work consists of a construction of six storied building with control tower on top level (total floor area – 5,090.0 sq.m. approximately) including a power house (floor area – 118.0 sq.m. approximately) and other associated works with Mechanical, Electrical and IT related works providing all materials and labour in accordance with the Specifications, Drawings and the Bill of Quantities. Located at Colombo International Airport, Ratmalana (CIAR)	
1.2	**Time for Completion**	The Time for Completion for the whole of works shall be **540 Days.**
2.1	**Source of funds**	The source of funds is Airport **and Aviation Services (Sri Lanka) (Private) Limited**
4.1	**Qualification Information** **The following information shall be provided in Section 9 - Schedules:** • ICTAD registration; Registration number …….. Grade …….. Speciality …….. Expiry date …….. • BOQ duly completed and signed, completed with detail break down of lump sum items and overheads applicable to BOQ items. • Certificate of Incorporation/Business Registration Certificate, Articles of Association of the Bidder, Form 13 – Change of registered office address (if applicable). • Copies of pages 23, 24, 25, 26, 27 of ICTAD Record Book. • Litigation History of the Company.	

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- Audited financial statements for the last 03 years (2023, 2022, 2021).
- Proposed implementation schedule and Cash Flow statement accordingly.
- Construction Programme.
- Staffing.
- Legal Status (Sole proprietor, Partnership, Company etc.).
- Total Monetary value of construction work performed for each of last eight years.
- Experience in works of a similar nature and size for each of the last ten years.
- Major items of construction equipment proposed to carry out the contract.
- Qualifications and experience of key site management and technical personnel proposed for the Contract.
- Power of attorney.
- VAT Registration Number.

4.2 (a) CIDA – Former ICTAD registration required

Specialty **Building Construction**

Grade **Grade CS2**

4.2 (b) Average annual volume of construction work performed in five years shall be at least: **Rs. 4,000 Million.** calculated as total certified payments received for contracts in progress and /or completed, **in the five (5) years out of last eight (8) years, divided by five (5) years.**

4.2 (d) Essential equipment

Proposals for the timely acquisition (own, lease, hire, etc.) of the following essential equipment shall be;

- Mobile Crane
- Pump car
- Concrete agitator truck
- Concrete vibrates
- Welding machine
- Welding transformer
- Bar bending machine
- Vibrating rammer compactor
- Concrete Breaker
- Concrete cutter
- Excavator
- Backhoe JCB
- Water tank truck
- Dump Trucks
- Generator

4.2 (e) (a) Qualifications and experience of the Contract Manager:

B.Sc. Civil Eng. with Charter and at least 10 years working experience in similar nature

4.2 (f) Liquid assets and/or credit facilities required:

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The minimum amount of liquid assets and/or credit facilities, net of other contractual commitments and exclusive of any advance payments which may be made under the Contract, shall be not less than **Rs. 550 Million.**

10.1 Clarification of Bidding Documents:

Employer's address for clarification of bidding documents is:

Name of Officer : **Head of Civil Engineering (P&D),**

Address: **Civil Engineering (P&D) Division,**
Airport & Aviation Services (SL) (Pvt) Ltd.,
Bandaranaike International Airport,
Katunayake

Phone : **011-2263502/011-2263500,**

Facsimile: **011-2251356**

E-mail : **pd@airport.lk, head.cepd@airport.lk– (e-mailed Questioners highly appreciated.)**

14.4 Adjustments for change in cost:

The Contract is subjected to price adjustment

14.5 If any discount is offered by a Bidder such discount shall be specified in the "Summary Sheet"

16.1 Period of Bid validity :

The Bid shall be valid up to **a period of 190 days from the date of Closing of Bids.**

17.1 Amount of Bid security:

The amount of Bid Security is **Rupees Sixty Two Million (Rs.62,000,000.00.)**

17.2 Validity of Bid Security:

The Bid Security shall be valid up to **3rd August 2025.**

The Bid Security issued by the following institutions is acceptable.

- A Bank operating in Sri Lanka, approved by the Central Bank of Sri Lanka.
- Construction Guarantee Fund.

19.1 Pre-Bid meeting:

Pre-Bid meeting will be held

Venue, time, and date of the pre-bid meeting.

Date: ……..

Time: ……..

AASL

Venue: The Conference Room at Admin Building, Airport & Aviation Services (SL) (Pvt) Ltd, Colombo International Airport, Ratmalana.

21.2 (a) Employer's address for the purpose of bid submission is:

Chairman,
Standing Cabinet Appointed Procurement Committee (SCAPC),
Aviation Procurement Division,
Ministry of Transport, Highways, Ports and Civil Aviation,
30th Floor, West Tower, World Trade Centre,
Colombo 01.

21.2 (b) Identification number of Contract:

Identification Number of the Contract is: **067/T/2024**

22.1 Deadline for submission of Bids:

Deadline for submission of Bids **on or before 14.00hrs. on ……2024.**

25.1 Bid opening:
Venue, time, and date of bid opening

Venue: **Chairman,**
Standing Cabinet Appointed Procurement Committee (SCAPC),
Aviation Procurement Division,
Ministry of Transport, Highways, Ports and Civil Aviation,
30th Floor, West Tower, World Trade Centre,
Colombo 01.

Time: on 14.00hrs.

Date: on …… 2024.

33.2 The procurement entity will not consider the following personnel, firms for the award of the contract

* Who are in the AASL/State Defaulting Contractors' List
* Who had/is having unresolved disputes with the AASL
* Who are in arrears in any payment owing to the AASL
* Who are in breach of any obligation towards the AASL including default as a surety
* Who have failed to perform diligently any previous contract with the AASL

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35.1 Amount of Performance Security:

The Standard Form of Performance Security acceptable to the Employer shall be a Guarantee from an Agency given below.

The amount of Performance Security is **5%** of the Initial Contract Price.

The Performance Security shall be valid and enforceable until **28** days beyond the contractor has executed and completed the works and remedied any defects.

The Performance Security issued by the following institutions is acceptable.

- A Bank operating in Sri Lanka, approved by the Central Bank of Sri Lanka.
- Construction Guarantee Fund

However the Public Finance Circular No. 03/2020(i) dated 11.01.2021 is applicable.

Registration of Tenderer's and Agents

1. No bid, if submitted by an agent, sub-agent, representative or nominee for or on behalf of a Tenderer shall be accepted for the purpose of evaluation unless the said agent, sub-agent, representative or nominee produces at the time of submission of the Bid, a Certificate issued under Section 11(1) of the Public Contracts Act No. 03 of 1987.

2. Every Tenderer who has himself submitted a Bid and who has been shortlisted for consideration of award, shall being so shortlisted produce a Certificate issued under Section 11(1) of the Public Contract Act No. 03 of 1987 prior to award. No Tenderer to whom this Condition applies shall be eligible for award of the Contract unless he has complied with the terms hereof.

3. Regardless of whether the Bid was submitted by the Tenderer himself or by an agent, sub-agent, nominee or representative for or on behalf of a Tenderer, the person that submitted the successful Bid shall register the ensuing Contract with register of Companies.

*(The registration process under the Public Contract Act No. 03 of 1987 has been totally converted in to online system through **web: eroc.drc.gov.lk** with effect from the 15.10.2019)*

Contractor's Employees:

The site is within the restricted area of the Airport and Access Control passes are required to enter the site. Such access control passes will be issued to the Contractor and his employees on submission of the following.

(i) Photograph of employee (ii) National Identity Card

(iii) Police Clearance Report

The contractor will be held responsible for the conduct of his employees. The access of the contractor's employees should be limited to the work site.

SECTION – 4
CONTRACT DATA

Note:-

This section shall be read in conjunction with Section 3 – Conditions of Contract, and is intended to provide specific information in relation to corresponding clauses in Section 3. Whenever there is a discrepancy, the provisions in Section 4 – Contract Data shall supersede these provided in the Section 3 – Conditions of Contract

Contract Data

Conditions of Contract Clause Number/s		
(*) 1.1.2.2 & 1.3	Employer's name and address	Name: **Chairman, Airport and Aviation Services (Sri Lanka) (Private) Limited** Address: **Bandaranaike International Airport, Katunayake.**
1.3	Contractor's name and address	Name: …… Address: ……
(*) 1.1.2.4 & 1.3	Engineer's name and address	Name: **Head of Projects,** Address: **Projects Division,** **Airport & Aviation Services (SL) (Pvt) Ltd.,** **Bandaranaike International Airport,** **Katunayake**
1.1.2.9		Replace existing Clause 1.1.2.9 with following: "Dispute Adjudication Board" (DAB) means three persons appointed under Sub-Clause 19.2 (Appointment of the Dispute Adjudication Board) or Sub-Clause 19.3 (Failure to Agree on the Composition of the Dispute Adjudication Board) of the Conditions of Contract.
(*) 1.1.3.3	Time for Completion of the Works	Time for Completion is **540 Days.**
(*) 1.1.3.7	Defects Notification Period	Defects Notification Period is **365 Days**
(*) 2. 1	Right to access to the Site	**14 Days** after Letter of Acceptance

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(*) 4.2	Amount of Performance Security	**5%** of the Initial Contract Price, in the currencies and proportions in which the Contract Price is payable, valid and enforceable until 28 days beyond the Defect Liability Period. The acceptable form is - **Form of Performance Security (Unconditional)** issued by the institutions acceptable as stated in 35.1 – Bidding Data. However the Public Finance Circular No. 03/2020(i) dated 11.01.2021 is applicable.
6.7 & 6.8	Contractor's Superintendent, Contractor's Personnel	Schedule of Key Personnel: Minimum persons with qualifications and experience defined as follows, ▪ Full time Project Manager with B.Sc. Civil Engineering with Charter & 10 years working experience in similar nature. ▪ Full time Civil Engineer (02nos.) with B.Sc. Civil Engineering with Charter and 6 years working experience in similar nature. ▪ Full time Quantity Surveyor with Charter and 5 years working experience in similar nature. ▪ Part time Electrical Engineer with Charter and 5 years working experience in similar nature. ▪ Full time Mechanical Engineer with Charter and 5 years working experience in Building Engineering Services. ▪ Full time Technical Officer (02 nos.) with Diploma in Civil Engineering (NDT, HNDE or NDES) with 05 years working experience in similar nature. ▪ Full time Quantity Surveyor with Diploma in Quantity Surveying with 05 years working experience in similar nature. ▪ Full time Technical Officer with Diploma in Mechanical Engineering (NDT, HNDE or NDES) with 05 years working experience in similar nature. ▪ Full time Technical Officer with Diploma in Electrical Engineering (NDT, HNDE or NDES) with 05 years working experience in similar nature. The Bidder should indicate the names of such persons he proposes to assign to the project on the relevant page of the bidding document. Above mentioned minimum staff shall be deployed by the main Contractor and Sub Contactor's personnel will not be considered as key personnel.

ASL

(*) 8.7	Liquidated damages for the Works	**Rs. 2,000,000.00 (Rupees Two Million) per Day**
(*) 8.7	Maximum amount of liquidated damages	**15 %** of the Initial Contract Price
12.2 (b)	Method of Measurement	**Measurement shall be made of the net actual quantity of each item of Permanent Works according to Bill of Quantities and other applicable schedules.**
13.4	Provisional Sums	The Following text to be added at the end of Sub-Clause 13.4 "As an exception to the above, the Provisional Sum for the cost of DAB shall be used for payments to the Contractor of the Employer's share (one-half) of the invoices of the DAB for its fees and the expenses, in accordance with GC 19.2. The Contractor shall produce the DAB invoices and satisfactory evidence of having paid 100% of such invoices as part of the substantiation of those Statements submitted under Sub-Clause 14.3, which contain requests for payment under the Provisional Sum towards the cost of DAB. The Engineer's certification of such Statements shall be based upon such invoices and such evidence of payment by the Contractor. Contractor's overhead, profit, etc. shall not be included in the provisional sums for the cost of the DAB."
(*) 13.4(b)	Percentage for adjustment of Provisional Sums	**10 %**
13.7	Weightings of Inputs	

ICTAD Reference for Indices	Input Name	Percentage %
M13	Reinforcement Steel	19.89%
L1	Skilled Labour	18.21%
M26	Electrical Wires	16.51%
L3	Unskilled Labour	11.08%
M36	Aluminum Doors, Windows & Partitions	6.60%
M38	Electrical Fittings	6.60%
M39	Ready Mixed Concrete	5.71%
M24	Glass	3.28%
M21	Formwork Timber	1.51%
M3	Cement – Local (Market Price)	0.61%
	Total	**90%**

Non adjustable element shall be:

BOQ Item Nos. - 1.1, 1.2, 1.3, 1.4, 1.5, 2.10, 3.12.28, 3.12.30, 5.160

(*) 14.2	Total Advance Payment	The Advance payments to be made by the Employer to the Contractor shall be released only through designated Escrow Account. The designated Escrow Account shall be opened by the Contractor in joint name of Contractor and the Employer with Bank after awarding the Contract. Details of Escrow Account shall be submitted by the Contractor to the Employer before submitting the request for Advance payments under the Contract. The designated Escrow Account shall be jointly operated by Contractor and Employer. For this purpose, appropriate authorization for the operation of Bank account will be done Employer and Contractor. 20% of the Initial Contract Price excluding provisional sums and contingencies i). First 10% after signing of the Contract Agreement. ii). Second 10% after achieving of 5% of physical progress.
(*) 14.3(c)	Percentage of retention	**10%**
(*) 14.3(c)	Limit of Retention Money	**5 %** of the Initial Contract Price
(*)14.8	Alternative method for Payment of Retention	On reaching the limit of retention, stated in the Contract Data under Sub-Clause 14.3, the Contractor may substitute full retention money with an unconditional guarantee acceptable to the Employer to a value equal to the full retention money, and valid up to 28 Days beyond the end of Defect Notification Period. On receipt of such guarantee the Employer shall repay the full retention money. The guarantee will be released to the Contractor upon the certification of the Engineer that all Defects notified by the Engineer to the Contractor before the end of this period have been corrected.

ASL

(*) 18.2	Third Party Insurance	The Amount of insurance per occurrence is: Rupees 1,000,000/=
		Delete existing sub-clause 19.2 (Dispute Resolution), Delete existing sub-clause 19.3 (Procedure for Adjudication), Delete existing sub-clause 19.4 (Replacement of Adjudicator), Delete existing sub-clause 19.5 (Arbitration), and insert the following new sub-clauses;
19.2	Appointment of the Dispute Adjudication Board	Any dispute of whatever nature arising out of or in relation to this agreement shall in the first instance be referred to a Dispute Adjudication Board (DAB) for decision in accordance with Sub-Clause 19.4 [Obtaining Dispute Adjudication Board's Decision]. The Parties shall appoint a DAB within 28 Days from the Commencement Date. The DAB shall comprise, three suitably qualified persons ("the members"), who shall be professionals experienced in the type of construction involved in the Works and with the interpretation of contractual documents, one of whom shall serve as chairman. Within 28 Days from the Commencement Date each of the Parties shall appoint one member to serve on the Dispute Adjudication Board (DAB). The Parties shall consult both these members and shall agree upon the third member, who shall be appointed to act as the chairman.

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The agreement between the Parties and each of the three members shall incorporate by reference the General Conditions of Dispute Adjudication Agreement contained in the Appendix to these Contract Data, with such amendments as are agreed between them.

The terms of the remuneration of the three members, including the remuneration of any expert whom the DAB consults, shall be mutually agreed upon by the Parties when agreeing the terms of appointment of the member or such expert (as the case may be). Each Party shall be responsible for paying one-half of this remuneration.

If a member declines to act or is unable to act as a result of death, disability, resignation or termination of appointment, a replacement shall be appointed in the same manner as the replaced person was required to have been nominated or agreed upon, as described in this Sub-Clause.

The appointment of any member may be terminated by mutual agreement of both Parties, but not by the Employer or the Contractor acting alone. Unless otherwise agreed by both Parties, the appointment of the DAB (including each member) shall expire when the discharge referred to in Sub-Clause 14.11 [Discharge] shall have become effective.

19.3 Failure to Agree on the Composition of the Dispute Adjudication Board

If any of the following conditions apply, namely:

(a) either Party fails to nominate a member of a DAB by such date,

(b) the Parties fail to agree upon the appointment of the third member (to act as chairman) of the DAB by such date, or

(c) the Parties fail to agree upon the appointment of a replacement person within 42 Days after the date on which the one of the three members declines to act or is unable to act as a result of death, disability, resignation or termination of appointment,

Then Institute for Construction Training and Development (ICTAD) shall, upon the request of either or both of the Parties and after due consultation with both Parties, appoint this member of the DAB. This appointment shall be final and conclusive. Each Party shall be responsible for paying one-half of the expenses / disbursements incurred by ICTAD.

ASL

19.4	Obtaining Dispute Adjudication Board's Decision	If a dispute (of any kind whatsoever) arises between the Parties in connection with, or arising out of, the Contract or the execution of the Works, including any dispute as to any certificate, determination, instruction, opinion or valuation of the Engineer, either Party may refer the dispute in writing to the DAB for its decision, with copies to the other Party and the Engineer. Such reference shall state that it is given under this Sub-Clause. The DAB shall be deemed to have received such reference on the date when it is received by the chairman of the DAB. Both Parties shall promptly make available to the DAB all such additional information, further access to the Site, and appropriate facilities, as the DAB may require for the purposes of making a decision on such dispute. The DAB shall be deemed to be not acting as arbitrator(s). Within 84 Days after receiving such reference, or within such other period as may be proposed by the DAB and approved by both Parties, the DAB shall give its decision, which shall be reasoned and shall state that it is given under this Sub-Clause. The decision shall be binding on both Parties, who shall promptly give effect to it unless and until it shall be revised in an amicable settlement or an arbitral award as described below. Unless the Contract has already been abandoned, repudiated or terminated, the Contractor shall continue to proceed with the Works in accordance with the Contract. If either Party is dissatisfied with the DAB's decision, then either Party may, within 28 Days after receiving the decision, give notice to the other Party of its dissatisfaction and intention to commence arbitration. If the DAB fails to give its decision within the period of 84 Days (or as otherwise approved) after receiving such reference, then either Party may, within 28 Days after this period has expired, give notice to the other Party of its dissatisfaction and intention to commence arbitration. In either event, this notice of dissatisfaction shall state that it is given under this Sub-Clause, and shall set out the matter in dispute and the reason(s) for dissatisfaction. Except as stated in Sub-Clause 19.5 [Failure to Comply with Dispute Adjudication Board's Decision] and Sub-Clause 19.6 [Expiry of Dispute Adjudication Board's Appointment], neither Party shall be entitled to commence arbitration of a dispute unless a notice of dissatisfaction has been given in accordance with this Sub-Clause. If the DAB has given its decision as to a matter in dispute to both Parties, and no notice of dissatisfaction has been given by either Party within 28 Days after it received the DAB's decision, then the decision shall become final and binding upon both Parties.

19.5	Failure to Comply with Dispute Adjudication Board's Decision	In the event that a Party fails to comply with a DAB decision which has become final and binding, then the other Party may, without prejudice to any other rights it may have, refer the failure itself to arbitration under Sub-Clause 19.7 [Arbitration]. Sub-Clause 19.4 [Obtaining Dispute Adjudication Board's Decision] shall not apply to this reference.
19.6	Expiry of Dispute Adjudication Board's Appointment	If a dispute arises between the Parties in connection with, or arising out of, the Contract or the execution of the Works and there is no DAB in place, whether by reason of the expiry of the DAB's appointment or otherwise: (a) Sub-Clause 19.4 [Obtaining Dispute Adjudication Board's Decision] shall not apply, and (b) the dispute may be referred directly to arbitration under Sub-Clause 19.7 [Arbitration]
19.7	Arbitration	a) Any dispute of whatever nature arising from, out of or in connection with this agreement, on the interpretation thereof, or the rights, duties, obligations or liabilities of any Party, or the operation, breach, termination, abandonment, foreclosure or invalidity thereof, shall be referred to by either Party to arbitration for final settlement, in accordance with the Arbitration Act No. 11 of 1995, or any amendment thereof, (b) Pending the award in any arbitration proceedings hereunder, (i) this Contract and the rights and obligations of the Parties shall remain in full force and effect and (ii) each of the Parties shall continue to perform their respective obligations under this Contract. The termination of this Contract shall not result in the termination of any arbitration proceedings pending at the time of such termination nor otherwise affect the rights and obligations of the Parties under or with respect to such pending arbitration. (d) Any award rendered by the arbitral tribunal shall determine the extent to which the cost of arbitration is to be borne by each Party. The arbitration centre charges and the compensation to the arbitrator shall be equally shared by the Parties initially.

Composition of the Arbitral Tribunal :

The arbitral tribunal shall consist of a sole arbitrator who shall be appointed in the manner provided in the Selection Procedure as given below.

Selection Procedure :

The Party desiring arbitration shall nominate three arbitrators out of which one to be selected by the other Party within 21 Days of the receipt of such nomination. If the other Party does not select one to serve as Arbitrator within the stipulated period then the Arbitrator shall be appointed in accordance with the Arbitration Act No. 11 of 1995, or any amendments thereof.

Venue & Language :

The venue of arbitration shall be in Sri Lanka.

Unless otherwise agreed to by the Parties the proceedings shall be conducted and the award shall be rendered in the English language.

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APPENDIX TO CONTRACT DATA

A General Conditions of Dispute Adjudication Agreement

1. Definitions

Each "Dispute Adjudication Agreement" is a tripartite agreement by and between:

(a) the "Employer";
(b) the "Contractor"; and
(c) the "Member" who is defined in the Dispute Adjudication Agreement as being one of the three persons who are jointly called the "DAB" (or "Dispute Adjudication Board") and, where this is the case, the other two persons are called the "Other Members."

The Employer and the Contractor have entered (or intend to enter) into a contract, which is called the "Contract" and is defined in the Dispute Adjudication Agreement, which incorporates this Appendix. In the Dispute Adjudication Agreement, words and expressions which are not otherwise defined shall have the meanings assigned to them in the Contract.

2. General Provisions

Unless otherwise stated in the Dispute Adjudication Agreement, it shall take effect on the latest of the following dates:

(a) the Commencement Date defined in the Contract,
(b) when the Employer, the Contractor and the Member have each signed the Dispute Adjudication Agreement, or
(c) when the Employer, the Contractor and each of the Other Members have respectively each signed a Dispute Adjudication Agreement.

This employment of the Member is a personal appointment. At any time, the Member may give not less than 70 Days notice of resignation to the Employer and to the Contractor, and the Dispute Agreement shall terminate upon the expiry of this period.

3. Warranties

The Member warrants and agrees that he/she is and shall be impartial and independent of the Employer, the Contractor and the Engineer. The Member shall promptly disclose, to each of them and to the Other Members, any fact or circumstance which might appear inconsistent with his/her warranty and agreement of impartiality and independence.

When appointing the Member, the Employer and the Contractor relied upon the Member's representations that he/she is:

(a) experienced in the work which the Contractor is to carry out under the Contract,
(b) experienced in the interpretation of contract documentation, and
(c) fluent in the language for communications defined in the Contract.

4. General Obligations of the Member

The Member shall:

(a) have no interest financial or otherwise in the Employer, the Contractor or Engineer, nor any financial interest in the Contract except for payment under the Dispute Adjudication Agreement;

(b) not previously have been employed as a consultant or otherwise by the Employer, the Contractor or the Engineer, except in such circumstances as were disclosed in writing to the Employer and the Contractor before they signed the Dispute Adjudication Agreement;

(c) have disclosed in writing to the Employer, the Contractor and the Other Members, before entering into the Dispute Adjudication Agreement and to his/her best knowledge and recollection, any professional or personal relationships with any director, officer or employee of the Employer, the Contractor or the Engineer, and any previous involvement in the overall project of which the Contract forms part;

(d) not, for the duration of the Dispute Adjudication Agreement, be employed as a consultant or otherwise by the Employer, the Contractor or the Engineer, except as may be agreed in writing by the Employer, the Contractor and the Other Members;

(e) comply with the annexed procedural rules and with Sub-Clause 19.4 (Obtaining Dispute Adjudication Board's Decision) of the Conditions of Contract;

(f) not give advice to the Employer, the Contractor, the Employer's Personnel or the Contractor's Personnel concerning the conduct of the Contract, other than in accordance with the annexed procedural rules;

(g) not while a Member enter into discussions or make any agreement with the Employer, the Contractor or the Engineer regarding employment by any of them, whether as a consultant or otherwise, after ceasing to act under the Dispute Adjudication Agreement;

(h) ensure his/her availability for all site visits and hearings as are necessary;

(i) become conversant with the Contract and with the progress of the Works (and of any other parts of the project of which the Contract forms part) by studying all documents received which shall be maintained in a current working file;

(j) treat the details of the Contract and all the DAB's activities and hearings as private and confidential, and not publish or disclose them without the prior written consent of the Employer, the Contractor and the Other Members; and

(k) be available to give advice and opinions, on any matter relevant to the Contract when requested by both the Employer and the Contractor, subject to the agreement of the Other Members.

5. General Obligations of the Employer and the Contractor	The Employer, the Contractor, the Employer's Personnel and the Contractor's Personnel shall not request advice from or consultation with the Member regarding the Contract, otherwise than in the normal course of the DAB's activities under the Contract and the Dispute Adjudication Agreement. The Employer and the Contractor shall be responsible for compliance with this provision, by the Employer's Personnel and the Contractor's Personnel respectively. The Employer and the Contractor undertake to each other and to the Member that the Member shall not, except as otherwise agreed in writing by the Employer, the Contractor, the Member and the Other Members: (a) be appointed as an arbitrator in any arbitration under the Contract; (b) be called as a witness to give evidence concerning any dispute before arbitrator(s) appointed for any arbitration under the Contract; or (c) be liable for any claims for anything done or omitted in the discharge or purported discharge of the Member's functions, unless the act or omission is shown to have been in bad faith. The Employer and the Contractor hereby jointly and severally indemnify and hold the Member harmless against and from claims from which he is relieved from liability under the preceding paragraph. Whenever the Employer or the Contractor refers a dispute to the DAB under Sub-Clause 19.4 (Obtaining Dispute Adjudication Board's Decision) of the Conditions of Contract, which will require the Member to make a site visit and attend a hearing, the Employer or the Contractor shall provide appropriate security for a sum equivalent to the reasonable expenses to be incurred by the Member. No account shall be taken of any other payments due or paid to the Member.
6. Payment	The Member shall be paid as follows: (a) a retainer fee per calendar month, which shall be considered as payment in full for: (i) being available on 28 days notice for all site visits and hearings; (ii) becoming and remaining conversant with all project developments and maintaining relevant files; (iii) all office and overhead expenses including secretarial services, photocopying and office supplies incurred in connection with his duties; and (iv) all services performed hereunder except those referred to in sub-paragraphs (b) and (c) of this Clause. The retainer fee shall be paid with effect from the last day of the calendar month in which the Dispute Adjudication Agreement becomes effective; until the last day of the calendar month in which the Taking-Over Certificate is issued for the whole of the Works.

With effect from the first day of the calendar month following the month in which the Taking-Over Certificate is issued for the whole of the Works, the retainer fee shall be reduced by 50%. This reduced fee shall be paid until the first day of the calendar month in which the Member resigns or the Dispute Adjudication Agreement is otherwise terminated.

(b) a daily fee which shall be considered as payment in full for:

(i) each day or part of a day up to a maximum of two Days travel time in each direction for the journey between the Member's home and the site, or another location of a meeting with the Other Members;
(ii) each working day on Site visits, hearings or preparing decisions; and
(iii) each day spent reading submissions in preparation for a hearing.
(c) all reasonable expenses including necessary travel expenses (hotel and subsistence and other direct travel expenses) incurred in connection with the Member's duties, as well as the cost of telephone calls, courier charges, and faxes: a receipt shall be required for each item in excess of five percent of the daily fee referred to in sub-paragraph (b) of this Clause.

The retainer and daily fees shall be as specified in the Dispute Adjudication Agreement. Unless it specifies otherwise, these fees shall remain fixed for the entire duration of the Contract.

The Member shall submit invoices for payment of the monthly retainer quarterly in advance. Invoices for other expenses and for daily fees shall be submitted following the conclusion of a site visit or hearing. All invoices shall be accompanied by a brief description of activities performed during the relevant period and shall be addressed to the Contractor.

The Contractor shall pay each of the Member's invoices in full within 56 calendar days after receiving each invoice and shall apply to the Employer (in the Statements under the Contract) for reimbursement of one-half of the amounts of these invoices. The Employer shall then pay the Contractor in accordance with the Contract.

If the Contractor fails to pay to the Member the amount to which he/she is entitled under the Dispute Adjudication Agreement, the Employer shall pay the amount due to the Member and any other amount which may be required to maintain the operation of the DAB; and without prejudice to the Employer's rights or remedies. In addition to all other rights arising from this default, the Employer shall be entitled to reimbursement of all sums paid in excess of one-half of these payments, plus all costs of recovering these sums and financing charges calculated at the rate specified in Sub-Clause 14.7 of the Conditions of Contract.

If the Member does not receive payment of the amount due within 70 days after submitting a valid invoice, the Member may (i) suspend his/her services (without notice) until the payment is received, and/or (ii) resign his/her appointment by giving notice under Clause 7.

7. Termination

At any time: (i) the Employer and the Contractor may jointly terminate the Dispute Adjudication Agreement by giving 42 Days notice to the Member; or (ii) the Member may resign as provided for in Clause 2.

If the Member fails to comply with the Dispute Adjudication Agreement, the Employer and the Contractor may, without prejudice to their other rights, terminate it by notice to the Member. The notice shall take effect when received by the Member.

If the Employer or the Contractor fails to comply with the Dispute Adjudication Agreement, the Member may, without prejudice to his other rights, terminate it by notice to the Employer and the Contractor. The notice shall take effect when received by them both.

Any such notice, resignation and termination shall be final and binding on the Employer, the Contractor and the Member. However, a notice by the Employer or the Contractor, but not by both, shall be of no effect.

8. Default of the Member

If the Member fails to comply with any of his obligations under Clause 4 (a) - (d) above, he shall not be entitled to any fees or expenses hereunder and shall, without prejudice to their other rights, reimburse each of the Employer and the Contractor for any fees and expenses received by the Member and the Other Members, for proceedings or decisions of the DAB which are rendered void or ineffective by the said failure to comply.

If the Member fails to comply with any of his obligations under Clause 4 (e) - (k) above, he shall not be entitled to any fees or expenses hereunder from the date and to the extent of the non-compliance and shall, without prejudice to their other rights, reimburse each of the Employer and the Contractor for any fees and expenses already received by the Member, for proceedings or decisions of the DAB which are rendered void or ineffective by the said failure to comply.

9. Disputes

Any dispute or claim arising out of or in connection with this Dispute Adjudication Agreement, or the breach, termination or invalidity thereof, shall be finally settled in accordance with Arbitration Act No 11, 1995 of Sri Lanka with a sole Arbitrator..

PROCEDURAL RULES

1. Unless otherwise agreed by the Employer and the Contractor, the DAB shall visit the site at intervals of not more than 70 days, including times of critical construction events, at the request of either the Employer or the Contractor. Unless otherwise agreed by the Employer, the Contractor and the DAB, the period between consecutive visits shall not be less than 35 days, except as required to convene a hearing as described below.

2. The timing of and agenda for each site visit shall be as agreed jointly by the DAB, the Employer and the Contractor, or in the absence of agreement, shall be decided by the DAB. The purpose of site visits is to enable the DAB to become and remain acquainted with the progress of the Works and of any actual or potential problems or claims, and, as far as reasonable, to endeavour to prevent potential problems or claims from becoming disputes.

3. Site visits shall be attended by the Employer, the Contractor and the Engineer and shall be co-ordinated by the Employer in co-operation with the Contractor. The Employer shall ensure the provision of appropriate conference facilities and secretarial and copying services. At the conclusion of each site visit and before leaving the site, the DAB shall prepare a report on its activities during the visit and shall send copies to the Employer and the Contractor.

4. The Employer and the Contractor shall furnish copy each to the members of the DAB all documents which the DAB may request, including Contract documents, progress reports, variation instructions, certificates and other documents pertinent to the performance of the Contract. All communications between the DAB and the Employer or the Contractor shall be copied to the other Party.

5. If any dispute is referred to the DAB in accordance with Sub-Clause 19.4 (Obtaining Dispute Adjudication Board's Decision) of the Conditions of Contract, the DAB shall proceed in accordance with Sub-Clause 19.4 (Obtaining Dispute Adjudication Board's Decision) and these Rules. Subject to the time allowed to give notice of a decision and other relevant factors, the DAB shall:

   (a) act fairly and impartially as between the Employer and the Contractor, giving each of them a reasonable opportunity of putting his case and responding to the other's case, and

   (b) adopt procedures suitable to the dispute, avoiding unnecessary delay or expense.

6. The DAB may conduct a hearing on the dispute, in which event it will decide on the date and place for the hearing and may request that written documentation and arguments from the Employer and the Contractor be presented to it prior to or at the hearing.

7. Except as otherwise agreed in writing by the Employer and the Contractor, the DAB shall have power to adopt an inquisitorial procedure, to refuse admission to hearings or audience at hearings to any persons other than representatives of the Employer, the Contractor and the Engineer, and to proceed in the absence of any party who the DAB is satisfied received notice of the hearing; but shall have discretion to decide whether and to what extent this power may be exercised.

8. The Employer and the Contractor empower the DAB, among other things, to:

   (a) establish the procedure to be applied in deciding a dispute,

   (b) decide upon the DAB's own jurisdiction, and as to the scope of any dispute referred to it,

   (c) conduct any hearing as it thinks fit, not being bound by any rules or procedures other than those contained in the Contract and these Guidelines,

(d) take the initiative in ascertaining the facts and matters required for a decision,

(e) make use of its own specialist knowledge, if any,

(f) decide upon the payment of financing charges in accordance with the Contract,

(g) decide upon any provisional relief such as interim or conservatory measures, and

(h) open up, review and revise any certificate, decision, determination, instruction, opinion or valuation of the Engineer, relevant to the dispute.

9. The DAB shall not express any opinions during any hearing concerning the merits of any arguments advanced by the Parties. Thereafter, the DAB shall make and give its decision in accordance with Sub-Clause 19.4 (Obtaining Dispute Adjudication Board's Decision), or as otherwise agreed by the Employer and the Contractor in writing. The DAB:

(a) shall convene in private after a hearing, in order to have discussions and prepare its decision;

(b) shall endeavour to reach a unanimous decision: if this proves impossible the applicable decision shall be made by a majority of the Members, who may require the minority Member to prepare a written report for submission to the Employer and the Contractor; and

(c) Member fails to attend a meeting or hearing, or to fulfill any required function, the other two Members may nevertheless proceed to make a decision, unless:

(i) either the Employer or the Contractor does not agree that they do so, or

(ii) the absent Member is the chairman and he/she instructs the other Members to not make a decision.

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DISPUTE ADJUDICATION AGREEMENT

[for each member of a three - person DAB]

Name and details of Contract
Name and address of Employer
Name and address of Contractor
Name and address of Member

Whereas the Employer and the Contractor have entered into the Contract and desire jointly to appoint the Member to act as one of the three persons who are jointly called the Dispute Adjudication Board (DAB) [and desire the Member to act as chairman of the DAB]

The Employer, Contractor and Member jointly agree as follows:

1. The conditions of this Dispute Adjudication Agreement comprise the "General Conditions of Dispute Adjudication Agreement" which is appended to the General Conditions of the "Standard Bidding Document, Procurement of Works, Major Contracts - Second Edition, January 2007" and the following provisions. In these provisions, which include amendments and additions to the General Conditions of Dispute Adjudication Agreement, words and expressions shall have the same meanings as are assigned to them in the General Conditions of Dispute Adjudication Agreement.

2. [Details of amendments to the General Conditions of Dispute Adjudication Agreement, if any

   For example:
   In the procedural rules annexed to the General Conditions of Dispute Adjudication Agreement, Rule____ is deleted and replaced by: "……."]

3 In accordance with Clause 6 of the General Conditions of Dispute Adjudication Agreement the Member shall be paid as follows:

   A retainer fee of _____ per calendar month,

   plus a daily fee of _____ per day.

4 In consideration of these fees and other payments to be made by the Employer and the Contractor in accordance with Clause 6 of the General Conditions of Dispute Adjudication Agreement, the Member undertakes to serve, as described in this Dispute Adjudication Agreement, as one of the three persons who are jointly to act as the DAB.

5 The Employer and the Contractor jointly and severally undertake to pay the Member, in consideration of the carrying out of these services, in accordance with Clause 6 of the General Conditions of Dispute Adjudication Agreement.

6 This Dispute Adjudication Agreement shall be governed by the law of _____

SIGNED by: _____	SIGNED by: _____	SIGNED by: _____
for and on behalf of the Employer in the presence of	for and on behalf of the Contractor in the presence of	the Member in the presence of
Witness: _____	Witness: _____	Witness: _____
Name: _____	Name: _____	Name: _____
Address: _____	Address: _____	Address: _____
Date: _____	Date: _____	Date: _____

- **Conditions of Contract Clause 4.2 - Performance Security, Clause 14.2 - Advance Payment guarantee and Clause 14.8 – Retention guarantee**

The above Security and Guarantees issued by the following institutions are acceptable

- A Bank operating in Sri Lanka, approved by the Central Bank of Sri Lanka.

- Construction Guarantee Fund.

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SECTION – 6
SPECIFICATIONS

GENERAL SPECIFICATIONS

SPECIFICATIONS

Specifications are composed of two sections. The General Specifications and the Particular Specifications together comprise the specifications governing the works of this contract.

GENERAL SPECIFICATIONS

The General Specifications are the specifications given in the following documents issued by the Construction Industry Development Authority (CIDA).

The Bidders are expected to be conversant with these documents. Therefore, the said documents are not being issued to the Bidders under this Tender.

However, the Bidders may purchase the documents from CIDA, "Savsiripaya", Wijerama Mawatha, Colombo 07.

PUBLICATION NO.	DECRIPTION
SCA/4 (Vol. I)	Specification for Building Works – Volume I
SCA/4 (Vol. II)	Specification for Building Works – Volume II
SCA/8	Specifications for Electrical & Mechanical Works associated with Building and Civil Engineering.
SCA/3/2	Specifications for Water Supply, Sewerage and Storm Water Drainage work.
ICTAD/SCA/05	Standard specifications for Construction and Maintenance of Roads and Bridges.
ICTAD/DEV/14	Fire Regulations.

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PARTICULAR SPECIFICATIONS

CIVIL/ARCHITECTURAL WORKS

PARTICULAR SPECIFICATIONS FOR FLOOR CARPETING

ALUMINIUM WORKS

1. The contractor shall maintain a very high standard of metal working to ensure the degree of precision normally demanded in aluminium fabrication and glazing.

2. All mitre joints shall be crimped using a custom-made aluminium lug or screwed together using stainless steel self-tapping screws to give the joints a neat appearance. A cleating or crimping tool of the hand operated type shall be used to crimp or cleat the mitred corner. A small gap sealant recommended for aluminium joinery shall be applied to the exposed cut of the sections prior to joining same. The excess sealant which squeezes out after the joining shall be wiped off neatly with a clean rag.

3. Self-tapping stainless-steel screws shall be used throughout for aluminium joinery work. Stainless steel machine screws shall be used to install hinges and other fittings. Pop riveting will not be acceptable.

4. Glazing gaskets shall be suitable for tropical conditions and fit the correct thickness of glass or any other panel.

5. Extrusions to approval and to British Standards and shall be powder coated (minimum coating thickness to be 60 microns) to the relevant British Standard. Minimum extrusion thickness of main sections to be 1.2 mm and the Engineer's approval for the proposed section to be obtained before fabrication. Colour to approval of Engineer.

   A manufacturer's test certificate should be produced as evidence that the powder coating is to the required thickness and the relevant British Standard.

6. The weather stripping shall be to British Standards and shall satisfy tests for both air and water infiltration when exposed to severe tropical conditions.

   It is the responsibility of the contractor to use the correctly profiled gasket and weather strip in conjunction with the aluminium section used.

   The extrusion must be designed to take the thickness of glass specified by means of compatible gaskets.

7. Bidders are required to submit the details (including thickness) of the aluminium extrusions, glazing gaskets, weather strips, stays and hinges, fasteners, etc., proposed, along with the BID. Every bidder must submit typical cross sections (Full size) of all aluminium extrusions that he proposes to use on the works, together with his Bid. The specifications and thickness of aluminium panels proposed to be used on the works also should be clearly indicated.

8. Glass –Plain glass of 5mm. thickness to all fixed and openable windows as per drawing.

9. Prior to commencing work, the contractor shall submit samples of all items to be used for Works to the approval of the Engineer.

PARTICULAR SPECIFICATION FOR METAL CEILING

The Ceiling shall be of stove enameled aluminium or steel panels which are clipped on to special carrier profiles. The panels shall be un-perforated/perforated and be colour fast, corrosion resistant and incombustible.

It should be possible to easily remove and replace individual panels. The Ceiling system shall be suspended from the Concrete slab/Steel roof frame work/Timber Roof frame work with a mechanism for accurate leveling of the Ceiling. Colour to approval.

Panels
Panel Size - 600 mm. x 600 mm
Panels shall be stove enameled 0.7 mm. thick (minimum) Aluminium alloy.

Suspension system - Galvanized Steel or to approval. Use an approved separation material for dissimilar materials to prevent corrosive action. Fixing clips black PVC for locking the panels. Accessories as recommended by the Ceiling system manufacturer.

Supply and fix according to fixing instructions of Ceiling system manufacturer.

Edge profiles also to be supplied and installed.

Provision required for Light Fittings, Fire and Smoke Detectors, Air Conditioning Diffusers etc.
Gap between panels to be 15mm. Approx. or to approval of the Engineer.

All samples should be approved by the Engineer prior to commencement of work.

Maintenance Tool
Contractor shall hand over the access tool to remove tiles for maintenance, comply with ASTM C635/C635M standard specifications to the Employer at the Employers taking over of the project

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ANTI-SHATTER FILM

1. Anti-Shatter Film – Clear Film

2. Minimum thickness of film – 100 µ m

3. The proposed Anti-Shatter film should conform fully to the American National Standards Institution (ANSI) latest specification of safety glazing material used in building.

4. The bidder should provide documentary proof from the manufacturer that the proposed anti-shatter film is in total conformity with ANSI Z 97.1 or equivalent to approval.

5. It should also satisfy CPSWC 16 CFR 120 (consumer products safety committee) (or equivalent) shot bag impact test for categories I and II or equivalent to approval.

6. The above documents proving conformity with the specifications referred to should be submitted together with the bid.

Anti-Shatter film should be installed completely free of entrapped air bubbles to entire surface.

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WATER PROOFING

Material : Cementitious or other material to the approval
(Technical literature to be submitted)

Principal of water proofing : By formation of crystals (water logged) or other material to the approval
(Technical literature to be submitted)

Properties :

- Could be applied from the inside surface against very strong hydro static pressure.
- Should not be harmful to concrete or reinforcing steel.
- Should not emit any harmful vapor etc.
  i.e. Should be environmental friendly.

Pond test to be carried out for 48 hours

Warranty: 10 year or better from the date of completion of water proofing work should be from Manufacture's Local Agent.

Note: Technical data and specifications to be submitted for the Engineer's approval prior to application and all work to be carried out in accordance to the approved procedure confirming to the relevant specification.

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INTERNAL PLUMBING & SANITARY FITTINGS INSTALLATIONS, TREATED WATER SUPPLY, SEWARAGE & WASTE WATER DISPOSAL SYSTEM

WATER SUPPLY SYSTEM, SEWERAGE & WASTEWATER DISPOSAL SYSTEM & SANITARY FITTINGS & FIXTURES

1.1 General

The requirement specified in this section shall apply to all the work involved in, Design, supply, installation, testing & commissioning of necessary pipes & fittings, valves and other accessories under Water Supply System, Sewerage & Waste Water Disposal Systems and Design, supply, installation, testing & commissioning of Sanitary Fittings & fixtures to the above project.

This tender is governed by the following documents issued by the Institute for Construction Training and Development (ICTAD)

The Tenderers are expected to be conversant with these documents. Therefore, the said documents are not being issued to the Tenderers under this tender. However, the Tenderers may purchase the documents from ICTAD, Sawsiripaya, Wijerama Mawatha, Colombo 7.
Plumbing contractor/Subcontract or minimum qualification shall be EM3 Grade, Qualification of the plumber shall be NVQ Level 4.

Publication No.	Description
SCA/3/2	Specifications for Water Supply, Sewerage and Storm Water Drainage Work
SCA/8	Specifications for Electrical & Mechanical Works associated with Buildings & Civil Engineering.

Engineering layout/ shop drawings shall be submitted before commencing the Plumbing works.

1.2 Scope of works

Work under this Division consists of the Design, Supply, Installation, Testing and Commissioning of the complete Water Supply System, Sewerage & Waste Water Disposal System and Sanitary Fittings & Fixtures, as specified herein, Bill of quantities and indicated on the Drawings.

The scope of works for the Internal Plumbing and Sanitary Fixtures is as follows:

a. Design, Supply, laying & testing commissioning of uPVC Type 1000 pipes & fittings for Water supply & Sewer & Waste system on the concrete slab, embedded in walls, under the slab, hanging in the wall/floor/slab, along walls and inside the duct and where necessary. Shall stability for high-pressure water supply (6 bar). Pipes supporting shall be in 1.0m spacing. Work shall be completed as per the drawings, specifications & direction of the Engineer in charge.

b. Supply and installation of all Plumbing and Sanitary Fixtures with all necessary faucets, fittings, fixing parts and other accessories as indicated in the drawings, specification & the direction of the Engineer in charge.

c. Connecting to existing system & connection to different types of pipes.

d. Cleaning, painting and labelling all equipment, exposed piping work and all accessories.

e. Anchor bolts, all supports, hangers, fixtures and fixings with back up metal framing where required.

1.3 System Design/ Performance Requirements

a. The contractor shall obtain the Engineers' approval for method statements & design/shop drawings before carrying out any installation work of the Piping network and sanitary fittings & accessories. (Initial Architectural drawings are provided for reference only).

b. All pipes, fittings & accessories shall be in relevant standard approved by the Engineer.

c. Water supply pipes & fittings shall be T1000 uPVC.

d. All water supplies from water supply piping system to the accessories shall be individual piping lines.

e. Each washroom shall be isolated by Isolation Valve.

f. All internal waste water and sewer disposal lines shall be of T1000 uPVC, properly and steadily fixed to the metallic structure.

g. All waste lines shall be properly trapped and should maintain ambient slope. All lines shall be provided with cleaning access in accordance with good engineering practice.

h. Waste and sewer outlets at its termination should be properly and steadily fixed to the main structure.

i. All waste and sewer lines shall be interconnected at the main line, and keep only one outlet which requires connecting to the main sewage disposal system. The contractor shall specify the method of connecting the waste line to the main sewage disposal system

j. Plumbing and Sanitary Fixtures shall be manufactured by Rocell /TOTO/ Geberit/ Roca or of an equivalent standard approved by the Engineer.

k. Contractor shall obtain Engineers approval for all the materials prior to order.

l. Discoloration of sanitary fittings and accessories due to the use of reclaimed water shall not be permitted.

m. All Plumbing and Sanitary Fixtures shall be compatible with all applicable Safety and Protection Constraints.

n. All Plumbing and Sanitary Fixtures shall be suitable for their intended purpose and environment, e.g. water tightness, ambient temperature and humidity, vandal resistant, etc.

o. Supply and installation of all Sanitary Fixtures & Accessories shall be inclusive of the connections to the water supply and sewage piping system.

p. All Sanitary Fixtures shall be provided with complete faucets, wastes, plugs, chains and all other fittings and trims instructed by the Engineer and recommended by the fixture manufacturer.

q. All fittings, metal trims, escutcheons, traps, exposed piping, etc. shall be chromium plated brass or bronze with a polished bright surface.

r. Sanitary Fixtures shall generally be products of a single manufacturer.

s. Comparable assemblies of manufacturers other than the one specified may be proposed if they differ in minor detail only and otherwise comply with the requirements shown or specified, subject to the prior approval of the Engineer.

t. All Sanitary Fixtures & Accessories shall be selected and installed so that all relevant components are easily accessible for maintenance, repair and replacement.

u. Maintenance access/provisions shall be provided where necessary and shall take approval from the Engineer.

v. Corrosion protection coating /application shall be used for the all metal parts where necessary and shall take approval from the Engineer.

w. Specific tools/ maintenance kit shall be provided for AASL maintenance.

x. All systems testing & commissioning shall be approved by the Engineer.

y. Gravity pipe works shall be installed with correct falls to ensure adequate venting and draining.

z. Valves, specials, etc., shall be installed in such a manner that maintenance access is maintained for all parts requiring service.

aa. All pipe works run in the wall chases, recesses, and pipes shaft etc., shall be carefully examined and tested prior to cover-up.

bb. All pipes and fittings shall be thoroughly cleaned before installation and any burrs removed. Off-cut pipes shall not be used to fabricate the length of pipes or other fittings. Standard fittings shall be used in all cases.

cc. The Contractor will be responsible for taking delivery of fixtures at site, unloading (including unpacking and inspection for damage), storing, protecting and installing them in their required position.

dd. The Contractor will be responsible for the fixtures against all risks including damage and theft as from the time he obtains the fixtures until handover of the installation to the Employer.

ee. Contractor shall provide all maintenance guidelines & installation manuals to AASL.

ff. Recently discontinuous products are not accepted.

gg. The contractor shall guarantee the Spare part availability in the Local agent for a minimum of Five years.

hh. A maximum gap of 5mm is allowed between the sanitary fittings and the wall.

ii. When sanitary fittings are fixed to the wall, a maximum gap of 5mm is allowed between the fittings and the wall.

jj. Water closets shall be properly fixed to the floor using construction grouts

1.4 Technical Specifications for Pipes, Sanitary fittings & accessories

Common items

- PVC cold water pipes & fittings – SLS 147 and Type 1000 make to approval. Piping sizes and the norms maintained by the AASL given below (BOQ prepared accordingly)

Cold water piping

- All water supply lines from the main distribution system by 63mm Diameter pipes
- Internal distribution system by 32mm Diameter pipes
- Connection lines to the plumbing accessories by 20mm Diameter pipes

Waste water piping

- Wash basin piping by 40mm Diameter pipes
- Waste water inter connected pipes by 63mm Diameter pipes
- Waste water down pipes by 110mm Diameter pipes

Sewer water piping

- Sewer connection pipes to the accessories by 110mm Diameter pipes
- Sewer inter connection pipes lines by 110mm Diameter pipes
- Urinals by 40mmDia pipes
- Urinal waste interconnected pipes by 63mm Diameter pipes

Other Fittings

- Bottle trap shall be stainless steel good quality - Samples to approval
- Angle valves, Isolation valves shall be minimum PN 10, Brass, chromium plated, European makes and samples to approval
- Flexible hose 1 ½" x ½" make Filnox or equivalent samples for approval
- Stainless steel gully covers with water & air trap Floor gully box and samples for approval

- Mirrors shall be bevelled edge mirror thickness 5mm and good quality and samples for approval.

Toilet fittings and accessories

- All Sanitary fitting & accessories shall be Rocell /American Standard or equivalent.
- All products shall come with a local agent.
- Vitreous china closed coupled Water Closet consisting of glazed Vitreous china pedestal, seat cover, duel flushing cistern with siphon mechanism including flexible pipes, bracket, Spring, Bolt Set, nut & bolts, PVC pipes/bend, "P" or "S" Trap and with all other necessary accessories complete to working order.
- C/P Bidet Spray with flexible connection & wall-mounted hand holder with all necessary fittings and accessories complete to working order.
- Vitreous china half pedestal wash basin complete with C/P Pillar tap, rubber plug, C/P Chain waste & C/P Bottle trap and with all necessary accessories complete to working order.
- Vitreous china Squatting pan with inbuilt foot rests, Concealed Cistern, duel flushing Siphon mechanism including all internal fittings "P" or "S" Trap. All complete to working order.
- Vitreous China Wall-hung Urinal fixed with plugs & screws and connected necessary stainless steel pipe with Concealed manual flush unit with all necessary accessories complete to working order.
- Floor gully, Supply water pressure 15 psi - 25 psi, discharge quantity shall be adjustable at range 2 -6 LPF Trap Floor Gully Stainless steel gully boxes with covers or gully boxes brass chromium plated with Stainless steel cover 6" x 6". Gully shall have water & air trap.
- Towel rail Make Rocell or Toto or Geberit or Mediclinics or Hansgrohe or equivalent sample for approval
- Wall mounted type Soap tray with all necessary fittings and accessories complete to working order.
- Manual operated wall mounted type Stainless steel Soap dispenser with all necessary fittings and accessories complete to working order.
- Toilet Paper Holder with all necessary accessories complete to working order.
- C/P Bib Tap with Lever Handel with all necessary accessories complete to working order.

1.5 Booster Package Specification for Water Supply

Part I – GENERAL

1.5.1 Work Included

A. Variable Speed Packaged Pumping System

1.5.2 Reference Standards

The work in this section is subject to the requirements of applicable portions of the following standards:

A. Hydraulic Institute
B. ANSI – American National Standards Institute
C. ASTM – American Society for Testing and Materials
D. IEEE – Institute of Electrical and Electronics Engineers
E. NEMA – National Electrical Manufacturers Association
F. NEC – National Electrical Code
G. ISO – International Standards Organization
H. UL – Underwriters Laboratories, Inc.

Part 2 – PRODUCTS

1.5.3 Variable Speed Packaged Pumping System

A. Furnish and install a pre-fabricated and tested variable speed packaged pumping system to maintain constant water delivery pressure.
B. The packaged pump system shall be a standard product of a single pump manufacturer. The entire pump system including pumps and pump logic controller, shall be designed, built, and tested by the same manufacturer.
C. The complete packaged water booster pump system shall be certified and listed by UL (Category QCZJ – Packaged Pumping Systems) for conformance to U.S. and Canadian Standards.
D. The complete packaged pumping system shall be NSF61 / NSF372 Listed for drinking water and low lead requirements.
E. The packaged pump system shall be ASHRAE 90.1 – 2010 compliant without the need of a remote mounted sensor. The control logic used to simulate a remote mounted sensor shall be proportional pressure control with squared or linear adaptation. An actual flow rate or calculated flow rate based on performance curves (5th order polynomial) loaded into the controller; shall be used to adjust set point pressure in proportional pressure control.

1.5.4 Pumps

A. All pumps shall be ANSI NSF 61 / NSF372 Listed for drinking water and low lead requirements.
B. The pumps shall be of the in-line vertical multi-stage design.
C. The head-capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region. The shut-off head shall be a minimum of 20% higher than the head at the best efficiency point.
D. Small Vertical In-Line Multi-Stage Pumps (Nominal flow from 0.5 to 30 m3 per hour) shall have the following features

I. The pump impellers shall be secured directly to the pump shaft by means of a splined shaft arrangement.

II. The suction/discharge base shall have PN16 flange, PN16 PJE type coupling or internal pipe thread (NPT) connections as determined by the pump station manufacturer.

III. Pump Construction.

a. Suction/discharge base, pump head: 304 Stainless Steel
b. Impellers, diffuser chambers, outer sleeve: 304 Stainless Steel
c. Shaft: 316 or 431 Stainless Steel
d. Impeller wear rings: 304 Stainless Steel
e. Shaft journals and chamber bearings: Silicon Carbide
f. O-rings: EPDM

Shaft couplings for motor flange sizes 184TC and smaller shall be made of cast iron or sintered steel. Shaft couplings for motor flange sizes larger than 184TC shall be made of ductile iron (ASTM 60-40-18).

IV. The shaft seal shall be a balanced O-ring cartridge type with the following features:

a. Collar, Drivers, Spring: 316 Stainless Steel
b. Shaft Sleeve, Gland Plate: 316 Stainless Steel
c. Stationary Ring: Silicon Carbide
d. Rotating Ring: Silicon Carbide
e. O-rings: EPDM

The Silicon Carbide shall be imbedded with graphite.

V. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, shaft coupling and motor. The entire cartridge shaft seal shall be removable as a one-piece component. Pumps with motors equal to or larger than 15 hp (fifteen horsepower) shall have adequate space within the motor stool so that shaft seal replacement is possible without motor removal.

1.5.5 Integrated Variable Frequency Drive Motors

A. Each motor shall be of the Integrated Variable Frequency Drive design consisting of a motor and a Variable Frequency Drive (VFD) built and tested as one unit by the same manufacturer.

B. The VFD shall be of the PWM (Pulse Width Modulation) design using current IGBT (Insulated Gate Bipolar Transistor) technology.

C. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of motor. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump control and to eliminate the need for motor de-rating.

D. The VFD shall utilize an energy optimization algorithm to minimize energy consumption. The output voltage shall be adjusted in response to the load, independent of speed.

E. The VFD shall automatically reduce the switching frequency and/or the output voltage and frequency to the motor during periods of sustained ambient temperatures that are higher than the normal operating range. The switching frequency shall be reduced before motor speed is reduced.
F. An integral RFI filter shall be standard in the VFD.
G. The VFD shall have a minimum of two skip frequency bands which can be field adjustable.
H. The VFD shall have internal solid-state overload protection designed to trip within the range of 125-150% of rated current.
I. The integrated VFD motor shall include protection against input transients, phase imbalance, loss of AC line phase, over-voltage, under-voltage, VFD over-temperature, and motor over-temperature. Three-phase integrated VFD motors shall be capable of providing full output voltage and frequency with a voltage imbalance of up to 10%.
J. The integrated VFD motor shall have, as a minimum, the following input/output capabilities:
    a. Speed Reference Signal: 0-10 VDC, 4-20mA
    b. Digital remote on/off
    c. Fault Signal Relay (NC or NO)
    d. Fieldbus communication port (RS485)

K. The motor shall be Totally Enclosed Fan Cooled (TEFC) with a standard NEMA C-Face, Class F insulation with a temperature rise no higher than Class B.
L. The cooling design of the motor and VFD shall be such that a Class B motor temperature rise is not exceeded at full rated load and speed at a minimum switching frequency of 9.0 kHz.
M. Motor drive end bearings shall be adequately sized so that the minimum L10 bearing life is 17,500 hours at the minimum allowable continuous flow rate for the pump at full rated speed.

1.5.6 Pump System Controller

A. The pump system controller shall be a standard product developed and supported by the pump manufacturer.
B. The controller shall be microprocessor based capable of having software changes and updates via personal computer (notebook). The controller user interface shall have a color display with a minimum screen size of 3-1/2" x 4-5/8" for easy viewing of system status parameters and for field programming. The display shall have a back light with contrast adjustment. Password protection of system settings shall be standard.

C. The controller shall provide internal galvanic isolation to all digital and analog inputs as well as all fieldbus connections.

D. The controller shall have the ability to be connected to a battery to maintain power on controller during periods of loss of supply power.

E. The controller shall have built in data logging capability. Logged vales shall be graphically displayed on the controller and able to be exported. A minimum of 3600 samples per logged value with the following parameters available for logging:
- Estimated flow-rate
- Speed of pumps
- Inlet pressure
- Process Value (usually discharge pressure of differential pressure depending on application)
- Power consumption
- Controlling parameter (process value)

F. The controller shall display the following as status readings from a single display on the controller (this display shall be the default):
- Current value of the control parameter, (typically discharge pressure)
- Most recent existing alarm (if any)
- System status with current operating mode
- Status of each pump with current operating mode and rotational speed as a percentage (%)
- Estimated flow-rate, (not requiring flow meter connection)

G. The controller shall have as a minimum the following hardware inputs and outputs:
- Three analogue inputs (4-20mA or 0-10VDC)
- Three digital inputs
- Two digital outputs
- Ethernet connection
- Field Service connection to PC for advanced programming and data logging

H. Pump system programming (field adjustable) shall include as a minimum the following:
- Water shortage protection (analogue or digital)
- Sensor Settings (Suction, Discharge, Differential Pressure analogue supply/range)
- PI Controller (Proportional gain and Integral time) settings
- High system pressure indication and shut-down
- Low system pressure indication and shut-down
- Low suction pressure/level shutdown (via digital contact)
- Low suction pressure/level warning (via analogue signal)
- Low suction pressure/level shutdown (via analogue signal)
- Flow meter settings (if used, analogue signal)

I. The system controller shall be able to accept up to seven programmable set-points via a digital input, (additional input/output module may be required).

J. The controller shall have advanced water shortage protection. When analogue sensors (level or pressure) are used for water shortage protection, there shall be two indication levels. One level is for warning indication only (indication that the water level/pressure is getting lower than expected levels) and the other level is for complete system shut-down (water or level is so low that pump damage can occur). System restart after shut-down shall be manual or automatic (user selectable).

K. The system pressure set-point shall be capable of being automatically adjusted by using an external set-point influence. The set-point influence function enables the user to adjust the control parameter (typically pressure) by measuring an additional parameter. (Example: Lower the system pressure set-point based on a flow measurement to compensate for lower friction losses at lower flow rates).

L. The controller shall be capable of receiving a remote analog set-point (4-20mA or 0-10 VDC) as well as a remote system on/off (digital) signal.

M. The controller shall be able to adjust the ramp time of a change in set point on both an increase or decrease change in set point.

N. The pump system controller shall store up to 24 warning and alarms in memory. The time, date and duration of each alarm shall be recorded. A potential-free relay shall be provided for alarm notification to the building management system. The controller shall display the following alarm conditions:

- High System Pressure Low system pressure
- Low suction pressure (warning and alarm) Individual pump failure
- VFD trip/failure Loss of sensor signal (4-20 mA)
- Loss of remote set-point signal (4-20mA) System power loss

O. The pump system controller shall be mounted in a UL Type 3R rated enclosure. A self-certified NEMA enclosure rating shall not be considered equal. The entire control panel shall be UL 508 listed as an assembly. The control panel shall include a main disconnect, circuit breakers for each pump and the control circuit and control relays for alarm functions.

P. Control panel options shall include, but not be limited to:

- Pump Run Lights System Fault Light
- Audible Alarm (80 db[A]) Surge Arrestor
- Emergency/Normal Operation Switches Service Disconnect Switches
- Qty (9) Configurable Digital Outputs available for monitoring

- The controller shall be capable of receiving a redundant sensor input to function as a backup to the primary sensor (typically discharge pressure).

Q. The controller shall have a pump "Test Run" feature such that pumps are switched on during periods of inactivity (system is switched to the "off" position but with electricity supply still connected). The inoperative pumps shall be switched on for a period of two to three (3-4) seconds every 24 hours, 48 hours or once per week and at specific time of day (user selectable).

R. The controller shall be capable of changing the number of pumps available to operate or have the ability limit the maximum power consumption by activation of a digital input for purposes of limited generator supplied power.

S. The controller shall be capable of displaying instantaneous power consumption (Watts or kilowatts) and cumulative energy consumption (kilowatt-hours).

T. The controller shall be capable of displaying instantaneous specific energy use (kW/gpm), (optional flow meter must be connected).

U. The actual pump performance curves (5th order polynomial) shall be loaded (software) into the pump system controller. Pump curve data shall be used for the following:
   a. Display and data logging of calculated flow rate (not requiring flow measurement)
   b. Proportional pressure control
   c. Pump outside of duty range protection
   d. Pump cascade control based on pump efficiency

V. The controller shall be capable of displaying an estimated flow-rate on the default status screen.

W. The controller shall have proportional pressure control to compensate for pipe friction loss by decreasing pressure set-point at lower flow-rates and increasing pressure set-point at higher flow-rates by using actual flow rate or calculated flow rate. Proportional pressure control that uses pump speed or power consumption only shall not be considered equal to proportional pressure control that uses actual or calculated flow rate.

X. The controller shall have the ability to communicate common field-bus protocols, (BACnet, Modbus, Profibus, and LON), via optional communication expansion card installed inside controller.

Y. The controller shall have Ethernet connection with a built in server allowing for connection to a network with read/write access to controller via web browser and internet.

Z. The controller shall have a programmable Service Contact Field that can be populated with service contact information including: contact name, address, phone number(s) and website.

1.5.7 Sequence of Operation

A. The system controller shall operate equal capacity variable speed pumps to maintain a constant discharge pressure or differential pressure (system set-point), depending on the application. The system controller shall receive an analog signal [4-20mA] from the factory installed pressure transducer on the discharge manifold, indicating the actual system pressure.

Standard Cascade Control (Pumping Efficiency Based):
The pump system controller shall adjust pump speed as necessary to maintain system set-point pressure as flow demand increases. Utilizing the pump curve information (5th order polynomial), the pump system controller shall stage on additional pumps when pump hydraulic efficiency will be higher with additional pumps in operation. Exception: When the flow and head are outside the operating pump(s) allowable operating range the controller shall switch on an additional pump thus distributing flow and allowing all pump(s) to operate in allowable operating range. When the system pressure is equal to the system set-point, all pumps in operation shall reach equal operating speeds. The pump system controller shall have field adjustable Proportional Gain and Integral time (PI) settings for system optimization.

Optional Cascade Control (Pump Start Speed Based):
As flow demand increases the pump speed shall be increased to maintain the system set-point pressure. When the operating pump(s) reach 96% of full speed (adjustable), an additional pump will be started and will increase speed until the system set-point is achieved. When the system pressure is equal to the system set-point all pumps in operation shall reach equal operating speeds. The pump system controller shall have field adjustable Proportional Gain and Integral time (PI) settings for system optimization.

B. The system controller shall be capable of switching pumps on and off to satisfy system demand without the use of flow switches, motor current monitors or temperature measuring devices.

C. All pumps in the system shall alternate automatically based on demand, time and fault. If flow demand is continuous (no flow shut-down does not occur), the system controller shall have the capability to alternate the pumps every 24 hours, every 48 hours or once per week. The interval and actual time of the pump change-over shall be field adjustable.

D. The system controller shall be able to control a pressure maintenance pump, (jockey pump), in the system in pressure boosting applications. The set point of

the pressure maintenance pump shall be able to be any value above or below the pump system's set point. The pressure maintenance pump shall be able to be staged on as back-up pump when capacity of pump system is exceeded.

1.5.8 Low Flow Stop Function (Constant Pressure Applications)

The system controller shall be capable of stopping pumps during periods of low-flow or zero-flow without wasting water or adding unwanted heat to the liquid. Temperature based no flow shut-down methods that have the potential to waste water and add unwanted temperature rise to the pumping fluid are not acceptable and shall not be used.

Standard Low Flow Stop and Energy Saving Mode

If a low or no flow shut-down is required (periods of low or zero demand) a bladder type diaphragm tank shall be installed with a pre-charge pressure of 70% of system set-point. The tank shall be piped to the discharge manifold or system piping downstream of the pump system. When only one pump is in operation the system controller shall be capable of detecting low flow (less than 10% of pump nominal flow) without the use of additional flow sensing devices. When a low flow is detected, the system controller shall increase pump speed until the discharge pressure reaches the stop pressure (system set-point plus 50% of programmed on/off band, adjustable). The pump shall remain off until the discharge pressure reaches the start pressure (system setpoint minus 50% of programmed on/off band, adjustable). Upon low flow shut-down a pump shall be restarted in one of the following two ways:

A. Low Flow Restart: If the low flow condition still exists, the pump shall start and the speed shall again be increased until the stop pressure is reached and the pump shall again be switched off.

B. Normal Flow Restart: If the pump system controller determines a low flow condition no longer exists the pump shall start and the speed shall be increased until the system pressure reaches the system set-point.

[OPTIONAL] Low Flow Stop and Energy Saving Mode

The pump system controller shall be capable receiving a digital signal from a flow switch or an analog signal from a flow meter to indicate a low flow condition. A bladder type diaphragm tank shall be installed with a pre-charge pressure of 70% of system set-point. The tank shall be piped to the discharge manifold or system piping downstream of the pump system. When low flow is detected (signal from flow switch or meter), the system controller shall increase pump speed until the discharge pressure reaches the stop pressure (system set-point plus 50% of programmed on/off band). The pump shall remain off until the discharge pressure reaches the start pressure (system set-point minus 50% of programmed on/off band). The pump shall remain in the energy saving on/off mode during low flow indication. When low flow is no longer present (low flow indication ceases), the pump(s) shall resume constant pressure operation.

It shall be possible to change from the standard low flow stop to the optional low flow stop (and vice-versa) via the user interface.

1.5.9 System Construction

A. Suction and discharge manifold construction shall be in way that ensures minimal pressure drops, minimize potential for corrosion, and prevents bacteria growth at intersection of piping into the manifold. Manifold construction that includes sharp edge transitions or interconnecting piping protruding into manifold is not acceptable. Manifold construction shall be such that water stagnation cannot exist in manifold during operation to prevent bacteria growth inside manifold.

B. The suction and discharge manifolds material shall be 304 stainless steel. Manifold connection sizes shall be as follows:
3 inch and smaller: Male NPT threaded
4 inch through 8 inch: ANSI Class 150 rotating flanges
10 inch and larger: ANSI Class 150 flanges

C. Pump Isolation valves shall be provided on the suction and discharge of each pump. Isolation valve sizes 2 inch and smaller shall be nickel plated brass or Stainless steel 304 full port ball valves. Isolation valve sizes 3 inch and larger shall be a full lug style butterfly valve. The valve disk shall be of stainless steel. The valve seat material shall be EPDM and the body shall be cast iron, coated internally and externally with fusion-bonded epoxy.

D. A spring-loaded non-slam type check valve shall be installed on the discharge of each pump. The valve shall be a wafer style type fitted between two flanges. The head loss through the check valve shall not exceed 0.3bar at the pump design capacity. Check valves 1-1/2" and smaller shall have a POM composite body and poppet, a stainless steel spring with EPDM or NBR seats. Check valves 2" and larger shall have a body material of stainless steel or epoxy coated iron (fusion bonded) with an EPDM or NBR resilient seat. Spring material shall be stainless steel. Disk shall be of stainless steel or leadless bronze.

E. For systems that require a diaphragm tank, a connection of no smaller than ¾" shall be provided on the discharge manifold.

F. A pressure transducer shall be factory installed on the discharge manifold (or field installed as specified on plans). Systems with positive inlet gauge pressure shall have a factory installed pressure transducer on the suction manifold for water shortage protection. Pressure transducers shall be made of 316 stainless steel. Transducer accuracy shall be +/- 1.0% full scale with hysteresis and repeatability of no greater than 0.1% full scale. The output signal shall be 4-20 mA with a supply voltage range of 9-32 VDC.

G. A bourdon tube pressure gauge, 2.5-inch diameter, shall be placed on the suction and discharge manifolds. The gauge shall be liquid filled and have copper alloy internal parts in a stainless steel case. Gauge accuracy shall be 2/1/2 %. The gauge shall be capable of a pressure of 30% above its maximum span without requiring recalibration.

H. Systems with a flooded suction inlet or suction lift configuration shall have a factory installed water shortage protection device on the suction manifold.

I. The base frame shall be constructed of corrosion resistant 304 stainless steel. Rubber vibration dampers shall be fitted between each pumps and base frame to minimize vibration.

J. Depending on the system size and configuration, the control panel shall be mounted in one of the following ways:
   - On a 304 stainless steel fabricated control cabinet stand attached to the system skid.
   - On a 304 stainless steel fabricated skid, separate from the main system skid
   - On its own base (floor mounted with plinth)

1.5.10 Testing

A. The entire pump station shall be factory tested for functionality. Functionality testing shall include the following parameters: Dry Run Protection, Minimum Pressure and Maximum Pressure alarms (where applicable), Setpoint Operation, and Motor Rotation.

B. The system shall undergo a factory hydrostatic test at the end of the production cycle. The system shall be filled with water and pressurized to 1.5 times the nameplate maximum pressure. Systems with 150# flange connections shall be tested at 350 psig, and systems with 300# flange connections shall be tested at 450 psig. The pressure shall be maintained for a minimum of 15 minutes with no leakage (slight leakage around pump(s) mechanical seal is acceptable) prior to shipment.

Samples

Samples of all plumbing fittings and accessories and other material intended to be used by the contractor shall be submitted to the Engineer for his approval before ordering them or before commencing work with such equipment and material.

Hydrostatic Pressure Test

Each pipe and fittings shall be tested under an internal hydrostatic pressure of 6kgf/cm2 for duration of 24 hours.

Shop drawings

The Drawings (three copies each) of Internal & External Plumbing and Sanitary Fittings Installations of Water Supply, Sewerage & Waste Water Disposal System at

Proposed above area shall be submitted for the approval of the Engineer before commencing any work. Such drawings shall indicate the location of all accessories of Internal & External Plumbing and Sanitary Fittings Installations of Water Supply, Sewerage & Waste Water Disposal System accessories and the Single Line representation with all quantities & dimensioning. All drawings shall be prepared in an acceptable manner conforming to good drawing office practices on A3 size paper. Soft copies in AutoCAD/Revit formats of the drawings shall be submitted the hard copy submission.

The contractor shall refer the existing as built drawing and make the shop drawings, according to the given architectural drawings and offered plumbing equipment & accessories.

These drawings shall be submitted in sufficient time (14 Working days) for approval to be granted prior to any works commencing on site or manufacturing of any equipment, plant or item.

All shop drawings shall be certified by the qualified plumbing Engineer before submitting.

As built Drawings

The As-Built Drawings (four copies each) of the Internal & External Plumbing and Sanitary Fittings Installations of Water Supply, Sewerage & Waste Water Disposal System at Proposed above area and the single Line representation of all the accessories with all quantities & dimensioning shall be submitted. All drawings shall be prepared in an acceptable manner conforming to good drawing office using Using AutoCAD/Revit software A1 size paper softcopy & hardcopy (4 Sets).

All as built hard copies shall be certified by the qualified plumbing Engineer before submitting.

Note:

The payments will be made according to the actual measurements of work done at site.

Electricity for welding works will not be provided by AASL. Hence the contractor shall have his own electrical power supply for the welding jobs.

Prior to commencement or installation works all the materials to be used for the above works, shall be inspected and certified by the AASL Engineer.

Water for Construction

- Water will be supplied from AASL, using for construction is not allowed.
- Metered water can provide for drinking purpose, on request, at prevailing changes.
- Water Supply, Sewerage & Waste Water Disposal System temporally diverting work include the contractor scope.

Warranty

General

All materials items of equipment and workmanship furnished shall carry one-year warranty against all defects in materials and workmanship. Defecting or improper material, equipment, workmanship or design shall be made good buy and at the expense of the contractor including all consequent damages to area, material and other systems resulting from this failure. Warranty shall be effective from date of the issue of the certificate of completion for the works.

Sanitary Fittings & Accessories

Warranty shall be given directly from the Manufacturer or the Local agent. The Contractor shall be specified the manufacturer warranty for sanitary fittings & accessories. Minimum 20 years' warranty for ceramic fittings and 5 years' warranty for Tap & other accessories are required.

AASL

QUALITY OF EQUIPMENT & MATERIAL OFFERED

(TO BE COMPLETED AND ATTACHED TO THE BIDDING DOCUMENT BY THE BIDDER WITH TECHNICAL CATALOG)

No	Description	Make Offered	Model Offered	Country of Origin	Country of Manufacture	Supplier	Delivery Period	Warranty Period	Remarks
1	Pipes & Fittings								
2	Angle Valve								
3	Stop Valve								
4	Bidet Spray								
5	Towel Ring								
6	Soap Tray								
7	Tap with Lever Handel								
8	Toilet Paper Holder								
9	Flexible Hose								
10	Trap Floor Gully								
11	Pillar tap								
12	Wash basin								
13	Robe hook								
14	Shower Mixer								
15	Shower Head								
16	Water Closet								
17	Plain Mirror								
18	Floor grating								
19	Soap Dispenser								
20	Urinal								
21	Urinal division								
22	Pump								
23	VFD								
24	Pressure Reducing Valve								

MECHANICAL VENTILATION & AIR CONDITIONING SYSTEM

MECHANICAL VENTILATION & AIR CONDITIONING SYSTEM

1. GENERAL

These specifications serve as general guidelines for the proposed air-conditioning system for tender purposes. Air conditioning system shall be designed for continuous operation.

The contractor shall design, supply, shop testing, delivery, fabrication erection/installation/fixing, connection, coordination, site testing, Final testing balancing and commissioning, maintenance and servicing of all the plants, equipment, material, required for the Mechanical Ventilation & Air Conditioning System (MVAC) shall be designed for continuous operation.

The tenderers shall offer a suitable Air conditioning system in accordance with the guidelines specified.

The MVAC Sub Contractor shall have EM1 Grade for the Air Conditioning System (applicable to local organizations only) and at least 10 years work experience with similar or higher capacity projects.

All materials & equipment which are related to the MVAC system should be selected and procured under the specialist contractor.

The MVAC contractor and their subcontractors shall review all tender documents and agree to provide all the requirements mentioned in the documents. This verification should be done by the main contractor before awarding the MVAC contract and proof document shall submit with the bid document. The bidder shall provide technical catalogues, methodology, method statements, work programs, etc. with the Bid

2. AIR CONDITIONING

A central air conditioning system shall be designed to cater to comfort level considering the following conditions as given below with including chillers (duty / standby), Cooling towers (duty / standby), Pumps (duty / standby), AHU (Duty) and FCU (Duty) including piping, ducting, valves, insulations, and air terminates etc. The contractor shall entirely design this system under a guidance of the chartered engineer and should be able to produce the design calculation with the submission.
The contractor shall hold the entire responsibility for the design. Systems shall be designed for 24-hour operation and it should be energy efficient.

Design Conditions

a. It is required to maintain condition of comfort in the building under normal load conditions and average lighting limits.

b. The outside conditions are assumed as follows:
   Dry bulb temperature - 30°C - 34°C

Reflective humidity- 80% - 90%

c. The indoor conditions shall be as follows:

Specified Area	Dry Bulb Temperature - °C	Relative Humidity - %	Sound Level- dB(A)
All Conditioned Spaces (Except equipment rooms)	23 ± 1	50-55	40
Equipment rooms (ATM/LINK/AWOS/AMHS/VCCS)	21 ± 1	43 ± 1	40

d. Chilled water and cooling water conditions as follows:

	Inlet of the Chiller	Outlet of the Chiller
i) Chilled Water Temperature (ºC)	12ºC	7ºC
ii) Cooling Water Temperature (ºC)	30ºC	35ºC

Scope of Work

The system shall be designed for easy of operation to guarantee efficient operations, energy efficiently, reliability and shall be provided with adequate standby facilities. Two water cooled magnetic bearing type chillers operating in sequence will serve the proposed building. The chillers shall be operated in a one-duty, one-standby configuration.

Magnetic bearing type chiller operates at part loads during the night or at times of reduced loads due to low occupancy thereby ensuring energy conservation.

The Fan Coil Units (FCU) will provide cooled air and Primary Air Handling Units (PAU) will provide fresh air to the required areas through insulated air distribution ducts, associated diffusers.

Chillers, Chilled water pumps, Condenser water pumps shall be located on Ground floor & Cooling Towers shall be located roof top as per the drawing. Properly insulated chilled water pipes shall be installed. The chilled water lines in the plant room and exposed to outside shall be cladded. This will guarantee good workmanship and less maintenance and repairs. Test facility & future connection facility shall be provided for the chilled water & condenser water system where necessary.

During the power failures, standby VRV/ VRF system shall be operated for equipment areas as specified.

The Refrigerant used shall be acceptable for environmental protection.

3. CONTRACTOR'S DESIGN WORKS

To the contractor, he shall ensure that his proposals, hereafter referred to as "**the Contractor's Proposals"**, comply fully with all the requirements stipulated in these tender documents hereafter referred to as "**Employer's Design Intent Requirements**"

The contractor shall be responsible for keeping the Client fully indemnified against any costs (liable for loss/damage or cost incurred for the works) arising from any inadequacy, errors, defects in the contractor's proposals. The contractor shall also responsible for engaging suitably qualified design professionals to carry out his design obligations & ensuring that the Contractor's proposals are endorsed and/or supervised by Professional Engineers.

It shall be at the entire discretion of the Employer whether or not to accept or approve the contractor's proposals. Such approval, permission where given shall relieve or discharge the contractor from his responsibility for the fitness of the employer's design intent requirements under the contractor's obligation under the contract.

The employer may appoint his own design consultants to continue with the design of the design of the works and to act as consultants for the works.

The contractor shall be deemed to have warranted that the contractor's proposed design/or any modifications to the original design is fit for its intended purpose and is to the level or standard normally expected of such a development. The contractor shall take full responsibility for the adequacy, suitability, integrity, durability and practicability of their proposed design.

Failure to achieve guaranteed performance/or any part of the works fails when tested, the contractor has to repair all the defects at his own costs (No extension of time shall be allowed).

4. Project Management

a. Adequate project management team shall be assigned for the specific engineering works for the MVAC system.
b. All approvals shall be submitted through Charted engineers' recommendations.
c. Minimum work force shall be recommended as follows and contractor shall be assigned same throughout the project implementation and as recommended by the Engineer

No	Designation	Qualification and Experience	Deployment	No
1	Charted Mechanical Engineer in similar experience.	10 years	Part time	1

2	Mechanical Engineer	BSc Eng./5Year	Full time	1
3	Technical Officer	NDT/HNDE/TTI	Full time	2
4	Skilled labor	German tech or similar qualification	Full time	4
5	Semi-skilled labor		Full time	6
6	Unskilled labor		Full time	6

d. Project monitoring meeting shall be conducted in the site and report shall be submitted to the Engineer once in week.
e. Site meeting shall be conducted daily at site and report shall be submitted in following day.
f. Project shall be implementing as per the scheduled and delay shall not be entertained due to any reason without valid justification.
g. All the staff of the manufactures and the contractor shall submit the safety procedure and follow the same to meet safety standards of the site.

SPECIFICATIONS

Specifications are categorized into two sections. The General Specifications and the Particular Specifications, which together governs, comprise the specifications governing the works of the Contract.

GENERAL SPECIFICATIONS

The publication listed under general specification, form a part of the specification to the extent indicated by the reference thereto.

Reference to forms and standards, codes, specifications and recommendations shall mean latest edition of such publications adopted and published at the date of invitation to submit tenders.

PARTICULAR SPECIFICATIONS

Particular Specifications have been specially drafted to suit the requirements of this particular project.

In case there are any discrepancies between General Specifications and Particular Specifications, the Contents in the Particular Specifications shall govern.

GENERAL SPECIFICATIONS

Federal Standard No.141A

Paint, Varnish, Lacquer and related materials, Methods of inspection, sampling and testing.

National Fire Protection Association (NFPA)

No.90A - Ventilation systems
No.90B - Air conditioning systems and warm water air heating

American National Standard Codes

ANSIB 31.5 - Refrigeration piping

ASHARE - American Society of Heating, Refrigeration and Air Conditioning Engineers Handbook and product directory, equipment 36

British Standards

BS 5720 - Code of practice of Mechanical ventilation and Air conditioning in building (formerly CP 352)

BS 4485 - Water Cooling Towers

BS 3958 - Insulation materials: Insulating materials that contain and/or require the use of CFCs in their manufacture, shall not be used. Flexible closed-cell insulating material shall be elastomeric expanded nitrile rubber and shall achieve Class 0 rating (the Building Regulations).
The outer surface shall be of smooth finish. The inherent vapour barrier shall be maintained at all joints Properties shall be: Bulk Density (nominal) 50-120kg/m3 Thermal Conductivity (maximum) 0.041 W/m K (20°C mean temperature).
BS 476 Part4 Unless otherwise indicated thermal insulating materials used within any building shall, when tested in accordance with BS 476: Part 4, be classified non-combustible. Insulation facing materials shall be inherently noncombustible. Thermal insulating materials used within any building shall be free from substances which, in the event of fire would generate appreciable quantities of smoke or noxious or toxic fumes.

BS 5493 - Code of practice for protective coating of Iron and Steel structure against corrosion

BS 5500	-	Welding and heat treatment of all pipes joints
BS 4941	-	Motor starters and controllers
BS 4999	-	General requirements for rotating electrical machines
BS 5486: Part 1:1977	-	Specification for factory built assemblies of switch gear and IEC 60439 control gear
BS 5467	-	XLPE insulated standard copper cable (armored/non armored) for Air conditioning & ventilation equipment power supply
BS 6346	-	PVC insulated stranded copper cables armored/unarmored 600/1000 V for power supply to Mechanical equipment
BS 7430:1991 (FormallyCP1013:1965)	-	Code of practice for Earthing

A R I Standard

550 - 92	-	Manufacture of chillers
550 – 88	-	IPLV performance

IEE Standard

IEE – 17th Edition of IEE wiring regulations

Pipe Bending

ICTAD Publication No.	Description
SCA/4(Vol.1)	Specification for Building works Vol.1
SVA/4/(Vol.II)	Specification for Building works Vol.II
SC/A8	Specification for Electrical & Mechanical works associated with Building and Civil Engineering
SCA/3/2	Specifications for Water Supply, Sewerage and Storm Water Drainage

Other Acceptable Standards

Standards and publications not listed may be used after obtaining written approval from the Engineer.

Note:
The Tenderers are expected to be conversant with the above documents. Therefore, the said documents are not being issued to the Tenderers under this Tender.

TECHNICAL SPECIFICATIONS

1. SCOPE OF WORK

Tenders are hereby invited for the Design, supply, installation, testing & commissioning of air conditioning system including chillers, cooling towers, chilled water pumps, condenser water pumps, AHUS & FCUs etc. for Proposed Navigational Service Complex at CIAR in conformity with the specifications & drawings issued.

The ceiling for the building is not available. Services shall be arranged properly using a color-coding system.

2. CHILLER PLANT

No. of units - 02 Nos. water-cooled step less variable speed oil free magnetic levitation centrifugal 300 RT capacity electrical chiller.

2.1. Capacity

Capacity of each chiller is 300 RT at 12 °C / 7 °C

2.2. Refrigerant

The refrigerant shall be non-CFC type and preferably be R-134a or latest. The chillers shall operate on environmental friendly refrigerant.

However, the type of refrigerant is to be reviewed in accordance with the Montreal Protocol Unit of the Ministry of Forestry & Environment of Sri Lanka.

2.3. Quality Assurance

A. Chiller manufacturer should have been manufacturing chillers utilizing magnetic bearing, oil free technology for more than 15 years across the globe with at least few International Airports using this technology.

B. There should be at least one local reference for the same technology chiller with similar or higher capacity for a minimum of 10 years.

C. Chiller Origin & Manufacturing should be Europe/ USA/ Australia/ Japan/Canada.

D. Chiller manufacturer plant shall be ISO 9001 and14001 Certified.

E. The chiller shall be factory tested at the manufacturer's plant prior to shipment. Testing shall perform on AHRI certified test stand.

F. Proposed chiller make should have authorized local agent in Sri Lanka for supply, installation and maintenance.

G. The local agent shall have at least 05 years of experience in supply, installation and maintenance of these chillers in leading projects in Sri Lanka.

H. Chiller local agent should maintain an adequate spare parts stock for the relevant chiller model.

I. The contractor should have in house maintenance capabilities with more than ten years of track records which can response within 04 hours.

2.4. Part Load Performance

The automatic capacity control of centrifugal compressor shall be as follows:

Capacity control of the chiller shall be achieved by variable inlet guides vanes operating through arc of 90 deg. or other appropriate capacity control device(s) as recommended by the manufacturer. This shall provide continuous modulating control from 100% to 10% of full load without surging for excessive vibration.

Variable inlet guide vanes shall be made of stainless steel or nonferrous alloy supported by high-quality, heat-treated solid stainless steel or nonferrous alloy shafts. Approved type positive seal shall be used at points where the vane-operating mechanism transmits motion to the linkage.
The inlet guide vanes shall provide a progressively and increasing swivel to the suction gas as load decreases to improve part load efficiency.

1. Minimum Integrated Part Load Value (IPLV) shall be 11 KWR/KW

2.5. Equipment details

The chiller unit shall be with an integrated Variable Speed with electronic expansion valve with lubrication and control system, factory mounted starter, evaporator, condenser, and any other components necessary for a complete and operable chiller package.
In VSD harmonic distortion to meet IEEE 519 with input of VSD, harmonic filtration is must to reducing harmonic distortion to less than 5% THD. Electrical components shall be housed in enclosures subjected to relevant standards.
The chiller should be able to perform rapid restarts after a momentary power loss occurs during the operation.
The chiller should ensure the stability while instantaneous load changes up to 50%.
The chiller shall be provided with a factory installed 10" LCD touch screen with access to inputs and operating information via the LCD touch screen display which uses full text display.
The chiller control system shall have high level interface with Automatic Control and Monitoring system and the protocol shall be Bacnet TCP IP. Further, refer to the Automatic Control and Monitoring system's point list and indicated points related to

chillers shall be fulfilled and if any additional points there, even those shall be given in proposed chillers. All Diagnosis alarms as well as the dedicated code for the occurring faults relevant to chillers shall be communicated to the Automatic Control and Monitoring system.

Automatic Tube Cleaning system in each chiller shall be communicated with the Automatic Control and Monitoring system as well (high level communication or low level communications).

Chiller capacity selection shall be based on a condenser water side fouling factor of 0.0440 m2K/kW in the evaporator tubes and 0.0180 m2K/kW in the condenser tubes.

Evaporator shall be shell and tube type design. Condenser and evaporator pressure drops of chillers are below 33kPa at designed full load water flow conditions shall conform to ASME Boilers and Pressure Vessels Code, for design and fabrication of pressure vessels for manufacture of tubular heat exchanger and heat exchanger shells as applicable.

The oil filter should be more efficient, the efficient can reach to 99.98% to remove the oil before the refrigerant enters the heat exchanger.

2.6. Chiller mounted instrument panel

- Chilled water & Condenser water temperatures - entering and leaving
- Chilled & Condenser water flow rates
- Refrigerant pressures - evaporator and condenser
- Motor power for individual compressors and all compressors
- Motor current for individual compressors and all compressors
- % Motor current
- Operating hours
- Number of compressor starts
- Saturation temperatures - evaporator and condenser
- Discharge temperature

2.7. Chiller Management System

Chiller Management System connecting chillers, chilled water pumps, condenser water pumps and cooling towers to be offered with the chiller to improve energy efficiency and energy savings. High Level Interface connectivity for the Building Management System from the Chiller Management System.

2.8. Safety Cut-outs and indications

Following chiller protection shall be provided

- Loss of refrigerant charge.

- Low chilled water temperature.
- Power supply error.
- Compressor motor thermal or electrical overload.
- Phase loss.
- High pressure.
- Low pressure.
- Loss of chilled water flow – (interlock to external flow switch).
- Loss of condenser water flow - (interlock to external flow switch).
- Anti-freezing cut off

2.9. Vibration and Noise

Vibration and noise control of equipment installed is of prime importance. The Contractor is required to pay special attention to the problem of vibration and noise and he is to guarantee that the installation will not generate vibration or noise of the intensity to cause annoyance to occupants in the area.

The noise & vibration in the offices neighbouring the Plant Room shall be conforming to BS 5228 of 1984. National building code 35-40 dB (A) corresponding to NR 30 as per ISO.

2.10. Compressor Units

Chiller's compressor-motor assembly can be either semi-hermetic. The compressor(s)-motor assembly that are being offered, Centrifugal shall comply with its respective specification stated below:

i. Compressor shall be of the semi-hermetic.
ii. Compressor shall be of the centrifugal type with the required number of stages.
iii. Impeller shall be made of nonferrous, fully shrouded, cast aluminium alloy or approved equivalent material. Each impeller shall be individually over-speed tested and dye penetrated tested before mounting on the shaft.
iv. Compressor assembly, impeller shafts, bearings shall be statically and dynamically balanced and tested to minimum 20% over-speed.

2.11. Harmonic Suppression

Shall comply harmonic mitigation standards mentioned above and Harmonic Distortion of Output Current and Voltage shall be 5% or less at nominal load

2.12. Chillers shall be fitted with the following components:

- 100 mm diameter suction and discharge pressure gauges, siphons and cocks. /Thermometers
- Flexible connections on inlet and outlet.
- Isolating gate valve on inlet and outlet.
- Water balancing Valve with measuring ports
- Vibration isolators below pump bases

2.11.1. Automatic Condenser Cleaning System

It shall be mechanical type condenser cleaning system which is recommended by the chiller manufacture. Automatic tube cleaning system shall be suitable for the water-cooled chillers complete with an injector, ball trap, injection valve, Drain valve, Ball valves, Check valves with necessary interconnected piping & fittings. The tube cleaning system should be a stand-alone system and shall not use any additional circulation pump. It should have intelligent integrated feature to monitor the approach temperature of the chiller to optimize the chiller efficiency and unnecessary energy consumption and maintenance.

2.13. Refrigerant pump out and storage system

The chiller shall be supplied with pump out condensing unit in par with the specifications of chiller. This refrigerant recovery unit shall be able to handle the total refrigerant volume of one Chiller.

2.14. Electrical Wiring

The contractor shall furnish and install components and wiring in accordance with the requirements and fully conforming to 17th edition of the IEE wiring regulations.

The cabling work shall be done to a standard using steel conduits, cable ladders, cable trays, cable ties etc. All cables shall be colour coded and numbered at each end. The switch board equipment such as main MCCB shall be rated as per B.S. 4572PT1. All metal parts of the installation shall be connected to the main earthing terminal as per CP1013 code of practice of earthing of British Standard Institution. All cables used for the installation shall be with standard copper conductor as per B.S. 6004.

2.15. Quality Standards

Chiller performance shall be rated in accordance with ARI standard 550-92.

Equipment and installation shall be compliance with safety code for ASHRAE 15 or EN 60204 - 1.

Cooler and condenser shall be proof tested on refrigerant side and leak tested with a refrigerant tracer gas. The waterside of heat exchanger shall be hydrostatically tested at 1.5 times the rated working pressure. All testing procedures shall comply with ASHRAE or European testing standards.

2.16. Factory Acceptance and Testing

Provision should be arranged for two AASL Engineers to witness Factory Acceptance Test of one Chiller at the manufacture's facility. All expenses shall be born by the Contractor.

Following performance tests are to be done for a one of chiller at manufacture's facility.

1. IPLV value confirming to the specification

All Equipment shall be connected to power distribution points of the Electrical Panels. All electrical wiring from power distribution points to Equipment shall be done according to IEE regulations, and shall include all necessary accessories. Commissioning test shall be carried out at the site in presence of AASL Engineers.

2.17. Training

a. Provision for four (04) AASL technical personnel for training on special features and differences, testing and commissioning etc. of the latest equipment to be procured of Manufacturer's facility Centre as specified blow not less than 24 hours theoretical and practical. All expenses shall be borne by the Contractor.

b. Provision of training to recommended AASL staff based on the followings.
   - Operation & maintenance.
   - Specific energy conservation techniques.
   - Fault diagnosis & rectification.
   - Operation & maintenance of VSD & control equipment.

2.18. Guarantee and Warranty

The contractor shall guarantee the equipment to be brand new and to be free from defects in materials, workmanship and satisfactory functioning under the normal use of service for a period of 02 years from the date of commissioning the air conditioning system. Minimum warranty period for the compressor shall be 5 years from the date of commissioning.

3. COOLING TOWER

3.1 General

(i) Cooling towers shall be open type, cross flow, factory or field assembled of super (ultra) low noise level standard and shall consist of tower body, pan, fan, motor and accessories.

(ii) All materials used for the cooling tower shall be non-inflammable as far as possible.

(iii) Average loss value for one cooling tower under normal condition shall be below 1% of cooling water circulation volume.

(iv) The normal service life of the cooling tower shall be ≥20 years

3.2 Tower Body

(i) The tower body shall be made by glass fiber reinforced polyvinyl chloride sheet, or rigid polyvinyl chloride sheet.

(ii) The structure of tower body shall be provided with access openings for inspection, easy maintenance and cleaning inside.

(iii) Water distribution device shall be made of stainless steel (SS304) sheet or FRP and the water spray distribution should be uniform.

(iv) The louver or wire to be set at the air inlet shall be the same materials above or rigid polyvinyl chloride, and the airflow should be well ventilated, and should not have water spray out

(v) The structure of the filler shall be provided to make sure that the water flow in the filler is equally distributed.

(vi) The external surface of the tower has a uniform gelcoat layer, and the fiber parts are made of water-resistant resin and alkali-free glass fiber raw materials. The surface should be smooth, crack free, uniform color, excellent strength, UV proof, easy maintenance and long service life.

(vii) The structure of the tower, all the steel material skeleton should be hot-dip galvanized treatment, galvanized layer thickness 50 ~ 70μm, the size of the bearing frame inside the tower shall not be less than 100mm×50mm, and the thickness shall be ≥2mm.

(viii) All the parts connected to the FRP parts shall be rubber, gasket and waterproof sealing belt to ensure no water seepage.

(ix) The fan stack is equipped with a fan guard to prevent foreign bodies from falling and protect the motor and fan.

(x) The fan stack shall be made of fiberglass-reinforced polyester with radius or cone inlet shape made of synthetic resins, or stainless steel (SS304) sheet. When multiple towers are combined, there must be a partition between the two towers to completely separate the air chamber to prevent airflow short circuit and backflow.

3.3 Pan

(i) The pan shall be constructed of stainless steel sheet (SS 304) or FRP.

(ii) The pan shall consist of drain pipe, overflow pipe, and make-up water pipe. The water inlet shall be provided with wire that is made of stainless steel (SS304) sheet or steel or synthetic resins for removing dust.

(iii) Low/ High water levels to be monitored through BMS.

3.4 Fan

(i) Fan shall be heavy-duty axial propeller type statically balanced.

(ii) Fan shall be heavy-duty propeller type or axial airfoil type, must be tested for dynamic and static balance.

(iii) Fan guard shall be stainless steel (SS304) sheet, or synthetic resins.

(iv) The casing material shall be the same as the tower body.

(v) The propeller shall be made of steel with hot dip galvanizing or aluminium alloy or synthetic resins or FRP.

(vi) The assembly mode of blade and wheel hub is static adjustable, and the bidder shall provide blade Angle positioning tools with the goods. The blade Angle can be adjusted according to the actual working conditions to ensure that the fan runs in the high efficiency zone.

(vii) The clearance between the wing tip of the fan blade and the inner wall of the tower should be uniform, and its value should not be greater than 0.008D (D is the diameter of the fan) to ensure that the blade and the wind duct do not collide.

(viii) Before the fan is assembled, the blade and hub of the fan should be tested for dynamic and static balance, and G6.3 grade should be taken according to the balance accuracy of the rigid rotor. Blades should be positioned and numbered after balancing.

(ix) The blades angle shall can be adjusted, low noise, high efficiency, large air volume, energy saving, long service life and other performance.

3.5 Motor

(i) Motor shall comply with British Standard.

(ii) The motor shall be a fully enclosed self-cooling low noise cooling tower special motor, three-phase squirrel cage type, motor protection level is not less than IP55, insulation class F.

(iii) The motor shall have the function of phase loss protection. The rated load of the motor should meet the needs of the corresponding equipment to start and run at full load, the normal service life is more than 15 years. The service life of the bearing is not less than 20,000 hours in normal operation.

(iv) The motor brand is Marathon, WEG, ABB grade and above products.

(v) Efficiency class IE3 or above

3.6 Infill

(i) The packing is made of PVC100% pure material, vacuum blister molding, hanging type, with the function of water collection, wind conduction and heat dissipation.

(ii) Infill shall be flame retardant; oxygen index is greater than or equal to 32.

(iii) The normal service life is more than 10 years.

(iv) Easy to install and clean hanging mounting method; After the packing is installed, the gap is uniform, the top surface is flat, there is no collapse and lamination phenomenon, and the packing sheet should not be perforated and broken.

(v) The packing should have good thermal performance and resistance characteristics, high temperature resistance (no geometric deformation at 55℃), low temperature resistance (no rupture and no brittle-cracking at the design minimum temperature), long service life, and long-term operation at

50℃ water temperature; The hydrophilicity of the packing should be able to meet the requirements of the cooling capacity of the cooling tower.

3.7 Bearing

(i) Adopt belt reducer, reducer should be equipped with high-quality bearings.

(ii) The bearing must be sealed completely in the belt box, the belt box protection level shall reach IP55, and the third party test report shall be provided.

3.8 Belt

(i) Use efficient and strong V-shaped triangle belt drive.

(ii) The pulley is made of anti-corrosion material, wear-resistant, oil resistant, water resistant, aging and chemical resistant, not easy to stretch, good deflection performance, good smoothness, large transmission power, high efficiency, fast heat dissipation and long service life.

3.9 Safety and maintenance equipment

(i) The structure of tower body shall be provided with access door, maintenance access, work platforms and internal ladder to easy maintenance and cleaning inside.

(ii) The size of safety access door shall not be less than 1020mm×620mm.

(iii) The maintenance walkway (width: 400mm) is set inside the tower, and the ladder to the top is set outside the tower.

3.10 Painting

(i) Painting shall be manufacturers standard.
(ii) Steel parts shall generally be hot dipped galvanized.

3.11 Accessories

(i) Ball Tap (Float Ball)
(ii) Ladder and Hand Rail: stainless steel (SS304)
(iii) Foundations and foundations bolts (SS304)
(iv) Nameplate

3.12 Special Note:

- The Cooling Tower should be a CTI certified.
- The Cooling Tower should meet ASHRAE90.1-2016 standard.
- The cooling tower fan motor & condenser water pump motors shall be interlocked to chiller.
- Makeup water of the Cooling towers to be metered and need to monitor through BMS.
- Maintenance access/ work platforms are to be provided for easy maintenance.

3.13 Factory CTI Test

Provision should be arranged for AASL Engineer to witness CTI Test at the manufacture's facility. All expenses shall be born by the Contractor. Commissioning test shall be carried out at the site in presence of AASL Engineer.

3.14 Design Conditions

Ambient wet bulb temperature 28°C and dry bulb temperature 32° C.
Water flow rate, cooling water inlet and outlet temperatures to be matched with the chiller supplied.

4.WATER TREATMENT SYSTEM

a. General

The water treatment equipment shall consist of conductivity control equipment with plastic box for outdoor use, chemical storage tank and high performance chemical injection pump.

b. Fully Automatic Conductivity Control Equipment

The Conductivity Control Equipment shall be as follows

i. Power source: 1Ø 50Hz 85~250V
ii. Power consumption: Less than 10VA
iii. Electrode/cable length: 5 electrode method/5m
iv. Measurement range: 0~1,999 mS/m
v. Control Range: 100~1,200 mS/m
vi. Measurement Error: within ±10 % OR ±3m S/m of an indicated value
vii. Single Output: 4~20mA DC

c. Chemical Storage Tank

i. Capacity: 250 L
ii. Type/Material: Rectangular or Circular / Polyethylene
iii. Outer dimensions: 650 x 285 x 1000H (for reference)
iv. Accessories: Lead switch level switch, transparent PVC pump
v. Cover: Cover shall be manufacturer's standard

d. High Performance Chemical Injection Pump

i. Power Source: 1Ø 230V 50Hz
ii. Capacity: 38ml/min, 1MPa
iii. Stroke : Stroke of slide: 0 to 100 %,
iv. Stroke per min.: 0 to 360 spm
v. Type: Electromagnetic driving diaphragm type
vi. Connecting tube: Ø4 x Ø6 polyethylene tube with a siphon backstop chuck valve

e. Chemicals Dosing for Cooling Tower Water Quality

i. The contractor shall collect and analyze the proposed make up water system and shall also study the specification of the cooling water system. From this information, the Contractor shall propose a suitable and comprehensive water treatment chemical for the proper, efficient and economic operation of the cooling water system.

ii. The water shall be introduced through a water meter coupled to a chemical injection pump so that the precise quantity of chemical required is injected.

iii. Automatic blow down systems shall be incorporated and monitored through BMS.

5.CONDENSER PUMP COMPLETE WITH STARTERS

The condenser pump shall be single stage end suction type/ inline type, capacity to match the chiller and the cooling tower system when operating at full capacity. Minimum overall efficiency of the pump shall be 75%.

The pump shall be equipped with shut off valves on either side and a non-return valve for the discharge side Strainer on inlet. The pumps shall be non-overloading and continuous rated. The nominal rates and dimensions shall comply with ISO 2858. The faces of the shaft seal of the pump shall be Tungsten Carbide. The impeller and shaft shall be made out of stainless steel.

The pump motor shall be controlled with VFD (If VFD fails, pump starting through Soft Starter with suitable mechanical & electrical interlocks) fitted with over current protective devices. The starters shall be fitted in the chillers room.

The pump shall have water flow rate and head suitable to operate with the chiller system at full load condition continuously. Necessary head calculations and selection criteria to be submitted for pump duty.

The water pump shall be installed with vibration isolators on a steel structure **treated for corrosion prevention**. Sufficient working space shall be maintained between the pumps to be installed.

The pumps shall be providing with strainer at its inlet, gate valves on supply and return lines and non-return valve on its discharge line.

All equipment shall be connected to power points at the central panel. All electrical wiring from power point to equipment shall be done according to IEE regulations, and shall include all necessary starters, MCCB, conduits, etc.

Data to be furnished

Make, Model, Design capacity, Total head, shut off head, Hydrostatic test pressure, Pump efficiency at duty point, Power input at duty point, Motor efficiency at duty point, rated speed, NPSH required, Details of material of construction, Orientation and size of suction and discharge nozzle, Impeller type, Pump weight.

5.1. Maintainability

The assembly of pump and motor shall be installed in such a way that either motor or pump shall be easily removable for maintenance.

6.CHILLED WATER CIRCULATING PRIMARY PUMP WITH MOTOR

The condenser pump shall be single stage end suction type/ inline type, capacity to match the chiller system when operating at full capacity. Minimum efficiency of the pump shall be 75%.

The pumps shall be non-overloading and continuous rated. The nominal rates and dimensions shall comply with ISO 2858. The faces of the shaft seal of the pump shall be Tungsten Carbide. The impeller and shaft shall be made out of stainless steel.

The pump motor shall be controlled with VFD (If VFD fails, pump starting through Soft Starter with suitable mechanical & electrical interlocks) fitted with over current protective devices. The starters shall be fitted in the chillers room.

The pump shall have water flow rate and head suitable to operate with the chiller system at full load condition continuously. Necessary head calculations and selection criteria to be submitted for pump duty.

The water pump shall be installed with vibration isolators on a steel structure **treated for corrosion prevention**. Sufficient working space shall be maintained between the pumps to be installed.

The pumps shall be providing with strainer at its inlet, gate valves on supply and return lines and non-return valve on its discharge line. All valves and connection fittings sizes should be match with site pipe sizes.

All equipment shall be connected to power points at the central panel. All electrical wiring from power point to equipment shall be done according to IEE regulations, and shall include all necessary starters, MCCB, conduits, etc.

Data to be furnished

Make, Model, Design capacity, Total head, shut off head, Hydrostatic test pressure, Pump efficiency at duty point, Power input at duty point, Motor efficiency at duty point, rated speed, NPSH required, Details of material of construction, Orientation and size of suction and discharge nozzle, Impeller type, Pump weight.

6.1. Maintainability

The assembly of pump and motor shall be installed in such a way that either motor or pump shall be easily removable for maintenance.

7. ELECTRICAL POWER AND CONTROL PANEL

7.1. A Main Power and Control Panel shall be provided for the smooth operation of air cooled packaged unit. It shall comprise all the equipment material and accessories necessary for proper operation and control functions of the Air Conditioning System such as Main Incoming MCCB, properly rated (sized) bus bars, outgoing MCCB's, star delta starters, soft starters, electrical & mechanical interlocking circuits & devices, indicator lamps to slow the status of Advanced power quality meet (Main meter Third-party certified at Class 0.1S and as a power quality instrument (PQI), the PowerLogic ION9000 Complies with recognized power quality monitoring standards: IEC61000-4-30 class A, IEC62586-1 / IEC62586-2, and verified by third-party lab certifications. Patented disturbance direction detection, extended waveform capture (0.5s pre-event data / 2.5s event data @1024 s/c) and high speed RMS data capture for in-depth analysis of any PQ disturbance in electrical system, DPA Power Analysers Measurement accuracy IEC 61557-12: PMD/[SD|SS]/K70/1, Display type LCD display: Monochrome graphical LCD, R.Y.B. Phases – ammeters, voltmeters and their selector switches, current transformers, fuses, phase failure relays and earth fault relays with shunt trips etc. and the list is not exhaustive.

7.2. IEEE 519-1992, Section 10.1: Point of Common Coupling Harmonic. Within an industrial plant, the PCC is the point between the nonlinear load and other loads.

7.3. At the PCC of MVAC Main Power and Control Panel, Motorized valve operation panel, Chiller, CHW Pump, PAHU control panels Power, CW Pump & Cooling Tower Power Panel MCC, in all these THD level shall be maintain as per the IEEE 519-1992 and application shall be specially considered for Airports.

7.4. It is the responsible of the AC Contractor to lay and terminate at both ends the incoming cable (sizes shown in the SDB – non essential single line diagram) on a cable tray suitably sized with all necessary accessories as per recommended installation practices.

7.5. While designing all relevant DBs, Motor control centres, (MCC) etc, related to the MVAC system, shall be coordinated with the BMS contractor as well. Due to confirmation of the Automatic Control and Monitoring system's requirements.

7.6. It is also the responsibility of the AC Contractor to propose get them approved by the Engineer and install, test and commission the power supply feeders, switch gear, etc. to all the mechanical (A/C) Equipment from the Main Power Control Panel to be installed by him.

8. SPECIFICATIONS OF EXTRACTOR FANS :-

8.1. Wall Fans

Wall fans complete with steel frame, guards, insect screens and automatic shutters and operate the room light switch.

The motor shall have splash proof protection and class 2 insulation. Neon light indicator shall be provided on the face grille for identification of run condition. Motor index of protection shall be IP55 and motor insulation class shall be of class F. The electric motor shall be fitted with internal thermal protection device to protect against abnormal overheating.

8.2. Axial Vane Fans

The Contractor shall prove direct-driven, manually adjustable or controllable pitch axial vane fans.

The motor shall be inside the fan housing. Fan rotor assembly shall be attached directly to the motor shaft, keyed to shaft and secured by ball bearing lock nuts and washers to prevent fan rotor from backing off shaft in case of motor reve

The fan shall be suitable for exhaust air supply application. The motor shall have splash proof protection and class 2 insulation. Neon light indicator shall be provided on the face grille for identification of run condition. Motor index of protection shall be IP55 and motor insulation class shall be of class F. The contractor shall submit fan and motor catalogues by giving evidence for this and ensure to select the fan motor according to that.

8.3. Centrifugal Fans

The fan shall be suitable for exhaust air supply application, Incorporating low weight metallic construction. The motor shall have splash proof protection and class 2 insulation. Motor index of protection shall be IP55 and motor insulation class shall be of class F. The contractor shall submit fan and motor catalogues by giving evidence for this and ensure to select the fan motor according to that.

9.DUCT WORK :-

Fresh air ducts to be sized by the Contractor and take necessary approvals by the Engineer with necessary calculations.

9.1. General

Duct work shall be constructed of galvanized sheet steel of minimum coating thickness of 275 gsm, unless otherwise approved, ducts shall accurately conform to the dimensions indicated and shall be straight and smooth inside, with joints neatly finished. Joints shall be made substantially airtight. Laps shall be made in the direction of airflow. Measuring holes with cover plates are to be provided for the use of Pitot Tubes, deflecting anemometer for measurement of air quantities. Such holes are to be provided at convenient positions to facilitate regulation of all branches and as may be required by the Engineer. Duct constructions, hangers and anchors shall comply with details outlined in ASHRAE, unless indicated otherwise. Sheet-metal ducts and stiffeners shall conform to table 1 and table 2 hereinafter.

Table 1 - Duct Thickness

Duct Size Largest Dimension (mm)	Steel Sheet Thickness (mm)
Less than 450	0.5
450 ~ 750	0.6
750 ~ 1,500	0.8
1,500 ~ 2,200	1.0
Over 2,200	1.2

a) Flanges shall be by structural steel conforming to JIS G 3191, G 3192 and G 3193.

b) Spacing of flanges shall be as shown in Table 52200.6

Table 2 - Flange spacing

Duct Size (largest dimension) mm	Size of L shape (mm)	Maximum Spacing (mm)
Less than 750	25 x 25 x 3	1820
750 ~ 1,500	30 x 30 x 3	1820
1,500 ~ 2,200	40 x 40 x 3	1820
Over 2,200	40 x 40 x 5	1820

c) Rivets for flanges to ducts shall be 4.5 mm diameter and 65 mm on centre maximum.

d) Bolts and nuts for duct flanges shall be as shown in Table 52200.7

Table 3 - Flange Bolts

Size of Duct Largest Dimension (mm)	Size and Spacing (mm)
Less than 750	8mm diameter x 100 mm O.C.
Larger than 750	8mm diameter x 100 mm O.C.

e) Reinforcing shall be provided at centreline and between flange joints, as shown in Table 52200.8

Table 5 - Duct Reinforcing

Duct Size (Largest Dimension) mm	Size of L shape (mm)
450 ~ 750	25 x 25 x 3
750 ~ 1,500	30 x 30 x 3
1,500 ~ 2,200	40 x 40 x 3
Over 2,200	40 x 40 x 5

f) Duct width or height 450 mm or above and not insulated shall be reinforced with reinforcing ribs spaced at 300mm on centre.

9.2. Rectangular Duct

a) Rectangular duct shall be suitable for a low velocity duct system and shall be fabricated at factory and/or at the Site.

b) Thickness schedule for galvanised steel shall be as shown in Table 52200.5

c) Duct construction shall be as follows:

i) Longitudinal corner seams : Pittsburgh lock or button punch

snap lock or equivalent.

ii)	Cross Joints	:	Transverse duct connector (TDC) or Angle Flange System for joint as required.
iii)	Joints in direction of flow	:	Permitted only when necessitated by the standard size of steel sheet, and shall be Acme Lock-Grooved Seam
iv)	Spacing of seams on the same plane	:	900mm minimum on centre and kept at least 300mm away from the site seam.

d) Duct bend construction shall be as follows:

i) Radius of duct bends shall be not less than 1½ times the width of the duct at centre line radius. When smaller radius is required, permission from the Engineer shall be obtained.

ii) Changes between sections of ducts shall be by gentle slope not greater than 15 degrees and where space requirements dictate, slope may be increased to 30 degrees but only when approved by the Engineer.

e) Turning vanes shall be provided according to the following requirements:

i) For all duct bends with largest dimension 460 mm and over and for all turns 45 degrees and over.

ii) For radius turns, single guide vanes shall be provided as shown on the Drawings.

iii) For square bends, air foil type double vanes manufactured specifically for purpose shall be provided and spacing shall be as shown on the Drawings.

f) Air extractors shall be provided for all branches from the main supply ducts to supply air diffusers and registers at right angles to air flow, and elsewhere when necessary. Extractors shall be standard product specifically designed for specified use, and types to provide uniform distribution of air throughout branch ducts or register openings with a minimum turbulence. Vanes of extractor shall be adjustable for all locations.

g) Template of each size for bend, elbow, etc. of the ducts shall be submitted to the AASL.

9.3. Hangers and Supports

a) The Contractor may at his option, use various hanger systems for ducts. All systems and components shall be approved by the Engineer prior to installation and shall be coordinated with the metalwork ceiling suspension system.

b) Hanger spacing shall not exceed 3.6 metres for 1,500 mm (maximum dimension) duct or smaller and 2.4 metres for over 1,500 mm (Rectangular ducts), and not exceeding 4.0 m (Spiral ducts).

c) Supports and hangers shall be steel angles the same as specified for duct flanges.

d) Hanger rods shall be provided and, where angle support is not the diameter shall be not less than 9 mm for 2,200 mm wide supports or smaller and 12 mm for over 2,200 mm wide.

e) All outdoor supports shall be made by hot dipped galvanized or SS 304.

9.4. Dampers

9.4.1. Fire Dampers (FD)

a) Construction shall be similar to volume dampers except where specified herein.

b) The blades shall be fixed in the fully open position by fusible links, to close automatically with parting of link, without outside operator.

c) Frame and vanes shall be made by sheet metal except thickness not less than 1.6 mm.

d) Inspection doors shall be provided to access fusible links from outside of duct.

e) Fusible link rating shall be as follows:

i) Kitchen exhaust and other dampers subjected to high temperature 120 ºC or above.
ii) All others shall be 72 ºC or above.

9.4.2. Volume Control Dampers (VCD)

a) The Contractor shall provide and install hand operated dampers where required for the proper regulation of the ventilating and air conditioning systems. In general, dampers shall be provided as follows.

i. In all main supply and exhaust air ducts, branches, supply air connections to fan coil units and all primary air supply outlets.

ii. Behind all supply and exhaust air diffusers/grilles or supply connection to grilles.

b) All volume dampers shall comply with DW/144 and shall be provided in separate purpose made flanged castings of rigid construction conforming to the same standards of air-tightness.

c) Materials for dampers in all cases are to be stainless steel or mild steel galvanized.

d) The damper spindles shall be provided with suitable seals when passing through the casing and penetrations shall be limited by the use of internal linkage.

e) Dampers up to width of 300mm in the plane of rotation shall be of butterfly type having blades of double construction fitted round a square mild steel spindle and the edges of blades folded and left smooth. Sides of blades shall be folded, left smooth, and in all cases shall be felt to give a good fit against sides of duct. The spindle shall be turned down at each end and be carried in substantial bronze bosses fixed to the sides of duct, with substantial cast quadrant piece in an accessible position and with means of clamping after adjustment.

f) Dampers on ducts larger than 300mm shall be of multi- leaf opposite blade type, mounted in built-up frames inserted in the ductwork and bolted thereto. Individual blades shall be as specified for butterfly dampers; each shall be carried on solid spindle with ends housed in bronze or nylon bushes. The group of blades forming the damper shall be linked to a hand operated mechanism, which shall be controlled by a quadrant in cases where the damper is accessible from ordinary working level and in all other cases, shall be provided with screw-operate remote-control gear with the winder at an accessible point.

g) After final testing and adjustment, all dampers shall be clamped in their correct positions which shall be marked on the quadrant in a permanent manner and stops fitted.

9.4.3. Modulating Dampers

a. Modulating dampers construction shall be the same as the volume dampers except multi leaf dampers shall be of parallel blade type.

b. Dampers required fully closed at any time shall be fitted with blade edge and blade end seals. Seals shall be of a standard such that total air leakage does not exceed 30, 40 and 52 l/s per m2 of damper area when closed against static pressures of 250, 500 and 1000 Pa respectively.

c. Blade seals shall be mechanically fastened in position. Seals which are glued on shall not be accepted.

d. Shafts shall be securely fixed to the centre of each blade.

e. Driven shafts shall run the full length of the blade and extend to provide suitable attachment to the drive motor.

f. Blade shaft bearing shall provide free rotation of shafts and shall be of brass or 'oilite' construction.

g. Bearings in fire smoke control dampers shall be sintered bronze, ball or roller type.

h. Dampers shall be interconnected to give the required parallel or contra rotating action.

i. Motors shall be rigidly mounted to prevent flexing and shall be linked to the driven blade shaft extension using suitable linkages. Maximum damper area per drive motor is 1.6 m2.

j. All modulated type dampers shall be controlled through the Automatic Control System. Also the compatibility shall be checked with Automatic Control System contractor, prior to proceed with procurement work.

k. Fresh air modulated type dampers (24V, 0-10VDC)related to the FCU/VRV shall be operated through (Control & Position)the Automatic Control System and the fresh air controlling mechanism shall be done base of the demand of the fresh air supply. Further, the fresh air supply demand shall be identified based on the operation of number of FCUs /VRV.

l. Once particular FCUs are shutting down, addressed MVCDs shall be shut-down. Meanwhile, the static pressure in the fresh air ducts will be increased and that signal shall be identified the installed air pressure sensors inside the duct and same required to be communicated to the Automatic Control System as well. Based on that, Command signal to ramp down the motor speed of particular PAHU's VSD shall be communicated through the Automatic Control System.

m. If the system is running under manual mode, VSD shall be setup by identifying the required minimum air flow rate to the system.

9.5. Air Outlets

(a) General

- All diffusers, registers, grilles, light troffer diffusers, linear diffusers and other air terminal fittings shall be an approved types as specified in the following clauses and as shown on the Drawings for the MVAC Systems. The Contractor shall submit for the Engineer's approval.

- The ceiling arrangement and type of tiles and suspension system, including type of air terminal fittings shall be checked before fittings are ordered.

- Volume control dampers of opposite blade type shall be provided behind all supply, return, exhaust and transfer air diffusers, registers and grilles to control the air flow rates. where flexible air ducts shall be used for the connection to the air outlets, they shall be dampered by butterfly dampers at the point of connections of the flexible ducts to the main ducts.

- Samples of each type of outlet to be provided shall be submitted for approval. The samples shall be supplied with the specified finishes and in the colours nominated and shall be retained until the completion of the project. All outlets installed shall match the samples provided in quality of finish and in colour.

- All volume controls where mounted behind grilles, registers and diffusers shall be finished in matt black paint.

- Opposite bladed dampers shall have blades linked together in sections for ganged operation from adjusting screws. Where opposite bladed dampers are mounted on the back of outlets or grilles, the screws shall be accessible through the blades of the outlet. Where the opposite bladed dampers are mounted in the duct spigots back from the outlets, then the screws adjustment from the outlets, then the screws adjustment shall be accessible by removing the registers or grilles.

- Outlets shall be fixed using concealed screws. Exposed fixing shall be rejected.

(b) Rectangular Supply Air Diffusers

- Rectangular ceiling air diffusers shall be of the adjustable multi- blade removable louvre face type with core designed to provide adequate air mixing without draught for either one, two, three or four-way discharge pattern. Each side of the diffusers shall supply the correct air volume for the space it serves. Ceiling outlets shall be suitable for mounting in place of ceiling tiles on ceilings suspended by exposed T-bars, and shall otherwise be suitable for surface mounting on the particular type of ceiling involved.

- Diffusers shall be of aluminum construction finished in colour anodized according to the Engineer's instruction and approval.

(c) Side Blow Supply Air Grilles

- Side blow supply air grilles shall be of the flange mounting type with horizontal adjustable louver blades in front of vertical louvre blades, unless otherwise shown on the Drawings.

- Frames and deflecting vanes shall be constructed from extruded aluminium finished in colour anodized according to the Engineer's instruction and approval.

- Grille sizes specified on the Drawings are the neck sizes of the core or element, and openings for grilles shall be subject to Engineer's approval.

(d) Linear Supply Air Diffusers

- Diffusers shall be constructed of extruded aluminium with fully adjustable air pattern controlling vanes for active sections and blanking panels for inactive sections. Diffusers shall be flange type.

- Each length of diffuser shall be installed without any visible means of fastening and shall incorporate an aligning device to permit long lengths to be aligned neatly.

- Diffusers shall be 2 slots (20mm per slot) unless otherwise specified on the Drawings.

- Air shall be supplied to the active lengths of each diffuser via plug in diffuser boots or plenum with spigots for round flexible duct connections. Boots or plenums shall be externally insulated. Each boot or plenum shall be fitted with butterfly dampers. Dimensions of boots or plenums shall be as shown on the Drawings.

- The linear diffusers shall be extruded aluminium with anodised finish to the Engineer's instruction and approval unless otherwise indicated on the Drawings.

- All internal surfaces that are visible from below shall be painted matt black.

(e) Return Air, Exhaust Air and Transfer Air Grilles

- Grilles shall consist of extruded aluminium horizontal louvers fixed securely in an aluminium frame with flanged surround. They shall be of the single louvre type and shall fit tightly into the frames and unsupported blade lengths shall not exceed 300mm.

- Where wire mesh grilles are specified in the Drawings, they shall be constructed of mild steel wire at 12mm apart at each direction and weld to each other and fixed to the mild steel frames. The grilles shall be galvanized after fabrication and painted to the Engineer's instruction and approval.

(f) Louvres

Where internal/ external louvers are shown on the Drawings to be provided and installed by the builder. This Contractor is responsible to provide the dimentions of louvre and submit for Engineers approval.

All louvers shall be of the weatherproof type, formed from extruded aluminium sections contoured to prevent the ingress of water during typhoon conditions and shall have detachable aluminium 13x13mm, 10mm diameter wire bird screen fitted on the rear face.

Louvres shall have an anodized finish of a colour approval by the Engineer.

Where the total louvre area exceeds 4m2,the louvre shall be made up of individual sections mounted on a rigid steel supporting structure spanning the opening. The Contractor shall provided the external frame and supporting steelwork.

The total free area of any louvre shall not be less than 50% of the face area indicated on the Drawings and the pressure drop through any louvre shall not exceed 25 pa unless otherwise specified.

All external louvers shall be protected internally with security bars.12mm steel bars at 50mm centres shall be mounted in a steel frame with 6mm cross breaking on spans over 1000mm. All external louvers shall be corrosion resistant and suitable for Maldives climatic conditions.

9.6. Test Points

Test points for measuring air flow shall be provided at the following locations:

(a) At all fans (in the straightest section of duct near to the outlet).

(b) At main branches after regulating dampers.

(c) At cooling coils, heater batteries (both before and after the coil or battery).

(d) Any other position indicated on the Drawings.

The location of these holes shall be confirmed by the Engineer

On insulated ductwork, these holes shall be boxed out for the thickness of the insulation.

Test holes shall be 25mm diameter and fitted with an effective removable seal.

9.7. Installation of Duct Work

9.7.1. All duct work shall be erected in a first-class and workmanlike manner, true to dimensions indicated, straight and smooth on the inside, with neatly finished joints lapped in the direction of air travel. Properly brace and reinforce all ducts with steel angles or other members. All duct work shall be of galvanized sheet steel unless otherwise specified or indicated. Fabricate changes in direction, both full radius bends, or fixed turning vanes in square elbows. Seal around frame of control dampers with duct sealant to make airtight.

9.7.2. Changes in duct size or shape necessitated by interference with other work shall be made using sized of equivalent friction loss.

9.7.3. Where pipes, structural members or other obstructions pass through ducts, provide a streamlined sheet metal collar around member and increase duct size to maintain net area. Fit collar and caulk to make airtight. This is expressly permitted only after consultation with and the approval of the Engineer.

9.7.4. Rectangular Duct Work

9.7.5. Round Duct Work

Beaded crimp slip joints with 13 mm. long sheet metal screws equally
Spaced a maximum of 120 degrees apart or 300mm. whichever is limit is less.

9.7.6. Sealing of Joints

Seal all joints and seams of low-pressure duct work with fire resistive and UL approved 6 kg/m2 asbestos tape, 75 mm. wide. After duct sections have been joined with mechanical fasteners, joints shall be aped with an approved waterproof duct tape. Final layer of sealer to be applied over duct tape shall be Tuff-Bond No. 12, or approved equal.

9.8. Cleaning of Internal surfaces of Ducting

Internal surfaces of all ducting shall be cleaned to remove any accumulated debris and treated to prevent microbial growth.

10. SPECIFICATIONS FOR FAN COIL UNITS

10.1. Basic units shall be heavy gauge galvanized steel, reinforced and welded. Interior parts exposed to moisture shall hot dip galvanized steel. Casing shall be acoustical and thermal insulated with glass filter blanketed material.

10.2. Coils shall have aluminium fins mechanically bonded to copper tubes. Return connections shall be fitted with manual air vents.

10.3. The auxiliary drain pans shall be hot dip galvanized and shall be insulated to prevent sweating. All end pocket piping, service and temperature control valves shall be insulated.

10.4. Fan wheels shall be centrifugal, forward curved, double-width type.

10.5. Four-way air distribution

10.6. Compact unit with easy maintainability of fan motors, coil assembly & condensate pan assembly.

10.7. Return air filters should be easily removed & cleaned.

10.8. The filter shall be concealed from sight and removable without unlocking the unit front panel. Filters shall be permanent washable aluminium mesh type panel filters or approval equal.

10.9. All motors shall be three speeds, 230, volt, 50 cycles, single phase, long life, and permanent split capacitor type with permanent lubricated ball bearings. All motors shall have integral overload thermal protection.

10.10. All Fan coil units, fans should have three Speed function mode with On/Off facility with Chilled water control valve.

10.11. All FCUs shall be wired controlled and the temperature should be monitored through BMS.

10.12. Each fresh air outlet which is connected to the occupant space shall be connected with motorized damper which communicates with FCU in the occupant space. When FCU is turn off, respect motorized damper shall be closed.

10.13. All FCUs shall be connected with Pressure Independent Control Valves (PICV) with valve assembly. Valve assembly shall be defined under the PICV.

10.14. All FCU related Thermostat Wired type should have three Speed function mode and for 2-position on/off actuator (Chilled water control valve) (2-wire) PICVs are On/Off type and the spec of each as 230VAC signal.

10.15. FCU6s which are located in equipment rooms shall be precise temperature & humidity control type.

10.16. All FCUs must be communicate with the Automatic Control and Monitoring system (BMS) with Modbus RTU communication. Shall have facility of On/OFF, temperature settings, Room temperature, false alarm & etc.

Types of FCU

All FCU capacities shall be match with specified design condition.

1. FCU1 – Ceiling Cassette Type – 9,000 Btu/hrs
2. FCU2 - Ceiling Cassette Type – 12,000 Btu/hrs
3. FCU3 – Ceiling Cassette Type – 18,000 Btu/hrs
4. FCU4 – Ceiling Suspended Type – 18,000 Btu/hrs
5. FCU5 – Ceiling Suspended Type – 24,000 Btu/hrs

6. FCU6 – Floor Standing Tower Type– 60,000 Btu/hrs (Precision type including humidity controller)
7. FCU7-Wall Mounted Type-9,000 Btu/hrs

11. PRIMARY AIR HANDLING UNITS (PAU)

a) PAU shall be floor mounted, draw through units consisting of a fan section, cooling coil section, air filter section and accessories.

b) Each section shall be tightened by bolts and mounted on a common base frame.

c) PAU shall be mounted on minimum100mm high concrete foundations.

d) The main components shall be as follows:

i) Casing

- Casing wall shall be 50mm thick double skin panel.
- Casing frame shall be assembled with structural shaped steel conforming to JIS G 3101 and JIS G 4051 or equivalent as approved by the Engineer
- Casing plate shall be not less than 0.6 mm thickness sandwich double skin panel (total 1.2mm) with synthetic resin formed insulation, hot dip galvanized steel sheet conforming to JIS G 3302 or equivalent as approved by the Engineer.
- Casing insulation shall be applied at manufacturer's factory, and shall be acoustically suitable and shall be 50mm thick insulation material.

ii) Cooling Coil Section

- Coil surface area passing air velocity shall be lower than or equal 2.5m/s
- Cooling shall be fin and tube type constructed of seamless copper tubes conforming to JIS H 3300, and copper fins conforming to JIS H 3300 or equivalent.
- Tubes shall be correctly circulated for proper water velocity without excessive pressure drop.
- Drain pans shall be stainless steel sheet (SUS 304).
- Thickness shall be not less than 1.5mm and shall be provided with anti-sweat insulation externally.
- Drain pans shall have sufficient grade and the drain connection shall be minimum 32 mm or above at lower side.

- A drift eliminator shall be installed parallel to the cooling coil to eliminate any carryover and the drain pan shall be sufficient to collect any drips from the drift eliminator.

iii) Fan Section

- Fans shall be double-inlet centrifugal backward curved type with each fan in a separate scroll. Fans shall be statically and dynamically balanced at the factory after assembly in the air conditioning unit.

- Fans impeller shall be mounted on steel shafts, accurately finished and supported in ball-type bearings provided with lubrication facilities.

- Fans shall be driven by a unit mounted motor connected to fans by V-belt drive complete with belt guard. Belt drives shall be designed for not less than 150 percent of the connected motor capacity, and sheaves shall be adjustable to provide not less than 20 percent speed variation.

- Motors for V-belt drives shall be provided with adjustable bases.

- Sheaves shall be selected to drive the fan at such speed as to produce the specified capacity when set at the approximate mid-point of sheave adjustment.

- Fan shall be mounted on vibration isolation bases with the motor.

- The fan motor shall be three phase 400 V, induction type conforming to manufacturer's standard. The motor shall be constructed with the motor mounted inside the air conditioning unit. The belt and pulley guard shall be installed with hinges for ease of removal when servicing the pulleys or adjusting the fan belt.

- The motor shall be mounted on a rigid but fully adjustable base to allow for belt tension adjustment.

- All belts, pulleys, couplings and drives shall be selected strictly in accordance with the drive manufacturer's recommendations. Each individual drive shall be aligned with a straight edge.

- Inspection doors for fan sections shall be not less than 500mm width.

iv) Air Filter Section

- Filter section length shall be more than 500mm to suit a high-capacity filter system

- Filter shall be multi pocket type or pleated panel type
- Filter efficiency shall be 85 % or above on ASHRAE 52.1-1992 arrestance.
- Holding frames shall be fabricated from galvanized steel sheet conforming to JIS H 4000.
- Filter media shall be washable type and initial resistance shall be not greater than 100 Pa.

e) PAU shall be provided with the following accessories:

i) Vibration isolator.

ii) Companion flanges for duct connection with packing, bolts, washers and nuts.

iii) Foundations, supports, anchor bolts, washers and nuts.

iv) Inspection lamp to each section. The lamp "On-Off" switch shall be mounted on the PAU.

v) Companion flanges for chilled water pipe connection where flange connection type.

vi) A pitot type differential pressure gauge shall be provided to indicate the pressure drop across the filter section.

vii) All PAUs, Fresh air to be taken through duct and External Static Pressure to be calculated according to the duct design.

12. PRESSURE GAUGES AND THERMOMETERS:-

12.1 Pressure gauges shall be capable of reading - 50 bars range dial size 4" Stainless Steel, Borden Tube type and connected to the system with stainless Pig Tail Connectors with ball cock valves. Thermometers shall be capable of reading the range of temperature – 10 ºC to + 50 ºC Blue reading liquid in glass, aluminium powder coated scale height 9" or more.

12.2 A Temperature and Humidity transmitters shall be installed in, VHF Equipment room (4th Floor), Area Control Centre (2nd Floor), NSC building (raised floor at tower area) and UPS room (Ground Floor). Those Temperature and Humidity transmitters shall available with a display to get physical readings as well as it shall be communicated with Automatic Control and Monitoring system as well.

13. EXPANSION TANK FOR THE CHILLED WATER SYSTEM:-

a) Expansion tanks shall be constructed for a working pressure of 150 psi and shall comply with the Japanese boiler and pressure vessel codes or international recognized codes and standards.

b) Expansion vessel shall be installed and fitted with all necessary equipment to achieve proper operation of the Plant and to comply with manufacturer's instructions.

c) Tank requirements shall be as follows:-

i) Closed type expansion tanks with complete accessories shall have make-up water introduced directly into the tank by means of a combination pressure regulating and relief valve.

ii) The material of the body shall be steel sheet complying with JIS G 3101, G 3141, G 3454, G 3457 and G 3131.

iii) The membrane shall be diaphragm type. The membrane material shall be butyl rubber, natural rubber, etc., complying with JIS K 6200.

iv) The valve core of air pressure adjusting valve shall comply with JIS D 4211.

v) Accessories to be provided shall include:-

- pressure gauge
- foundations and foundation bolts
- name plate

d). Makeup water connection shall be given through double check non-return valve to avoid the contamination of potable water.

14. PIPING

The bidder shall quote for all piping work, anchoring of pipes, and necessary fittings to make chiller/pump and chiller/header/pump system complete.

The tender drawings shall be submitted by the tender to indicate the general layout of the various pipe works.

14.1. The cooler water pipes & condenser water pipes shall have balancing valves and shut off valves for the inlet and outlet.

14.2. All the piping from the chiller shall be of adequately sized to cater for designed flow rate and installed with necessary fittings for optimum operation, pressure gauges, thermometers etc.

14.3. The supplied pipes shall be subjected to a hydrostatic pressure test. The pressure shall not be less than 1,5 times operating pressure.

14.4. Chilled water piping shall be Heavy Duty/ Schedule 40 Black Steel and condenser water piping shall be Heavy Duty/ Schedule 40 GI. All fittings relating to chilled & condenser water pipes shall be Heavy Duty/ Schedule 40 to match with the piping grade.

14.5. All condensate piping shall be uPVC type 1000.

14.6. All pipes are to be sized by the Contractor and take necessary approvals by the Engineer with necessary calculations.

15. Wiring

15.1. Supply and installation of following cabling work within the Plant Rooms, complete with GI Conduting, Hangers, Brackets, etc. Cable termination at both ends included under Technical and Engineering Services BOQ.

15.2. 0.5 mm2 or above Shielded Twisted Pair (STP) Cables for Analog Points and Un-Shielded Twisted Pair Cables for Digital Points, shall be used between MCC's & DDC Panels and between Field Devices & DDC Panels. Cost shall include laying 3C x 1.5mm2- cabling from DDC Panel up to actuators, field devices, etc., which may require separate power for driving.

15.3. 0.5 mm2 or above Shielded Twisted Pair (STP) Cables shall be used for Communication Cabling for BACnet or Modbus RTU.

15.4. 0.75 mm2 or above Un-Shielded Twisted Pair (UTP) Cables shall be used for Communication Cabling between FCU and modulating damper Control UDDC networking.

16. Tropicalization

The equipment shall be tropicalized in order to run continuously in salty laden atmosphere.

17. Test Requirement

Unless otherwise specified the required test pressures shall be maintained continuously for 2 hours without loss of test medium or pressure.

18. Insulation

18.1.General

(1) Thermal insulation shall consist of the follows:

- Insulation
- Jackets and casings
- Vapour barrier materials

- Accessory materials

(2) Insulation, adhesives, and other accessories except as specified herein shall comply with certified properties as stated below:

- Foam must be having a fine, closed cell structure. Insulation foam water vapour resistance shall be μ≥7000 according to DIN52615.
- Insulation foam shall have a thermal conductivity less than 0.04 w/m^{0}c at 40^0 C according to DIN 52613.
- Heat resistance of the insulation foam should comply with following standards 57^0 C ⟨heat resistance⟨+125^0 C.
- Insulation shall be certified as BS476 part 7 class 1 for its Surface Spread of flame. When combined with a hammered aluminium layer (0.1 mm thick) or steel jacketing, fire propagation shall be certified as BS 476 part 6 Class 0.
- At total burn up the insulation from should be emitting non-toxic smoke, consisting of at least 99 % of H_2O and Co_2 . Smoke emissions level should be classified as 'low' in accordance with ASTME84.

(3) Pipe corrosion needs be avoided in line with following corrosion standards:

- Product Chloride Mas.% shall be lower than 0.0020, Ammoniac (NH_3) Mas. -% below 0.001 % and Nitrite (NO2) ppm levels L DIN 1988 provides for accepted certification.

(4) Insulation materials should be closed cell, having an intrinsic water vapour resistance μ ≥ 7000.

(5) The Contractor shall carefully pay attention to provision of insulation which will be installed in tropical weather condition.

18.2.Scope of Work

This division shall consist of the following;

(1) Insulation for duct
(2) Insulation for piping
(3) Insulation for equipment

18.2.1. Thermal Ducts Insulation

(1) All supply and return ducts shall be insulated with a closed cell structure type insulation to a thickness of 30mm, and with a thermal conductivity not more than 0.040 W/mK at 40oC, Insulation shall be of the flexible,

closed cell type for concealed duct, completed with UV protection paint or aluminium layers for exposed ducts.

(2) All insulation shall be lightweight closed ell structure , which shall display no thermo – plastic tendencies. The foams hall be Class I spread of flames (BS 476 part 7), smoke emission shall comply with ASTM E84 classification low.

(3) Insulation shall be secured to ducts by glue viscosity at 250 C should be 400 MP a with a solids content of approximately 23%.

(4) In all cases where insulation joints occur, facing edges shall be glued together. At pressure joints additional securing should be achieved by using a closed cell insulation tape..

(5) Ducts exposed in equipment rooms or their locations subject to damage, shall be insulated, vapour sealed and finished with galvanized sheet metal or a hammered aluminium layer of 0.1 mm thickness by approval of the Engineer.

(6) Insulation base material shall comply with the requirements of BS 476 part 7 class I and other specifications as mentioned in the General requirement.

18.2.2. Air-Conditioned Spaces

Duct work shall be insulated with rigid Nitrile rubber or pre-formed sections faced with aluminium foil/paper laminate, securely fixed with an approved adhesive directly to the metal duct work. Joints between slabs shall be covered with 7.5 mm. wide plastic coated adhesive tape fixed to a tack coat of adhesive on the aluminium surface.

18.2.3. External Duct Work

Duct work shall be insulated as for non-air-conditioned spaces but shall be covered with final protective coating of 0.55 mm. 'hammered' aluminium sheeting. All joints overlapped and secured with pop rivets. Bends shall be neatly formed with segments and tees gartered and bands shall be fitted at all termination points.

18.2.4. Fittings

Fittings requiring insulation shall be covered with an insulation of thickness of equal to that of the adjacent duct and cut to shape. It shall then be fixed to the metal and to adjacent insulation with the appropriate adhesive and with any open joints filled in with a mixture of mastic and granulated insulation, thereafter the whole smoothed down by building up sharp corners with mastic,

covered with reinforced expanding foam. A further coating of sealer and painted in accordance with the requirements for the adjacent duct work.

18.2.5. Supports

Hangers and brackets supporting insulated services in non-air-conditioned spaces shall be fixed external to the thermal insulation and vapour barrier with a 1.6 mm. thick galvanised sheet half sleeve with a length of not less than one twentieth of the circumference of the duct. Rigid insulating material is to be inserted between the sleeve and the duct of thickness equal to that of the normal insulation.

18.3.Thermal Pipes Insulation

I. Interior air-conditioning drain-lines, after being tested, shall be cleaned, and insulated with 1x9 mm thick foam closed cell polyethylene pipe insulation. Fittings and valves shall be covered with the same material.

II. All insulation shall be lightweight closed cell structure, which shall display no thermo-plastic tendencies. The foam shall be Class I spread of flame (BS 476 part 7), and smoke emission shall comply with ASTM E84 classification low.

III. The foam shall contain no toxic or volatile components. The foam shall be suitable for temperatures between 57C and +125C for continuous application;

IV. Insulation for pipe work shall be by applying flexible insulation tubes or panels cut from flexible insulation sheet for large pipe sections.

V. Where more than one layer of insulation is applied joints shall be glued together and at these points glued to the under-layer for at least 50mm Insulation shall secured in position by means of non-ferrous bands and insulation shall be covered with a vapour barrier which shall be covered with a vapour barrier which may be of PVC or neoprene, securely sealed at all joints.

VI. All visible pipe work and insulation also within plant rooms shall be vapour sealed by means of hammered aluminium cladding, as well serving purpose of providing mechanical strength.

VII. All valves, fittings and flanges shall be insulated to the same standard and connected. In the case of valves, pumps, etc. removable aluminium boxes shall be used or aluminium cladded flexible insulation. At all pipe support points, hardwood blocks or high-density insulation shall be installed and the outside of the insulation or the vapour barrier protected with aluminium sleeves so that the insulation is not Deformed under operating conditions.

All chilled water pipework shall be insulated to the following thickness:

Inside Building		Outside Building	
Pipe size	Thickness	Pipe size	Thickness
Up to 50 mm	25mm	Up to 114mm	30mm
50mm⟨ dia ⟨ 114	30mm		
Over 114mm	40mm	Over 114mm	50mm

VIII. Where lines pass through pipe sleeves the space between insulation and sleeves shall be filled with diffusion proof material. If passing firewall and floor, the filling shall be fireproof.

IX. All pipe insulation inside the plant room should be with a factory laminated aluminium jacket not less than 0.1mm thickness or to provide with a metal jacketing with a thickness not less than 0.4mm thickness for approval of the Engineer.

X. Insulation base material shall comply with the requirements of BS 476-part 7 class I and other specifications as mentioned in the General requirements.

XI. Template of each size for bend, elbow, etc of the claddings (metal jacketing) shall be submitted to the AASL.

18.3.1. Air-Conditioned Spaces

The insulation shall be closed cell flexible foamed sections securely fixed with an approved adhesive directly to the pipe surface. All joints between sections shall be covered with 75 mm. wide plastic contact adhesive tape fixed to a tack coat of adhesive on the aluminium surface. All raw edges shall be filled with reinforced expanded foam. The insulation shall be covered with a coat of sealer, and whilst tacky with a covering of heavy quality canvas, the whole being then covered with a finishing coat of sealer, and finishing material.

18.3.2. External to Building above Ground

a. The insulation shall be closed cell flexible foamed sections, securely fixed with an approved adhesive directly to the pipe surface. All joints between sections shall be covered with 75 mm. wide plastic contact adhesive tape fixed to a tack coat of adhesive on the aluminium surface. All raw edges shall be filled with reinforced expanded foam. The insulation shall be covered with a coat of sealer, and whilst tacky with a covering of heavy quality canvas, the whole being then covered with a finishing coat of sealer, and finishing material.

b. The insulation shall then be finished and protected with 0.55 mm. 'hammered' aluminium sheeting, all joints overlapped and secured with pop rivets. Bends shall be neatly formed with segments, tees gartered and bands shall be fitted at all termination points.

18.3.3. External to the Building below Ground

Pipe work and fittings below ground shall be of the pre-insulated 'pipe within a pipe' system. The inner pipe shall be steel with an outer casing of polyethylene securely bonded to the inner pipe with rigid polyurethane foam. Joints shall be carried out using specially developed plastic coated steel fittings and purpose made bends and tees. Expansion of the underground mains shall be checked by the specialist manufacturers and purpose made foam pads shall be installed in accordance with their recommendations.

18.3.4. Flanges, Valves and Fittings

Flanges, valves, and fittings requiring insulation shall be covered with an insulation of thickness equal to that of adjacent pipe and cut to shape. It shall then be fixed to the metal and to adjacent insulation with the appropriate adhesive and with any open joints filled in with a mixture of mastic and granulated insulation, thereafter the whole smoothed down by hereafter building up sharp corners with mastic, covered with tape, and a further coating of sealer to be vapour sealed. The insulation shall be finished to match the adjacent pipe work, except that all valves in plant rooms shall be finished with 0.91 mm. thick 'hammered' aluminium boxed which shall be designed for easy removal and access for maintenance without disturbing the insulation on the adjacent pipe work.

18.3.5. Supports

Hangers and brackets supporting insulated services in non-air-conditioned spaces shall be fixed external to the thermal insulation and vapour barrier with a 1.6 mm.

Thick galvanized sheet half sleeve of not less than twice the bore of the pipe. Rigid insulating material or timber rings shall be inserted between the sleeve and the pipe. On services in air-conditioned spaces the bracket or support shall be fixed to the pipe and the thermal insulation and vapour barrier carried over and any gap filled in with mastic.

All outdoor hangers and bracket supporting should be hot dipped galvanized or SS304.

18.4.Equipment Insulation

Insulate cooling, and refrigeration equipment, and accessories. Apply equipment insulation to fit as closely as possible to equipment.

Insulation shall be grooved or scored where necessary to fit the contours of equipment.

Bevel the edges of the insulation for cylindrical surfaces to provide tight joints.

After the insulation is in place on areas to be insulated, fill joints, seams an chipped edges with bedding compound to form a smooth surface.

Insulation on equipment that must be opened periodically for inspection, cleaning and repair shall be constructed so insulation can be removed and replaced without damage.

Secure the equipment insulation with 1.6 mm dia. galvanized wire or with 20mm wide 0.2mm in thickness galvanized band spaced at 300mm centers.

Glass cloth shall overlap 50mm at joints.

Insulation is not rocket for factory-insulated equipment and pumps.

19. Insulation Jackets and protection

(1) The insulation foam should be 100 % closed cell having a Water vapour resistance value Mu 〉 3000,. to prevent the need for water vapour barriers.

(2) All pipe insulation inside the plant room should be with a factory laminated hammered aluminium layer not less than 0.1mm thick or provided with a metal jacketing with a thickness not less than 0.4mm thick.

(3) All insulation exposed to UV radiation must be treated either by applying UV resistant paint with 400% elasticity or by applying a factory laminated hammered aluminum layer not less than 0.1mm thick.

(4) (4) All sites where insulation is exposed, mechanical protection needs to be achieved by applying a factory laminated hammered aluminium layer (0.1mm thick) or steel jacketing (0.4 mm thick)

Bare insulation foam seams need to be glue sealed and taped with closed cell polyethylene insulation tape (50mm wide)

Protection aluminium layer or steel jackets shall provide excellent fire behavior properties tested as Class 2 material according to BS 476 part 6.

20. Insulation Adhesives

General

Insulation adhesives shall be supplied by the same manufacturer as approved for the insulation and shall be according to the approved manufacturer's recommendations for the site conditions.

21. Valves (Manufactured to standard PN10)

Valves manufactured to standard PN10 shall be used.

The tender drawings shall be submitted by the Tenderer to indicate the general layout of the various pipe works.

22. Gate Valves

Valves shall be first quality of standard series or lines of products form manufacturers regularly providing items of types required.

All valves of like kind, type and size shall be products of a single manufacturer throughout for work under this Contract with like units and like parts and readily interchangeable.

Type of connections shall be as follows:

- Valves 50mm dia. or smaller – screw ends;
- Valves 65mm dia. and larger – flanged ends;

22.1.General

Gate valves shall be of cast iron with bronze moving parts and a rubber facing to ensure tight seating. The stem shall be provided with a square head and shall be key operated, or it shall be wheel operated. If key operated, a key shall be provided for every valve

22.2. Products

- Type : Inside screw (bronze valve) or inside screw and yoke Outside screw and yoke for fire protection.

- Materials: 50mm dia. and smaller by bronze body and trim
  65mm dia. and larger by cast-iron body and bronze trim.

- Joint : 50mm dia. and smaller by screwed ends.
  65mm dia. and larger by flanged ends.

- Pressure : 5 kg/cm^2 or 125 psi.Rating 10 kg/cm^2 or 150 psi
  12 kg/cm^2 or 175 psi UL/FM rated for fire protection

- Applicable : Screwed ends to meet JIS B 2011 or
  Equivalent Standard Flanged ends to meet JIS B 2031 or equivalent

23. Globe Valves

- Type : Outside screw or outside screw and yoke

- Materials : 50mm dia. and smaller by bronze body and trim
  60mm dia. and larger by castiron body and bronze trim.

- Joint : 50mm dia. and smaller by screwed ends.
  65mm dia. and larger by flanged ends.

- Pressure : 5 kg/cm^2 or 125 psi.Rating 10 kg/cm^2 or 150 psi

- Applicable : Screwed ends to meet JIS B 2011 or equivalent
  Standard Flanged ends to meet JIS B 2031 or equivalent

24. Angle Valves

- Type : Outside screw
- Material : 50mm dia. and smaller by bronze body and trim
  65mm dia. and larger by cast-iron body and bronze trim

25. Strainers

25.1. General

i. Strainer shall be equipped with easily removable cover and screen suitable for service intended and with a net free area of at least four times that of the entering pipe.

ii. Body pressure ratings shall be in accordance with scheduled working pressure of the equipment serviced.

iii. Strainers up to 50mm inclusive shall have a bronze body, screen and screwed connections. Strainers over 65mm shall be of cast iron body, stainless steel screen and flanged connection.

iv. Perforation shall be as scheduled herein after for all chilled water system or as required by manufacturer of equipment to be protected.

v. Strainers 50mm and smaller perforations shall be of 1.60mm and strainers 65mm and larger shall be of perforations 3.00mm.

25.2. Products

- 50mm and smaller : Screw type, cast-iron or bronze, Y-shape.
- Larger than 50 mm: Flange type, cast-iron,Y-shape or bucket type
- Strainer Plugs : Brass, and bolted cast-iron cover for bucket type
- Strainer Screen: Stainless steel mesh or brass mesh.

26. Water pressure Reducing Valves

i. The Contractor shall provide a cold-water make-up line to each chilled water system, and a water pressure reducing valve designed to maintain constant pressure as indicated, within the system.

ii. Each reducing valve shall be made of brass, ASTM B 62, with a stain less steel spring in a cast iron spring case, with brass disc holder, renewable composition disc and neoprene diaphragm. An adjusting screw shall be provided for changing the pressure setting. The valve assembly shall be complete with strainer and blow-off valve.

iii. With strainer upstream, relief valves downstream and valve by pass.

27. Check Valve

27.1. General

Non return valves shall be of the spring-loaded type, with cast iron body and bronze internal parts. The pressure rating shall be in accordance with the working pressure of the equipment.

27.2. Products

- Type: Solid seat or renewable seat, Top Covered. Rubber seated for fire protection
- Materials : 50mm dia. and smaller by bronze body and trim.65 mm dia. and larger by cast-iron body and bronze trim
- Joint: 50mm dia. and smaller by Screwed ends. 65 mm dia. And larger by flanged ends
- Pressure : 10 kg/cm2 or 150 psi. Rating 12 kg/cm2 or 175 psi, UL/FM rated for fire protection.
- Applicable: Screwed ends to meet JIS B 2011 Standard Flanged ends To meet JIS B2031

28. Relief Valves

- Type : Pop spring, bronze body Principal parts of stainless steel.
- Materials To meet JIS G4801 for Springs

29. Automatic Air Relief Valve

- Writing Pressure :As listed in the Drawings.
- Relief Valve :Equipped with one (1) stop valve and one (1) 15mm gate valve for manual air relief.

30. Vacuum Breaking Valves

- Type : Standard commercial units or Fabricated from standard parts.
- Material:All moving parts brass or Bronze and remainder of unit Corrosion resistant material or coated for protection as approved.

31. Flow Control Valves

i. Flow control valve shall have a bronze body, and tapping for manometer gauges to check flow rates. All valves shall be capable or airtight shut-off.

ii. The opening and closing of the valve shall not interfere with the flow control set point, and the valve stem movement shall be automatically stopped when the set point is reached.

iii. Valves up to 125mm in size shall have wrench operator and an adjustable balance stop. Valves over 125mm in size shall have enclosed worm and gear operator selected for the required pressure differential.

iv. For each operator, two wrenched shall be furnished. for insulated lines, valves shall be provided with extended necks.

32. Pressure Relief Valve

i. The contractor shall provide relief valves where indicated, of all bronze construction to 40mm outlet size, above 50mm iron body, bronze trim.

ii. Valve settings and capacities as indicated for application. Capacities are to be rated at 25 percent accumulation.

33. Butterfly Valve

i. Butterfly valve shall be constructed with a cast iron body, alubronze disc, stainless steel shaft, rubber seat and packing and polyacetal bushing.

ii. Valves shall be rated at 16 kg/cm2 pressure differential in closed position. Valve shut off shall be 100% at the above – mentioned pressure.

iii. Valves shall have heavy duty water bodies, if not Indicated otherwise. Section valves in main transport lines shall have tapped body lugs. Manual valve operation shall be provided with a hand wheel and gear with position indicator.

34. Pressure Independent Control Valve (PICV) and Valve assembly

34.1. Pressure Independent Control Valves

i. The Pressure Independent Control Valve should be comprised of an equal percentage control valve, an integrated membrane-based pressure controller and a flow limiter which is independent of the stroke adjustment of the valve.

ii. The pressure independent control valve shall be an automatic flow limiter, resulting in optimum maintenance of delta T across the Chillers/Heat Exchangers.

iii. 230VAC type PICV, 2-position on/off actuator (Chilled water control valve) (2-wire) 230VAC signal.

iv. No Cartridge (insert type) type Pressure independent control valve will be acceptable.

v. The discrete flow limiter in the valve should be used as a flow limiter and independent of the Stroke of the valve.

vi. The valve should have a mechanism to set the flow externally without the requirement of removing the actuator to set the flow.

vii. The pressure Independent Control Valve and the modulating actuator shall be from the same manufacturer.

viii. Control Valve actuators shall be modulating type and must auto-calibrate.

ix. The smaller valves up to sizes 32 mm shall be of Brass body and more than 32 mm should be a robust design Ductile Iron body.

x. At any minimum setting, modulation, modulation to 0% of the flow should be possible.

xi. The flow presetting should be possible without removal of the actuator and presetting values should be visible even when the actuator is mounted.

xii. Shut off service function should be possible with setting mechanism.

xiii. The Valve shall have a fail-safe operation, when there is power failure the valve shall be in closed position.

xiv. The setting, which can be locked, should be visible from to at all times even when the actuator is on the Valve for valves up to DN 32

xv. The Pressure Independent control valve should be fully serviceable at any time during the life span of the valve.

xvi. The stroke of the valve should be the same at all times even if the flow setting is set at the lowest possible for the valve.

xvii. Control valve should have Equal percentage characteristics to all flow settings to have energy saving at low load conditions. Same shall be proven with a third-party Lab report.

34.2.Valve Assembly

i. All two-way control valves shall be dynamic, modulating, pressure independent control valves and shall be provided by the same manufacturer.

ii. Balancing Valves and associated balancing shall not be used where pressure independent modulating valves are installed.

iii. All valves shall have at least two factory installed pressure/temperature ports to allow field verification of low flow and pressure independent operation. It should be possible to set the flow rate without removing actuator from valve. The valve shall be Equal Percentage characteristics.

iv. Valve bodies 2" (50 mm) and smaller shall be dezincification resistant brass and cartridge shall be Stainless Steel with high resistance polymer.

v. The Pressure independent control valve shall be prepackaged, factory assembled and factory tested with factory made insulation boxes and hoses.

vi. The valve assembly shall include a PICV; isolating valves on both flow and return pipe work a flushing bypass and blow down valve for independent authentication of flow measurement. The assembly shall be complete with two flat unions. The assembly shall have a filter ball combined isolating valve and strainer and a flushing bypass valve. The ball valve with integral filter shall be made of corrosion resistant brass alloy. The filter shall be stainless steel AISI 304.Proposed valve should be BSRIA tested.

vii. The by-pass comprises two through connections, with an integral full bore 3-port ball valve in the top section, which is then linked to the bottom of the unit by way of a perpendicular by-pass section.

viii. The valve assembly unit can be configured for both horizontal or vertical, and left or right hand access, dependent upon where the fan coil is to be mounted.

ix. The hoses shall be flexible EPDM tube with stainless steel braiding with end connections matching FCU inlet/outlet.

x. The insulation shall be provided along with the kit that would be at least Class 1 Fire rated.

34.3.Execution

i. Install valves components and accessories per manufacturer's instructions and approved shop drawings.
ii. Install with piping per requirements as specified.

35. Meters and Gauges

35.1. Scope

This Section includes the following items:

I. Water meters
II. Pressure and compound gauges;

III. Level gauges;
IV. Thermometers; and
V. Related work.

35.2. Products

35.2.1. General

Materials required and not otherwise specified herein shall be Provided in accordance with applicable requirements under referenced Sections, and shall be as shown.

Meters and gauges shall be first quality of standard series or lines or products from manufacturers regularly providing
items of types required.

35.2.2. Pressure and Compound Gauges

Outside diameter shall be 100mm and equipped with a cock.

Scale shall indicate working pressure of system; highest scale shall indicate 150% to 200% 0 working pressure.

Vacuum scale of compound gauge shall be 760mm Hg.

Applicable standards shall be JIS B 7505 or equivalent.

35.2.3. Level Gauges

Glass tube liquid level gauge capable of withstanding 150% Highest possible pressure.

Glass tube shall be 10mm inside diameter with metal guard.

L-shape or straight shaped thermometer, liquid-in glass tube, and self-indicating with highest scale of 1200C.

Dial indicator, liquid sealing pressure type with range 00 C to 1200 C.

Applicable standard shall be JIS B 7420, B7421 or equivalent.

35.2.4. Thermometer

35.2.4.1. General

- Installed where indicated and as follows:
- Supply and return piping of each Air Handling Unit
- In supply and return main piping of each header
- Inlet and outlet of each chiller

35.2.4.2. Temperature Ranges

Temperature ranges shall be within 6^0C of the following. Submission shall list specific range proposed for the below mentioned.

- Chilled water- 0 to 20^{0}C with 1-degree divisions
- Condenser water-0 to 50^{0}C with 1- degree divisions

35.2.5. Execution

Install meters and gauges and related accessories per manufacturer's instructions and approved shop drawings.

Thermometer shall be installed at location clearly legible at eye level.

Pressure gauges shall be installed as required at pump suction and discharge line.

36. Variable Speed Drives

Variable Speed Drives shall be installed for all the PAU's fan motor.
Variable speed drives shall be selected in accordance with the KW rating of the PAU fan motor.
Variable speed drives shall be of reputed make for which a local agent/representative from the principal is compulsory. Details of similar make installation in Sri Lanka shall be forwarded. All VSDs and Soft starters shall be communicated with BMS and the protocol is Modbus RTU.

36.1.Technical Specification

36.1.1. Supply Voltage

The VSD shall be able to convert a 3-phase AC voltage, which varies ± 10%, 50 -60 Hz, onto a variable output voltage and frequency. The VSD must be able to supply a full output voltage to the motor, even a continuous supply voltage of -10%.

36.1.2. Voltage/Frequency Ratio

The voltage/frequency ration must be suitable for speed control of centrifugal pump and fans. It must not be possible to set a constant U/f ratio to prevent damage to connected equipment and to optimise energy consumption.
Variable-frequency Drive) protects the motor mainly in the following aspects: overvoltage protection, under voltage protection, overcurrent protection, phase loss protection, reverse phase protection, overload protection, grounding protection, short circuit protection, over frequency protection and stall protection.

36.1.3. Load Adaptation

The VSD must regulate the output to adapt it continuously to the current load on the pump or the fan, to minimize energy consumption.

36.1.4. Motor Types

The VSD must be able to regulate all types of IEC standard motors without load reduction, and without the motor temperature becoming higher than under normal operation (under class B).

36.1.5. Motor Connection

The VSD must be able to control motors of different sizes connected in parallel, and it shall be possible to stop a machine during operation without the risk of tripping.

36.1.6. Test Reports

It shall be possible to provide documentation on the effect that the manufacturer has subjected the VSD to various tests, including motor load tests.

36.1.7. Basic Properties

The VSD shall be able to supply the motor with a sine-shaped current and fully circular magnetic flux to obtain full motor torque at rated frequency, without the motor becoming warmer than in normal mains operation.

36.1.8. Documentation

The following items shall be document able:

(a) Minimum Efficiency at 100% load 96% at 20% load 92%

(b) Rated Input Voltage 400V±10%, 3-phase, 50 Hz, ±2 Hz

(c) Ambient Temperature During Operation : -10 0C to +40 0C, Relative humidity : maximum 85% rH non-condensing. Vibration:0.7G.

(d) Output Frequency : 1 to 120 Hz

(e) 3-phase Output Voltage: Adjustable from 10% to full mains voltage, even at 10% of mains voltage.

(f) Use of over-size motors shall be possible, where the maximum power consumption is within the current range of the VSD.

(g) The output torque must be limited to 1.10 x the rated torque to prevent damage to connected equipment.

(h) The VSD shall be able to use 0 – 10 V, 1-5V, 4-20 mA as a control signal.

(i) The VSD shall have two(2) output relays, i.e. for the following signals: ready, running, warning, alarm; and three (3) relays shall be

programmable. Two (2) analogue outputs – 0/4-20 mA or 24DC- must be programmable so as to be able to display the speed or 25 other parameters for the EMS system.
It shall be possible to programme 20 different speeds for night time lowering, smoke filled rooms, morning/evening lad, etc.

(j) The VSD shall be able to avoid at least four (4) by pass frequencies with adjustable band width to avoid mechanical resonance.

(k) A hard ward lock shall be an integral feature; it must serve to prevent unintended programming or the VSD

36.2. Design Requirements

36.2.1. Harmonic Suppression

The VSD shall have built-in filters in the intermediate circuit for harmonic suppression. The total harmonic distortion (THD) shall be kept on the lowest possible level.

36.2.2. EMC Compliance

The VSD shall comply with EMC and RF1requirements according to EN 55011, and the supplier must be willing to issue a certificate of such compliance if requested to do so.

36.2.3. Flying Start

Regardless of the direction, the VSD shall be able to catch a running fan without any tripping occurring.

36.2.4. Power Electronic Components

The VSD shall contain a diode input bridge and a DC intermediate circuit with a fixed voltage, and with both induction coils and capacitors forming an intermediate circuit filter. In addition, there must be an inverter with IGBTs(Insulated Gate Bipolar Transistors), and there must be output induction coils. Al equipment must be inside the VSD enclosure.

36.2.5. Control Electronic Components

The inverter must be controlled by a 32-bit processor and ASICs(application specific integrated circuits). The control principle is intended to guarantee full motor voltage and sine-shaped motor current.

36.2.6. Short-and Earth Circuiting

The current limiting function must be quick enough for the VSD to resist short-term earthling and short-term earthling and short-circuiting on the output terminals without any damage to the components.

36.2.7. Disturbances on mains and motor

The VSD shall have integrated protection against: the mains transients in accordance with VDE 0160, missing phase in the mains cable (3-phased), missing phase in the motor cable, earthling and short-circuiting of motor phases. If the speed reference is lost, it must be a programming option to either maintain the motor speed, or regulate to stop.

36.2.8. Over-Ride Protection

The VSD shall have an over-ride function, which, in the case of overloads during operation and starting, reduces the motor current to prevent damage.

36.2.9. Motor overheat protection

The VSD shall be able to give off a warning or stop the motor if the motor is overheated. This function must form an integral part of the VSD; consequently, a thermistor in the motor shall not be required.

36.2.10. Reactive Factor (Cos.φ)

The VSD shall have a coa φ = 1 o n the supply side (AC) at all loads and speeds, extra AC coils for stable operation must not be required.

36.2.11. Switching on output

The output circuit is to ensure the possibility of unlimited switching between the VSD and motor regardless of load and speed, without any damage to the VSD, and without extra equipment being required.

36.2.12. Self-adjusting switching frequency

VSDs up to and including 45 kW shall have a self-adjusting switching frequency from 4.5 Hz to 14 Hz, at which load reduction is not necessary. The switching frequency must be optimised automatically to match the output frequency. VSDs over 45 kW must have a maximum switching frequency of 4.5 kHz.

36.2.13. PID Controller

The VSD shall have an integrated PID-regulator as standard to obtain closed loop control.

36.2.14. Current Limitation

The VSD shall not lead to an actuating current when the start signal is given, and the current must be limited to 110% to prevent damage to other equipment.

36.2.15. Local and remote control

The VSD shall be suitable for local as well as remote control

36.2.16. Motor Pre-Heat

VSDs up to 45 kW must feature a function that prevents condensate from forming in the motor.

36.2.17. Operation without motor

The VSD shall not be damaged if a start signal is given without the motor being connected.

The VSD shall have sleep mode facilities making it possible to stop the motor when running at low speed if consumption in the system goes back up the VSD shall start the motor and supply power required.

36.2.18. Standard Functions

The VSD shall contain the following functions as standard:

- Inverter trip at 75% C on the heat sink; extends service life.
- Protection against under-voltage.
- Protection against over-voltage.

- Alphanumeric display (alphanumeric code).
- Choice of language in display.
- Light diode indicating "ON"
- Light diode indicating "Alarm".
- Choice of 12 different displays, e.g. of output current, voltage, frequency, speed, output, torque, motor temperature, energy kWh.
- The speed must be controllable via the keys (manual operation).
- A lock to prevent unintended programming of the VSD.
- Four (4) individually adjustable remps – two (2) acceleration, two (2) deceleration, with a setting range of 0-3, 600 secs. Four(4) set-up menus.

36.2.19. Common Control Panel

The same control panel must be used for all VSD sizes.

36.2.20. Mechanical Requirements and Installation

I. Metal Enclosure

The VSD shall have a metal enclosure, which is supplied to IP 54, to ensure that an extra enclosure is not necessary.

II. Integrated Fan Cooling

The VSD shall have integrated fans as required. The supplier must provide information on heat dissipation.

III. Detachable Control Panel

The control panel shall be detachable and be able to function three(3) meters away from the VSD to ensure that it can be mounted in a central control panel, if used. The control panel shall have a minimum protection rating of IP 54.

IV. Service Access

Servicing must not require access from the back of the VSD.

V. Motor Cables

All outgoing power cables used for motor feeding (from VSD to motor) should be screened or SWA 3C cables and all the panel boards should be properly grounded in order to reduce RF interferences to other ELV Systems. Any design/Implementation which having single core cables to supply the motors will not be accepted. For all long cables (above 50m) contractor shall be determined what kind of RFT shall be compliance is required, as per the capacity of the VSD.

36.3. Soft Starters

Soft Starter Specification.

Soft starter Working conditions	
Load type	Three-phase Pump motor,
Voltage range	100-240/380-500 +/- 10% Volts control voltage
Rated frequency	50Hz ± 2Hz
General power range	5kW- 60kW
Control power	220VAC, supplied by cabinet PT or on spot small bus
Cooling method	Natural cooling
Environment requirements	Ambient temperature: -15℃-50℃
	Relative humidity: 5%-95%
	Altitude: at most 2,000m
Soft starter Parameters setting	
Start mode	Voltage ramp start
	Constant current start
	Kick-up start
Start period	(1-120) s, adjustable
Start current	(1.0 -5.0) Ie, adjustable
Initial voltage	(30-100) % Ue, adjustable
Kick-up impulse period	(1-5) s, adjustable

Shutdown mode	Direct shutdown/soft shutdown
Soft shutdown period	(1-120) s, adjustable
Soft starter Protective functions	
Under-load protection	Setting range: (1-99) % Ie
	Actuation time: (1-250) s
Overload protection	Setting range: (100-400) % Ie (effective when bypass is running)
	Actuation time: (1-250) s
Under-voltage protection	Setting range: (1-99) % Ue
	Actuation time: (1-250) s
Overvoltage protection	Setting range: (100-180) % Ue
	Actuation time: (1-250) s
Open-phase protection	Actuation time: (1-250) s
Phase-sequence protection	Actuation time: 0 s
Start-up over-frequency protection	Setting range: startup or shutdown (1-99) times per hour
	Actuation time: 0 s
Three-phase current unbalanced protection	Setting range: (1-100) %
	Actuation time: (1-250) s
Bypass Abnormality Protection after startup	Actuation time: 2 s
Thyristor fault protection	Actuation time: 0 s
Locked rotor protection	Setting range: (400-800) % Ie
	Actuation time: 0 s
Communication interface	
Communication interface	RS-485
Communication protocol (optional)	Modbus RTU
Operation interface	
User-friendly man-machine interface	colored LCD screen display
Display content in touchscreen	Display whether system working voltage value and curve, working currentvalue and curve, communication and working status are normal
Memory function	

Historic fault record	Record most recent five fault messages, including fault type and systemworking state when fault occurs

37. PAU Control System

The controllers shall modulate the PAU fan speed in accordance with the supply main duct pressure sensed by pressure sensors.

Each fresh air outlet which is connected to the occupant space shall be connected with motorized damper which communicates with FCU in the occupant space. When FCU is turn off, respect motorized damper shall be closed.

Pressure sensors shall be located in main air supply ducts of the PAUs and regulate the flow by the VFD.

Pressure Independent Control Valves on the chilled water line shall be modulated based on the supply air temperature automatically.

Necessary isolating valves and by pass arrangement shall be provided. This is necessary for the continuous operation of the PAU in the case of a breakdown of a motorized valve.

PAU shall be automatically tripped, when there is a fire in particular PAU service area or smoke detect in fresh air supply.

The equipment to be proposed for PAU control system shall be of reputed make for which local agent in Sri Lanka shall be available. Details of similar make system installed in Sri Lanka shall be forwarded.

38. Standby Air-conditioning System for the Instrument Areas

38.1. Variable Refrigerant Volume (VRV) or Variable Refrigerant Flow (VRF) System

38.1.1 Indoor Units

Supply and install, VAV/VRF system as indicated in the schedule of equipment. Ceiling Suspended type indoor units.
Space available for the units shall be confirmed with the civil and architectural and sizes of units shall be selected to fit into the space available.

38.1.2 Indoor Units-Ceiling Suspended Unit

Indoor units are ceiling Suspended type units comprising indoor unit and outdoor condensing unit.

1. The unit shall have wireless remote controller
2. Auto swing mechanism for air delivery.
3. Auto operation

4. Auto re-starts function
5. Energy saving hydrophilic coating on cooler coil
6. Washable Air filter

38.1.3 VRV / VRF Outdoor Units

All VRV/VRF condensing units shall comprise of inverter driven compressors or Digital scroll variable capacity compressors, refrigerant R407C/R-410A/R-32, and be able to couple to multiple indoor units. The amount of refrigerant should be regulated freely according to the load on the indoor units by the inverter driven compressor in the outdoor unit. The efficiency, COP of outdoor unit shall be minimum 4. Aluminum plate fins mechanically bonded to seamless copper tubes. Outdoor unit shall meet the minimum efficiency requirements of ASHRAE Standard 90.1- 2013 and AHRI Standard 1230. All VRV shall be communicated with the BMS and the protocol is BacNet IP.

Units having side inlets shall have coil guards

The bidder shall submit the manufacture's details on the suitability of the system and the capacity rating factors accordingly. Both the indoor unit and the condensing unit shall be of the same make.

a) Fans

- Direct driven propeller up flow horizontal type
- Fan motors shall have inherent overload protection, be permanently Lubricated, and resiliently mounted.
- Each fan shall have a safety guard
- Cycle fans or use solid state fan speed control for low ambient operation

b) Compressors

Compressor units shall complete with following features.

- All compressors shall be inverter type
- Spring isolators
- Crankcase heater
- Compressor motor overload protection
- Ring, reed, or disc type valves
- Service valve, back seating type

c) Controls

- Factory wired and located in separate enclosure
- Factory installed safety devices-
  High and low pressure cutouts
  Internal of plug type relief valves
- Integral magnetic starters
- Anti-cycle timers of prevent units from starting up against for five minutes after any power interruption.
- Individual remote control.

e) Casing

- Fully weatherproof for outdoor installation, finish shall be weather resistant.
  The casing and the condenser fins shall be specially treated for anti-corrosion.
- Openings shall be provided for power and refrigerant connection.
- Panels shall be removable for servicing

f) Accessories

- Vibration isolators – neoprene type vibration isolation pads

38.1.4 Control & Monitoring

Monitoring & control indoor & outdoor unit
As it shall be communicated with
Automatic Control and Monitoring system as well. Interface Type BACnet TCP IP
Touch panel 10 inch minimum colour LCD easy to use

- With Smartphone like operations, such as swiping and flicking

Enhanced energy saving control functions

- Packed with demand function
- Set temperature auto return setting. Auto shutoff, Set temperature range limit settings

Energy visualization

- Displays electricity & gas usage distribution
- Supports energy saving plans with graph display function

History record

- One month history record facility

38.1.5 Refrigerant Pipe Work

Refrigerant Piping

Meet requirements of ASTM B 280 hard drawn straight lengths. Soft copper tubing not permitted. Very hard copper with sufficient thickness shall be provided. Refrigerant pipes are used to connect outdoor condensing units and indoor units including header branch, Y branch and other piping accessories to complete the system.

Do not use pre-charged refrigerant lines.

Refrigerant lines shall be sized in accordance with manufacturer's recommendation.

Refrigerant fittings - Wrought copper with long radius elbow
Suction line traps - Manufactured standard one piece traps

All indoor & outdoor refrigerant lines shall be properly insulated with fine close cell type to prevent condensation.

Manual refrigerant shut off valves

Ball valves designed for refrigeration service

- Value shall have cap scales
- Valves with hand wheels are not acceptable

Condensing unit and evaporator on systems

- Refrigerant Supports
  1. Support Spacing
     a) Piping 32mm and larger – 2.4m on center maximum
     b) Piping 28mm inch and smaller – 1.8m on center maximum
     c) Support each elbow

  2. Isolate pipe from supports and clamps
  3. Run protective cover continuous from condensing units to risers or penetrations at building structure.

Field Quality Control

Make evacuation and leak tests in the presence of Client's Engineer after for procedures outlined below:

a) Draw vacuum on each entire system with two state vacuum pumps.
b) Break vacuum with nitrogen and re-establish vacuum test. Vacuum shall hold for 30 minutes.
c) Conduct test at 21^0C deg. Ambient temperature minimum.
d) Do not run systems until above tests have been made and systems started up as specified.
e) After testing, fully charge system with refrigerant and conduct test with Halide Leak Detector.
f) Recover all refrigerant in accordance with applicable codes.

Provide service valve on each liquid and suction line at compressor.

Filter Drier

- On lines 25mm outside diameter and larger filter drier shall be replaceable core type.
- On lines smaller than 25mm outside diameter, filter drier shall be sealed type using flared copper tubing.
- Size shall be full line size.

Sight Glass

- Combination moisture and liquid indicator with protection cap.
- Sight glass shall be full line size.

- Sight glass connections shall be solid copper or brass. No copper – coated steel sight glasses allowed.

Installation

a. Refrigerant Lines

i. Outdoor unit install as Roof top.

ii. Slope suction lines down toward compressor 1:125 Locate traps at vertical risers against flow in suction lines.

b. Connections

Refrigeration system connections shall be copper-to-copper, copper-to brass, or copper-to-steel type properly cleaned and
brazed with specified rods. Use flux only where necessary. No soft solder connections will be allowed in system.

Remote system controller for each set of Variable Refrigerant Air Conditioning System shall be provided**.**

38.1.6 Condensate Drain Pipes

Condensate drain pipes and fittings shall be rigid thermoplastic pipes rated to pressure type 600. Fittings shall be moulded and both pipe and fittings shall be of the same make.(drain line connect to the storm water floor gully).

38.1.7 Electrical Works

The HVAC system shall have 1 Control Panel adjacent to the condensing units and power supply to the same will be provided by the Contractor. However, the Contractor will provide the switch gears and carry out the necessary power cabling and Control wiring to the Condensing units, indoor units which is covered under the HVAC Contract.

38.1.8 Thermal Pipes Insulation

i. Interior air-conditioning drain-lines, after being tested, shall be cleaned and insulated with 1x9 mm thick foam closed cell Polyethylene pipe insulation. Fittings and valves shall be covered with the same material.

ii. All insulation shall be lightweight closed cell structure, which shall display no thermo-plastic tendencies. The foam shall be Class I spread of flame (BS 476 part 7), and smoke emission shall comply with ASTM E84 classification low.

iii. The foam shall contain no toxic or volatile components. The foam shall be suitable for temperatures between 57C and +125C for continuous application;

iv. Insulation for pipe work shall be by applying flexible insulation tubes or panels cut from flexible insulation sheet for large pipe sections.

v. Where more than one layer of insulation is applied joints shall be glued together and at these points glued to the under-layer for at least 50mm Insulation shall secured in position by means of non-ferrous bands and insulation shall be covered with a vapour barrier which shall be covered with a vapour barrier which may be of PVC or neoprene, securely sealed at all joints.

vi. All visible pipe work and insulation also within plant rooms shall be vapour sealed by means of hammered aluminium cladding, as well serving purpose of providing mechanical strength.

vii. All valves, fittings and flanges shall be insulated to the same standard and connected. In the case of valves, pumps, etc. removable aluminium boxes shall be used or aluminium cladded flexible insulation.

viii. At all pipe support points, hardwood blocks or high-density insulation shall be installed and the outside of the insulation or the vapour barrier protected with aluminium sleeves so that the insulation is not Deformed under operating conditions.

38.1.9 Insulation Adhesives

General

Insulation adhesives shall be supplied by the same manufacturer as approved for the insulation and shall be according to the approved manufacturer's recommendations for the site conditions.

38.1.10 Approval of Material

General

Insulation material will only be approved if the following information is submitted to the Engineer, Stating thickness of the material only is unacceptable.

Submission

i. Thickness of material;
ii. Thermal conductivity W/m deg. C/h and DIN test certificates.
iii. BS Part 476 test certificates from UK based independent test institute,
iv. Insulation shall bear manufacturers'

38.1.11 Execution

Pipe Insulation

Wrap bend joints/pressured joints with closed cell insulation tape of 50mm wide.

Overlap longitudinal jacket laps not less than 50mm.

Where insulation is required on flanges, unions, fittings, and valves use pre-molded, pre-cut, or job-fabricated insulation of the same thickness and conductivity as used on adjacent pipe.

When segments of insulation are used, provide elbows with not less than three (3) segments.

For other fittings and valves, cut segments to required curvature. Where unions, flanges, and valves are indicated not be insulated, terminate the covering neatly at the ends with insulation cement.

Cover unions and flanges will removable section of insulation. Continue insulation through pipe hangers and pipe sleeves. Provide protection shields at hangers where pipe is supported by insulation.

Provide metal jackets on piping insulation in outside locations or where otherwise indicated.

38.1.12 Familiarization

a. Provision for Four (04) AASL technical personnel for familiarization on special features and differences, testing and commissioning etc. of the latest equipment to be procured at Manufacturer's Facility as specified blow not less than 15 hours theoretical and practical. All expenses shall be borne by the Contractor.

1. Understand basic operation principles at each stage of operation of VRV System
2. Wiring schematics, VRV components
3. Demonstrate refrigerant flow software & how to use for diagnostics
4. How to trace refrigerant flow
5. Learn advanced field settings and repair maintenance
6. Learn advanced troubleshooting using Service Checker
7. Hands-on activities & practice

b. Provision of local training to recommended AASL staff based on the followings.

- Operation & maintenance.
- Specific energy conservation techniques.
- Fault diagnosis & rectification.
- Operation & maintenance of control equipment.

38.1.13 GUARANTEE AND WARRANTY

The contractor shall guarantee the equipment to be brand new and to be free from defects in materials, workmanship and satisfactory functioning under the normal use of service for a period of 02 years from the date of the issue of the acceptance certificate for the air conditioning system. Minimum warranty period for the compressor shall be 5 years from the date of commissioning.

39. Split Air Conditioning system

39.1. Technical

Capacity : 9,000 BTU/Hr
Type : Split Inverter Type, Wall Mounted
Refrigerant : R32 or Environmental friendly
Power Supply : 230 V 50 Hz Single Phase
Standard Features :
Provisions should be available to control the room temperature (wireless Remote and Manual) incorporated with a visual temperature indicator

I. Power on Auto delay (3 min) start feature
II. Compressor shall be of rotary type
III. Condenser and evaporator shall be copper tubes and fins treated with heavy anticorrosive treatment
IV. Noise level shall be lower than 45 Db (indoor-Hi)
V. Moisture removal more than 1.2 L/hr
VI. E E R shall be more than 11.27 BTU/hW

39.2. General:

A. The air-conditioning unit shall be supplied with following protection / device.

i. Internal Thermostat
ii. Over Current Relay
iii. Phase failure protection
iv. Low and high voltage protection

B. The air-conditioning unit shall be air cool and free-blower type.

C. Outdoor unit shall be consisting suction valve and discharge valve for the convenience of repairs.

D. Housing of the outdoor unit shall be corrosion resistance and shall be able to bear salty and hot weather conditions.

E. Housing of the indoor unit shall be plastic or non-corrosive material.

F. Power supply, Compressor Operation & Air Swing indicators shall be available with Indoor unit.

G. Remote Control shall indicate Room Temperature, Strength of the Batteries, Operational errors of the unit etc.

H. Facilities shall be available for Temperature Setting 16 ^{0}C to 30 ^{0}C, Fan speed setting – Low/Medium/High, Air Swing on/off.

39.3. Technical Literature:

A. Supplier shall provide catalogue /Manufacturer's Technical literature depicting all the specifications of the unit with the quotations to assist in the evaluation of Offers.

B. Technical literature catalogues and complete set of installation and service manuals should be submitted with each air conditioning unit.

C. Warrantee certificates shall be submitted with the air conditioning unit.

39.4. Warranty:

A. Warranty period for the air-conditioning unit should be minimum one year from the date of commissioning of the units.

B. The warranty period for the compressor and condenser should be a minimum of five years from the date of commissioning of the units.

C. The warranty period for the control card should be a minimum of two years from the date of commissioning of the units.

D. The supplier shall guarantee all other parts to be free of defects independent of the service agreement for a minimum of one year from successful operation.

E. If the compressor or any other parts have to be replaced due to a defect identified during the guarantee period, the supplier should not introduce any replacement cost that will be incurred to AASL.

F. Supplier shall ensure that the A/C is serviced free of charge at least once in three months in the first year of operation. (Four services)

G. Proposed brand of A/Cs should have a proven record of good performance, at least for 10 Years.

39.5. Condensate Drain Pipes with insulation

Condensate drain pipes and fittings shall be rigid thermoplastic pipes rated to pressure type 600. Fittings shall be moulded and both pipe and fittings shall be of the same make. (All drain lines to be connected to nearest drain with trap at the ground)

39.6. Installation and Maintenance

A. Mounting/ Fitting indoor & outdoor units at the respective locations as per standard practice including Leak testing.

B. Supply, Installation, Testing and commissioning of suitable size (minimum gauge 0.61mm) copper refrigerant lines (suction and return) including insulation of minimum 13mm thickness nitride rubber with aluminum foil covering along with required electrical and control cabling as per standard practice.

C. Supply and laying of PVC drain piping as per standard practice.

D. In case of emergency breakdown, supplier should attend the repair and maintenance works within 24 hours.

40. General Requirement for the Air Conditioning work

40.1. Painting & Rust Prevention

All work, which has to be field painted, shall be free of scale, oil or dirt of any kind. Field finishes shall be in accordance with the Engineer's requirement. All machinery including compressors, electric motors, fans and equipment bases, shop fabricated and factory-built where not factory finished, galvanized or protected by plating, shall be cleaned and given one shop coat of a red lead, zinc-chromate or other suitable primer before delivery to site. Any portions of shop coat damaged in delivery or during construction shall be re coated and restored to original condition, after approval by the Engineer. After installations, all items shall be given two coats of finish paint.

Ferrous metal work requiring finish painting shall be thoroughly cleaned and given one coat of rust inhibiting paint before installation. Ferrous metal work specified to receive finish painting shall be primed as specified above to receiving the finish painting.

Steel pipes, cradles, vibration isolation rails, etc. that will be covered, partially covered, set in cement or fill, or not accessible when the installation is completed, shall be given two coats of black asphalt or other similar purpose paint. Aluminium components for outdoor installation shall be primed and painted with a finish coat. Exposed nuts, bolts and washers shall be galvanized or painted with 2 coats of anticorrosive paint.

40.2. Guarantee

The contractor shall guarantee the all the equipment and material to be brand new and to be free from defects in materials, workmanship and satisfactory functioning under the normal use of service for a period of 02 years from the date of the issue of the acceptance certificate for the total mechanical ventilation and air conditioning system.

40.3.Software Authority

The manufacturer shall provide access authority to the chiller controlling software for both operational and maintenance activities to the AASL. This includes fulfilling all necessary requirements, such as training, software and providing the required tools.

40.4.Familiarization

Provision for four (04) AASL Mechanical technical personnel for familiarization on special features and differences, testing and commissioning etc in offered item manufactures factory.

Provision of training to recommended AASL staff based on the followings.

- Operation & maintenance.
- special features and differences with normal chillers
- Specific energy conservation techniques.
- Fault diagnosis & rectification.
- Operation & maintenance of VSD & control equipment.

Provision of Local training to recommended AASL staff based on the followings.

- Operation & maintenance.
- Specific energy conservation techniques.
- Fault diagnosis & rectification.
- Operation & maintenance of VSD & control equipment.

40.5.Tropicalization

The equipment shall be tropicalized in order to run continuously in salty laden atmosphere.

40.6.Documents to be furnished for Installation & commissioning

The contractor shall supply upon completion of works, complete Technical Documents & Manuals in English Language in triplicate shall be handed over.

The documents should include.

- Full description of installation with diagrams.
- Complete set of As-Built Drawings –Hard Copy
- Complete set of As-Built Drawings –Soft copy in PDF, AutoCAD & Revit versions
- Maintenance & workshop manuals & schedules
- Operational manuals
- Illustrated parts catalogue
- Wiring diagrams
- List of tools & instruments
- List of essential spares
- Commissioning test reports witnessed by Engineer and consultant.

40.7.The following information shall also be provided

- The percentage of spare parts for major equipment available ex-stock and the minimum lead-time required to importing spares.

- Availability of workshop facilities.
- Availability of after sales service facilities.

40.8. Testing and Commissioning

The contractor shall upon completion commissioning and testing the system submit two copies of a comprehensive report on commissioning and testing to the Engineer for approval.

Prior to commencement of commissioning a detailed procedure schedule is to be provided by the Contractor for the approval of the Engineer

Initial start-up and commissioning of the Air conditioning unit shall be done by or in the presence of the approved supplier. Final commissioning report shall be approved and signed by the supplier.

Finally, the Contractor shall demonstrate to the Engineer that the operation and the installation are in accordance with the specification.

All testing and commissioning records shall be bound into the operation and the installation is in accordance with the specification.

All testing and commissioning records shall be bound into the operation and maintenance manuals when the system has been successfully completed and witnessed by the Engineer.

40.9. Record Drawings

The Contractor is expected to keep one set of white prints of his approved drawings on site throughout the contract. This set of prints shall be used solely to record the progress of works and the exact nature of any deviation in the installation from that detailed on the approved working drawings. The prints shall be kept up to date on a day-to-day basis and shall be available for inspection by the Engineer at any time during working hours.

At the completion of each section of the work a record drawing should be prepared by the Contractor for submission to the Engineer.

The record drawings shall show the position of every item of plant, all pipe work runs, valves, drain cocks and all items requiring access for maintenance or cleaning and any other item of equipment forming part of the Mechanical Services Installation. Where relevant all sizes, capacities or ratings of equipment shall be given. All items buried or otherwise concealed shall be precisely located on the 'as installed' drawings by means of dimensions taken on site from some readily identifiable point (ie, main walls of building or finished floor levels). Where necessary, the Contractor shall also produce sections, elevations and part plans.

When all record drawings have been submitted to the Engineer and have been submitted to the Engineer and have subsequently been approved, the Contractor shall supply copies of these drawings in the following forms:

(i) Three sets of prints on white paper
(ii) One set of plastic copy negatives
(iii) Three sets of 'reduced' prints on A4 size card (Suitable for inclusion in operating and maintenance manual binder)
(iv) One set of soft copies in PDF, AutoCAD & Revit versions

40.10. After Sales Services

A price list of recommended spares for a two-year period of trouble free operation shall be submitted with the tender. These prices should remain valid for two years from the acceptance certificate issuance.

Tenderer shall guarantee the availability of spares for a period of ten years from the commissioning.

40.11. Operating and Maintenance Manual

The Contractor shall submit for approval an Operating and Maintenance Manual. This should include following items.

(i) Brief description of the system and the list of all parties involved in the project, architects, consultants, contractor etc.

(ii) Equipment schedule with make and model

(iii) Manufacturer's catalogues for all items of equipment forming the mechanical services installation

(iv) Manufacturer's operating and maintenance instructions for any item of plant chillers, pumps, air handling units, tanks etc.

(v) Manufacturer's drawings and spare parts schedule for the major items of equipment.

(vi) List of local suppliers and manufacturers of all items of equipment forming the mechanical services installation with their addresses, telephone/telex/fax numbers, contact personnel etc.

(vii) Reduced prints of services installation on A4 size card.

(viii) A Copy of the commissioning report

The Contractor having obtained the Engineer's approval for the Operating and Maintenance Manual shall supply three copies in PVC covered binders, Prior to Completion Certificates being issued.

40.12. Maintenance Tools

Each plant room shall be provided with a set of spanners, gland keys and other special tools required for testing or dismantling such items of equipment as compressors, pumps, valves, fans, coolers, etc., together with suitable holding rack arranged for wall fixing for one set and a padlocked box for the other two sets.

Two keys shall be provided for each size of lock-shield regulating valve air cock, automatic air valve or other valve requiring special tools to operate, together with duplicate keys for any clockwork mechanism or locks or instruments, safety valves, etc., supplied under the Contract.

Two grease guns of the lever type with oiling heads to suit grease nipples on equipment should also be supplied.

40.13.Spare Parts

The Contractor shall supply sufficient spare parts for each item of the equipment to provide maintenance for two years all in accordance with the recommendations of the individual manufacturers of equipment and as agreed in the contract.

Tenderer shall guarantee the availability of spares for a period of ten years from the commissioning.

Following List of Spare parts are to be handed over except 2 years recommended spares mentioned above.

1). Chiller Manufacture recommended spare parts for two years (Spare part List to be submitted)
- Chiller Touch Display with controller

2). Chilled water pump
- Spare pump with motor – 1 set
- VFD – 1 No.
- Mechanical seal – 2 sets
- Bearing – 2 Sets

3). Condenser water pump
- Spare pump with motor – 1 set
- VFD – 1 No.
- Mechanical seal – 2 sets
- Bearing – 2 Sets

4). Cooling Tower
- Fan motor including pulley – I set
- Motor bearing – 2 sets

5). Primary Air Handling Units
- 3 sets of fan belts for each unit
- 1 set of fan shaft bearing for each unit
- 1 set of PAU fan blower unit for each unit

6). Fan Coil Units
- Fan motors for each type as following table
- Bearing sets for each type as following table

FCU Quantity	Spare part Quantity
1 - 20	1
21 - 40	2
41 - 60	3
61 - 80	4
81 - 100	5

7). VRV/ VRF Manufacture recommended spare parts for two years. (Spare part List to be submitted)

a) PCB indoor & outdoor different type capacity-1Nos
b) Outdoor unit Fan motor-1Nos
c) Propeller-1Nos
d) Condenser coil different capacity-1Nos
e) Indoor unit Blower Motor different capacity-1Nos
f) Blower different capacity -1Nos
g) Drain Pump different capacity -1Nos

40.14.Air Conditioning & ventilation system, testing, balancing and commissioning

All air conditioning and ventilating equipment shall be tested in the presence of the Engineer. The tests shall be carried out for all automatic controls including, thermostats and safety controls. Pressure controls temperature controls; thereafter performance tests shall be carried out for specified capacities in the specifications. If tests are found unsuccessful, such equipment or accessories shall be replaced, free of charge by the bidder.

All medium and high-pressure ductwork shall be field tested during construction prior to insulating.

Duct risers and branches shall be individually tested. Each risers and branch shall be isolated from the remainder of the system by seals, plugs or caps. Risers installed in shafts shall be tested in sections to allow erection of shaft wall and duct insulation. Horizontal mains in mechanical rooms shall be tested after all riser tests have been accepted and after rises have been connected to mains.

40.15.Cleaning

Ducts, plenums and casings shall be thoroughly cleaned of all debris and blown free of all foreign mater and dust before installing outlet faces.

Equipment shall be wined clean with all traces of oil, dust, dirt or paint spots removed. Temporary filters shall be placed for all systems, which are to be operated during construction. Before final testing and balancing and commissioning new filters shall be installed. Bearings shall be properly lubricated with all oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. All control valves and other miscellaneous equipment requiring adjustment, shall each be adjusted to the settings indicated or required.

40.16.Field Test and Inspection

40.16.1. Inspection

After completion of installation, materials and equipment shall be inspected by the Engineer.

All equipment, materials, or work rejected because of defects or non-conformance with the Drawings and the Specifications shall be replaced or corrected by the Contractor as directed at no additional cost.

40.16.2. Testing

40.16.2.1.General

Upon completion and prior to acceptance of the installation, the Contractor shall subject the unit to operating tests to demonstrate satisfactory functional and operational. The Contractor shall furnish all instruments, and tests personal required for tests.

40.16.2.2.Test Requirements

Each mechanical system shall prove satisfactory and acceptable in accordance with requirements throughout and under the Contract Documents.

In addition to requirements herein, test shall be concluded as work progresses as required elsewhere under these Specifications.

Testing required herein shall be performed at presence of the Engineer, and times schedule arrangement shall be submitted in advance.

Sufficiently qualified personnel, time, materials and fuel shall be allotted and provided by the Contractor as necessary to provide and conduct all required tests.

Upon completion of electrical equipment (panel board, motor, control equipment, etc.) the Contractor shall not operate any equipment without the express approval of the Engineer.

40.16.2.3. Test Programs

Quality and commissioning test shall be carried out and conducted per programs as prepared and issued by the contractor and approved by the Engineer.

Test program shall also include such forms as deem necessary by the Engineer, which the Contractor shall utilize and execute accordingly and as applicable to the various kinds of work to be tested.
Test required shall be completed on schedule for activation of mechanical systems as required in accordance with this Section.

40.16.2.4. Test Reports & Records

(1) Reports

Forms to be issued by the Engineer and such others shall be devised by the Contractor and appropriate for information and data to be recorded.

For such tests as are required to be conducted work progress and for required tests conducted upon completion of work.

In cases where it may be necessary to perform a partial test and flaws are discovered at a later date such shall be corrected by the Contractor at his expense.

(2) Records

Furnish to the Engineer, within 14 days after completion of testing, one (1) copy for review.

Exact indication of site, date, hour, types of instruments used and precision of such instruments shall be recorded; in addition, necessary notes shall be registered regarding operations plus observed deficiency. This report shall be signed by the Contractor's representative and by the Engineer and shall serve as a basis for final documentation required under the Contract.

40.16.2.5. Repetition of Test

If any portion of the system or any piece of equipment fails to pass the tests, the Contractor shall make the necessary repairs or adjustments and the test shall be repeated until satisfactory performance is achieved at the Contractor's expense.

Test expense shall mean and include costs of materials and/or equipment, whether purchased or rented, and fees and expenses of the Engineer and others incurred in or for conduction such tests.

40.16.2.6.Quality Test

(1) General requirement

Quality testing shall include and consists of all such examinations, measurements, inspections; via visual, mechanical, instrumental or other means; as is necessary to demonstrate work does in fact meet all quality standards and performance requirements as shown or specified.

At least two (2) pressure gauges shall be used, with a total range of the scale not exceeding 4/3 of the test pressure. Precision shall be less than 5%.

(2) Piping test

Test all piping at completion of roughing in before permitting work to be covered or concealed per Following schedule.
Piping shall no loss in pressure or visible leaks after a minimum duration of 4 hours at test pressure indicated.

40.17.Test Requirement

Unless otherwise specified the required test pressures shall be maintained continuously for 2 hours without loss of test medium or pressure.

All joints in piping shall be accessible during test and shall not be painted, insulated or otherwise covered until satisfactory completion of testing.

All orifice plates, which interfere with filling, venting or draining, shall be removed prior to testing.

Records shall be made of each system tested, which shall include:

a. Date of test.
b. Identification of piping tested
c. Test medium
d. Test pressure
e. Approval by the Engineer

All tests records and Authorized certifications shall be retained in the job records.

40.18.Special Requirements

i. The specialized sub-contractor should have the ability to execute major projects. Documentary evidence in this regard should be forwarded by the tender.

ii. List of plant & equipment available & staff to be engaged in this project with qualification shall be submitted.

iii. The contractor shall submit with the offer broad outlines of the design of the Air-conditioning System offered inclusive of ductwork & piping lay out to meet the guidelines provided..

iv. Successful Bidder shall submit necessary design calculations for the selection of Equipment, AHU, Ducting, Piping and Insulation.

v. The complete installation shall be tested and commissioned in the Presence of the Commission Engineer from the manufacture with AASL Engineers.

40.19.Maintenance work during Defect Liability Period

a) Scope and Frequency of Maintenance
The Contractor shall carry out any preventive maintenance work as often as necessary to ensure that all M&E installations operates safety, free of faults, at the designed capacity and duty and in accordance with good trade practices, recommendations of the equipment manufacturers and statutory requirements.

b) Routine Inspection
The Contractor shall carry out periodic visual and physical inspection on the state of individual items of plant and equipment to find out if there are any items having abnormal wear and tear, malfunction, oil leakage, overheating, unusual noise, dislocation, mis-alignment, visual cracks, overloading, abnormal slackening or elongation, and excessive vibration etc. and to carry out subsequent re – inspection, tests and remedial measures to prevent further deterioration of the equipment and eventual unexpected costly break – downs and disturbance to building operation.

c) Maintenance Schedules
Based on the above requirements, the Contractor shall submit details of maintenance schedules stating clearly the weekly, fortnightly, monthly, quarterly, and yearly maintenance work in 3 months before commencement of the Defects Notification Period to the Engineer for approval. The Contractor shall carry out the work in accordance with the approved schedules. Any deviation which he intends to do shall be subject to the Engineer's approval in advance.

d) Site Records
The Contractor shall keep a record of all maintenance work giving relevant details of Contractor's staff, time of arrival, time of departure, and brief description of the work done for each visit. At least two copies of site record sheets shall be submitted to the Engineer for verification each time before the Contractor leaves the site. The format of the record shall be subject to Approval.

e) Stocking of Maintenance Spares

The Contractor shall bear all costs for spare parts used during routine maintenance. The Contractor shall be responsible for the stocking up the anticipated requirements of maintenance spares.

f) Emergency Call –out

The Contractor shall provide a 24 hour call – out service to attend to any breakdowns or faults immediately in the Plant irrespective of the causes of the damage of faults. For causes falling under the Contractor's liability, the costs of repairs shall be borne by the Contractor under the scope of this maintenance work. For other causes, the cost shall be determined in accordance with conditions of Contract. Where an immediate and complete restoration of the failed item is impractical or may cause inordinate disruptions to the building operations, the Contractor shall carry out any work necessary to ensure that the plant is safe and where possible, operable with the minimum penalties to the function of the buildings. The Contractor shall obtain the agreement from the Engineer before he commences work.

- Staff Requirements

The Contractor shall have enough appropriately qualified staff on standby at all time, to respond to summons for emergency services promptly. During the day time the response time shall be less than one hour, but during the other hours the response time shall not be longer than 2 hours. Response time is defined as the period between the placement of a

summon for service and the arrival on site of a full strength repair team with the appropriate tools and necessary spares.

Under all circumstance, the Contractor shall answer the call within ½ hours.

- Call out procedures.

The call out procedure shall be as follows:-

The Engineer shall place a telephone call to an approved, continuously- manned telephone number to summon for emergency call –out services. As far as practical the site conditions, the nature of the faults or damages will be given in the summon. The time such summon is placed will be recorded by the Engineer. When the Contractor arrives on Site, the time of arrival, the relevant details of staff and the accompanying equipment & tools, shall be verified by the Engineer.

On completion of the repair work, two copies of site record sheet shall be submitted for verification by the Engineer.

- Maintenance Gang

The Contractor shall submit the names, qualifications and relevant experiences of the emergency call – out team as well as routine maintenance gang for

approval not later than three months before the start of Defects Notification Period.

- Failure to Respond

If the Contractor fails to respond as prescribed in herein above within the specified hours, the Engineer may seek alternative service to remedy the fault. Any cost so incurred in connection with breakdown & repair irrespective whether the Contractor or deducted from monies retained for the Contract.

g) Standard of Workmanship

A workmanship shall be consistent with good trade practices and at least comparable to the standards achieved at the installed Plant. The Engineer may direct the Contractor to redo any maintenance work at no extra cost, if in his opinion the workmanship is considered sub– standard.

h) Quality of Spares

- All replacement spares used shall be new and of genuine parts supplied by the original manufactures.

- Subject to approval, the Contractor during emergency repair may use equivalent parts as temporary measures. However, the Contractor shall replace these parts at a later date when instructed by the Engineer. The Contractor shall bear the full cost of the work of replacing the temporary parts and any associated work.

40.20.GUARANTEE AND WARRANTY

All materials, items of equipment and workmanship furnished shall carry the two (02) years warranty against all defects in materials and workmanship. Defective or improper material, equipment, workmanship or design shall be made good by and at the expense of the Contractor including all consequent damage to areas, materials and other systems resulting from this failure. Warranty shall be effective from date of the issue of the certificate of completion for the Works.

(j) Maintenance Reports

The Contractor shall provide a detail report on any defect or breakdown experience during either the routine maintenance services or the emergency. This report shall normally be submitted for approval within one week after the above remedial work.

41. MVAC BMS CONTROL AND MONITORING SYSTEM

41.1. Introduction

The Automatic Control and Monitoring System for the proposed Chiller plant shall be supplied, configured, installed, commissioned and demonstrated by the BMS & Automatic Controls System Specialist.

41.2. General Description

A Computerized Automatic Control and Monitoring System shall be provided for the MVAC installation, as specified in the tender document. This system is intended to enhance energy efficiencies and improve the overall durability of the system. By utilizing advanced control algorithms and real-time monitoring capabilities, the system shall optimize the operation of the MVAC equipment, ensuring that it operates at peak performance while minimizing energy consumption. Additionally, the system shall provide detailed insights into the performance of the MVAC system, enabling proactive maintenance and troubleshooting to further enhance its longevity and efficiency.

41.3. General Description

The system shall be installed by competent technical team certified by the manufacturer of the Automatic Control and Monitoring System
The Automatic Control and Monitoring System Contractor shall be the single source responsibility for the complete installation and proper operation of the BAS and controls system, and shall include debugging and proper calibration of each component in the entire system.

The complete Automatic Control and Monitoring System installation shall be in strict accordance with the national and local electrical codes.

The contractor shall be competent in providing a total quality assurance for both his control products and services by consistently maintains a quality system in accordance with standard Tender Submittal Procedure to allow evaluation of vendors and systems, a detailed technical proposal shall be provided and formatted strictly in accordance to this outline. Contractor standard literature not complying with this format and content requirement will not be considered or evaluated. Proposal requirements as follow.

I. Proposed system schematics complete with block diagram including central computer type and memory, peripherals, communication interfaces, all, network layout and distributed DDC controllers.
II. System write-out / Description of the proposed Automatic Control and Monitoring System.
III. The following functions/items shall be included in the proposal for system evaluation
    - Computer based central operator workstation

a) Day-to-day interactive operator interface description with sample English/Graphic displays (refreshing rate, analog display bars etc.), penetration scheme for display/command and system configuration (password assignment, global holiday broadcast etc.)
b) Color graphic system description with sample system displays, color graphic penetration and command schemes (schedule, PID loop, trend plot etc.), graphic creation means and library of symbols.
c) On-line DDC programming and control parameter modification: Interactive data editing scheme for modification/ adding & delete of DDCs application database and parameters including point descriptors text, time schedules, point monitoring limits, event initiated control, and control application program parameters.
d) DDC data point trending for both dynamic and historical sample plot and technical information.
e) Sample sequence of operation and flowchart display.
f) Sample text for alarm message and action message.

i. Technical description of all hardware components.
ii. Direct Digital Controller (DDC) technical write-out.
- Functional description
- Scan/report speed and alarm detection speed
- Control cabinet layout.
- Self-diagnostic features and circuit protection and MTBF.

iii. Communications network architecture
- Protocol description, host independent, LAN-cut reaction.
- LAN limitation (number of controller, number of points, number of work stations etc.)
- Error checking, collision prevention, recovery.
- Point sharing/update scheme (LAN wide global points sharing - number of points per DDC / LAN, LAN to LAN communication etc.)
- Remote communication capabilities: (Alarm dial-out, remote dial-in, GUI remote operator terminal, number of remote sites supported etc.)

IV. Available services for DDC local production, full system maintenance, software updates and modifications, hardware spare parts, adds and changes, system training and training classes.
V. Contractor experience/capability.
a) Organization with key brief resumes.
b) Local experience.
c) Local facility description

VI. Quality Assurance procedure, person in charge and certification.

41.4. Scope of Work

The Automatic Control System shall be supplied, installed, connected to the existing BMS server which shall be installed at a place requested by the client. And test, commissioned, demonstrate to the operating staff at control room BIA and local control room at CIAR.

The following equipment shall be incorporated.

i. Computerized control and monitoring system with DDC on a local network (LAN) and IP enabled. Each controller shall be capable of stand-alone operation and communication with other controllers on the network.
(All the control programs, graphics, time schedules, and history logging shall be stored in the DDC memory, and a full backup of the DDC should be saved to the Central Server every night. In the case of DDC failure, the backup should be able to upload to the new controller without any modification. The new controller should perform all the functions of the failed controller.)

ii. Integration of workstation complete with PC and printer as well as communicating gateways for the LAN for all the Integrated Systems as detailed below.

iii. Supply of Control equipment (sensors, valves, valve actuators, damper actuators) etc as detailed within the schedules for MVAC system.

41.5. MVAC Control System Architecture

The ACMV control system architecture shall be designed to ensure efficient monitoring and control of the building's air conditioning, mechanical ventilation, and other related systems. It shall consist of the following components:

i. **Server and Workstation:** The system shall include server and workstation license software along with a computer. The server shall act as the central hub for data collection, processing, and storage, while the workstation shall provide a user interface for system operators.

ii. **DDC Controllers:** The system shall incorporate microprocessor-based DDC controllers with a web server and memory for local operation in the event of communication failure with the central server. These controllers shall be responsible for monitoring and controlling various ACMV systems, such as chillers, air handlers, and ventilation fans.

iii. **Sensors and Actuators:** A comprehensive array of sensors and actuators shall be deployed throughout the building to ensure precise monitoring and control of the MVAC systems. These devices shall enable the system to optimize energy consumption while maintaining the durability of the components.

iv. **Network and Cable Management:** A robust network and cable management system shall be implemented to connect all MVAC control system components with the central server computer. This infrastructure shall also facilitate connectivity with DDC controllers and field devices, ensuring seamless communication and data exchange.

Overall, the MVAC control system architecture shall be designed and implemented in accordance with industry standards and best practices to ensure reliable and efficient operation of the building's air conditioning and mechanical ventilation systems.

41.6. Integration of the system to the Existing Control and Monitoring Server (BMS) at pier building

The new system needs to integrate seamlessly with the existing Building Management System (BMS) at Katunayaka Bandaranaike International Airport, which currently uses Schneider Struxureware SBO V 1.9. This integration involves ensuring that the two systems can communicate effectively and share data.

i. **Monitoring and Control:** The system should be capable of monitoring and controlling various facilities within the airport. This includes functions such as checking the status of equipment, sensors, and systems, as well as being able to adjust settings or turn devices on and off as needed.
ii. **Central Control System:** There should be a central control system at Katunayaka Airport that serves as the main interface for monitoring and controlling the facilities. This central system should provide a comprehensive overview of the entire BMS and allow operators to manage it efficiently.
iii. **Local Control at CIAR:** In addition to the central control system, the new BMS should also allow for local control at CIAR. This means that operators at Ratmalana should be able to perform functions such as history assignment and monitoring /control, scheduling, and set point adjustment directly from their location.
iv. BIA control room workstation license software along with a computer
v. Portable workstation computer for On-line DDC programming
vi. **Remote Operation:** The system should support remote operation, allowing authorized personnel to access and control the BMS from a remote location. This enables operators to manage the facilities even when they are not physically present at the airport.

Overall, the goal of these specifications is to ensure that the BMS is flexible, user-friendly, and capable of meeting the monitoring and control needs of the airport's facilities both locally and remotely.

41.7. Local Area Network (LAN)Network Provided by ELV Contractor or AASL, IP Provided by AASL

The DDC LAN shall be directly connected to the workstation. Connections via a communication interface / gateway will not be accepted. The network shall allow PC work stations to interface to the DDC LAN at any point on the network directly.

41.7.1. Direct digital controller (DDC)

41.7.1.A. Controller Hardware

All points in the system shall be monitored and controlled through an intelligent" Direct digital controller (DDC). It shall be capable of executing application control programs to provide:

a. Calendar functions
b. Scheduling
c. Trending
d. Alarm monitoring and routing
e. Time synchronization by means of an Internet site including automatic synchronization
f. Native integration of Modbus controller data or BACnet controller data and Modbus controller data

Two ethernet port should be there which capable for connecting through redundancy network or connect portable workstation to direct login to the DDC for Monitor, control and change the configuration if necessary.

DDC in the system shall contain its own microprocessor and memory with a minimum 30 days battery backup.

The controller shall be configured with not more than 250 control points. DDC Panel shall have sufficient capacity to accommodate a 10% increase in the number of external I/O points connected without requiring any additional components. Following point types must be supported by the DDC's.

- Discrete/digital input (contact status).
- Discrete/digital output (maintained, momentary, dual momentary, floating).
- Analog input (4-20 mA / 1-5 VDC/0-10 VDC with 12-bit A/D conversion resolution minimum).
- Analog output (4-20mA / 0-10 VDC).
- Pulse input capable of accepting 8 pulses/ second and accumulating total.
- Pulse Width Modulation (PWM) output capable of producing a pulse in duration with 100 ms resolution.

The DDC shall have the ability to monitor, control or address not less than 250 data points.

DDC shall contain the necessary firmware and I/O capability to function independently in case of a network failure. No active energy management or environmental control sequences shall be resident in the PC work stations.

System making use of a Master & Slave DDC architecture (where more than two type of controllers; one as a master, the other as a slave); and DDC with software generated clock timing (require gateway for clock synchronization) shall not be acceptable.

To minimize the down-time the CPU of the DDC Panel and all the I/O Modules shall be a hot swappable two-piece modular design.

41.7.1.B. DDC Upload/Download Capability

DDC shall be able to download from or upload to any PC operators work station. This upload/download shall be readily performed on a regular basis without interrupting the control functions in the DDC. All upload/downloads shall be performed without the operator workstation being taken "off-line".

Automatic Restart on Power Failure

The DDC shall include a software program to automatically restart field equipment on a restoration of power following a DDC power failure.

An owner defined time delay between individual equipment restart shall be provided. In addition, the software program shall allow equipment to be energized or de-energized based upon the time of day start/stop program in effect at the time of power restoration at the DDC.

Optimum Start/Stop

Each controlled point shall include an adaptive, self-learning, software program to perform optimized start-up and/or shutdown of selected equipment. The SSTO program (Start stop optimization program) shall start MVAC equipment at the latest possible time and still allow the equipment to achieve the desired zone conditions by occupancy time. The SSTO program shall also shut down MVAC equipment at the earliest possible time before the end of the occupancy period, and still maintain desired comfort conditions.

The system operator shall be able to, for each point under control of the SSTO program, establish and modify the following parameters:

- The occupancy period
- The desired temperature at the beginning of the occupancy period
- The desired temperature at the end of the occupancy period
- The maximum earliest start allowed prior to the scheduled start of the occupancy period. The actual system calculated time to start shall be displayable as a system value.

The Central Plant shall be started as the result of the first zone being activated by its distributed SSTO program - not by a separate time based or optimized program.

Direct Digital Control (DDC) Modules

Microprocessor-based, modular type DDC shall be used with separate CPU Module, Power supply Module, and adequate number of Hot Swappable I/O Modules to interchange in failure of any module during operation without shutdown the DDC for 24-hour operation of critical applications. Each module shall be able to separate from its terminal base to allow the site to be wired prior to the installation of the electronics.

All the DDC's shall be web enabled and can be logged via web browser from anywhere in the network. It should also be accessible from anywhere via a static IP address.

DDC Controller must have a flash type memory not less than 4GB, for 2GB for application historical data and 2GB for backup storage purpose of Control Logic, Events and Trends and a Built-in USB port to connect to external devices. DDC should have the capacity to store the historical data logs of I/O points locally. If the DDC LAN fails it should automatically store the relevant data in the DDC and back it up to the Main server when the DDC LAN reconnected.

The DDC must natively support to the BACnet, Modbus and LonWorks communication protocols via a built-in ports. All device which communicate through those protocols must be directly connected to the DDC and protocol converters must not be used between device and DDC. (The DDC shall be operating on an open standard protocol and no propriety protocols and middle level servers and converters shall be allowed)

The following types of modules shall be supported in firmware for each DDC in the system:

- PID controller with analog output or PWM output
- PID controller with floating (paired) output
- Two-position controller
- Primary and secondary reset schedule selector
- Hi/Low signal selector
- Single pole double throw relay
- Single pole double throw time delay relay with delay before break, delay before make and interval time capabilities

Each DDC shall provide "Block" and "Script" both programming software so that the operator can easily develop custom control strategies and sequences of operation, without learning a programming language. Control loops and sequences shall be defined using "Block" that are analogous to traditional pneumatic or electric control devices. Modules may be linked together to form more complex control strategies. The use of mathematical equations, "BASIC", or proprietary programming languages for defining a DDC control loop is unacceptable.

Potentiometers for Analog Output Commands, and Override Digital command switches for simulation, commissioning and easy troubleshooting purposes.

The DDC Panel shall be responsible for performing all of the features of the system including:

(i) Password Protection
(ii) Alarm Management
(iii) Scheduling
(iv) Trend Log
(v) Point History
(vi) Totalization

Uninterruptable Power Supply (UPS)

The contractor shall provide on line configured UPS to supply power for the work-station and DDC for a period of 30 minutes in the event of loss of mains supply.

41.8. Sensors and transducers

41.8.1. Temperature Sensor

Provide thermistor or thin film silicon sensors for all temperature applications. Sensors shall require only a one-time calibration. Thermistors, or similar non-linear temperature devices shall be linearized by a look-up table in the connected controller.

i. Space temperature sensors shall be provided with blank institutional type locking plastic covers.
ii. Duct temperature sensors shall be rigid stem type.
iii. Water sensors shall be provided with a separable thermo-well.
iv. Outdoor air wall mounted temperature sensor shall be provided with a sun shield if installed outdoors.

41.8.2. Humidity Sensor

Space and duct Relative Humidity sensors shall be of the state-of-the-art capacitance type. Humidity sensors shall have an effective sensing range of 10% to 90% RH. Output signal shall be 4-20 mA corresponding to 0% to 100% RH. Accuracy shall be better than +/-5%.

41.8.3. Analog Static and Differential Pressure Sensors and Transducers

Water pressure monitored points shall be provided with analog sensors of high accuracy, with no moving parts, and suitable for the expected pressures to be encountered, be selected for approximately 100% over- range, and have 4 to 20 mA or other suitable outputs for direct connection to the DDC inputs. The pressure

sensors shall have integral temperature compensation and stability shall be +/- 0.5% F.S.O. or better. Short circuit protection shall be integral with the sensor.

Air flow and static pressure analog sensors shall be high accuracy, suitable for the low velocity, pressures to be encountered, be selected for approximately 50% over range, and have standard output signals, e.g. 4-20 mA. Signals that are specific to a manufacturer's DCP input range will be acceptable provided the sensor is of the same manufacturer as the DCP. These differential and static pressure sensors shall have temperature compensation built-in and stability shall be +/- 1% F.S.O. or better. The differential pressure sensors shall be connected to the air flow measuring stations and other measuring devices with valve lines for testing and calibration, and shall have integral zero and span adjustment or DCP controlled zero and span adjustment. For contractor who offer a lesser accurate sensor, sufficient quantity of such sensors shall be provided to average out to the specified standard. Example, 2% type needs two number of sensors.

41.8.4. Digital Static and Differential Pressure Sensors and Switches.

Fan proof-of-flow switches shall be with adjustable set point and differential pressure type. Switches shall be piped to fan discharge except where fans operate at less than 1-inch water column, they shall be piped across the fan. For fractional horsepower and non-ducted fans, relays or auxiliary contacts maybe used. Adjustable range shall be 0.05 to 9.0-inch WC.

Pump proof-of-flow switches shall be adjustable differential pressure or flow type. Device shall be 150psi rated, except chilled water flow switches shall be provided with totally sealed vapor tight switch enclosure on 300 psi body. Differential pressure switches

41.8.5. Stand-alone Digital Fan Coil Thermostat

Features

Modern appearance
Large, blue backlit, LCD screen
Eco button for energy saving
Button lockout function avoids unauthorized operation
Non-volatile memory (EEPROM) retains user setting during power loss
Low temperature protection
Standard 86x86mm box for installation
Temperature sensors are provided with failure alarm function to facilitate maintenance
Room temperature displayed
Set Temperature displayed

Technical specifications

Power supply: AC 85 ~ 260 V, 50/60Hz
Terminals: can be connected to 2 x 1.5 mm2 or 1 x 2.5 mm2 conductors
Load current: 2 A (resistive load),1 A (inductive load)

Motorized valve control FCU Thermostat for 2-position on/off actuator (2-wire) ON/OFF, PICV type 230VAC

Motorized valve control (2-pipe models): In cooling mode,

The cold water valve will be opened when the room temperature is 1°C higher than the temperature setting or closed when the room temperature drops to the setting,

Communication protocol is Modbus RTD
Modbus baud rate 9600 bps, 02: 19200 bps,
Fan mode setting can be High, Medium,
Low or Auto. No Fan Auto in Ventilation mode
Temperature sensor selection: Built-in, 01: External Accuracy ±1 °C
Set-point range 5 to 35 °C
Display range 0 to 50 °C (shown in 0.5 °C)

41.9. Cabling

0.75 mm^2 shielded twisted pair (STP) cables shall be laid between DDC and field devices. All cable shall be laid using necessary conduits trays etc. in proper manner.

41.10. Mounting of field devices

All Field Devices shall be mounted in easy accessible locations for maintenance work, and shall be installed according to the manufactures recommendation.

41.11. Control Logics and HMI Graphics

Control Logics and HMI Graphics shall be submitted for AASL Approval prior to commencement of work
Integration to the existing system shall be done with a minimum down time and shall not disturb the function of exiting BMS system.

41.12. Site Training

A comprehensive operational and maintenance training shall be carried out at the site by a manufacturer certified trainer. This shall be carried out during the implementation period.

41.13. Warranty

All components, system software, parts and assembles supplied by the manufacturer shall be guaranteed against defects in materials and workmanship for two (2) years from the date of acceptance certificate.
Labor to troubleshoot, repair, reprogram, or replace system components shall be furnished by the control contractor at no charge to the owner during the warranty period.
All corrective modifications made during warranty service periods shall be updated on all user documentation and on user and manufacture achieved software disks.
All software adjustment, during the warranty period shall be free of charge.

QUALITY OF EQUIPMENT & MATERIAL OFFERED

(TO BE COMPLETED AND ATTACHED TO THE BIDDING DOCUMENT BY THE BIDDER WITH TECHNICAL CATALOG)

No.	Item	Make offered	Supplier	Country of Origin	Country of Manufacture
1	Chillers				
1.1	Compressors of the Chillers				
2	Automatic Condenser Cleaning System				
3	Chilled water pumps				
3.1	Motor of chilled water pumps				
4	Condenser water pumps				
4.1	Motor of condenser water pump				
5	Cooling Tower				
5.1	Motor of Cooling Tower				
6	PAUs				
7	Chilled Water Pipes				
8	Condenser Water Pipes				
9	Thermal Insulation				
9.1	Insulation Adhesive				
10	Valves				
11	Sensors				
12	Gauges				
13	Chemical Dosing Pumps				
14	Grille				
15	Louvers				
16	Diffusers				
17	Dampers				
18	Fire Dampers				
19	CO2 sensors				
20	Ducts				
21	Electrical Panels				
22	VSD				
23	RCCB / RCD				
24	MCB				
25	MCCB				
26	Isolator				
27	Cu/PVC/SWA/PVC Cables Cu/PVC/PVC Cables				
28	Cu/ XLPE/SWA/PVC Cables Cu/XLPE/PVC Cables				

No.	Item	Make offered	Supplier	Country of Origin	Country of Manufacture
29	Steel Enclosures (Epoxy Powder coated finish)				
30	PVC Conduits				
31	G.I. Conduits				
32	Energy Meter / Power analyzer				
33	Cable Trays/Cable Ladders				
34	BMS Item				
35	Communication cable				
36	Monitor				
37	Printer				
38	LED Lamps				
39	13A Switched socket outlets				
40	10A one Gang switches				
	VRV Units				

Date :……..

Signature of Bidder: ……..

Company Seal : ……..

AASL

FIRE WATER SYSTEM

FIRE WATER SYSTEM

1.0 GENERAL TECHNICAL SPECIFICATIONS

1.1 Introduction

The requirement specified in this section shall apply to all the work involved in, supply and installation of fire pumps, necessary pipes & specials, valves and other accessories for the Proposed Navigational Service Complex at CIAR.

All equipment being supplied shall be suitable for operation under tropical conditions with ambient temperature up to 36°C and relative humidity up to 90% but not both simultaneously.

1.2 Fire Protection

This section consists of the general rules that apply to the design, manufacture, shop testing, delivery to site, installation, commissioning, factory testing, site testing, maintenance during defects liability period and handing over the plant, equipment and services required for the Fire Protection System and related work as stipulated in the specifications, drawings and the equipment list for **the Proposed Navigational Service Complex at CIAR.**

To meet the requirements of the Local Fire Department regulations the following services shall be provided in the premises complying with BS standards and CIDA Fire Regulation in Sri Lanka and as detailed in the drawings.

I. Supply and Installation of wet riser fire hydrant system complete with fire pumps, landing valves, hose reels, pipelines, fittings, fire cabinets etc. as per drawings and specifications.

II. Supply and Installation of portable fire extinguishers at the locations shown on drawings.

Co -Ordination

The Fire Contractor shall co-ordinate the Fire Protection installation with installation work of all trades involved in the project to avoid interference with lighting fixtures, piping, ducts, etc.

1.3 Submission of Contractors

1.3.1 General

The Contractor shall make for approval by the Engineer of the following, but not be limited to those.

- Selection Data/Equipment Data
- Samples of Materials, Component and Fixtures and Equipment
- Design analysis and calculations
- Detail and/or Shop Drawings

- Schematic & Interconnection Diagrams
- Monthly Progress Report
- Certificate of Compliance/Test Reports
- Operation and Maintenance Manuals

All the documents shall be in language of **English.** Selection data shall be submitted in triplicate and shall consist of engineering selection tables provided by the manufacturer for the performances and the acoustics of equipment. The Contractor shall indicate in these, the items selected and their designation for cooling equipment.

These documents in required number of copies specified should be handed over to the Engineer and Engineer required minimum **twenty-one (21) days** to check and give the approvals. Therefore, the Contractor shall consider that time period for submissions and approval process, while preparing the Schedule of Contract Work. All the submittals (technical, sample and shop drawings etc.) forms shall be signed by the Technical Manager assigned for the project, on behalf of the Contractor.

1.3.2 Shop Drawings (Working Drawings)

The contractor shall prepare and submit to the Engineer for approval three copies of the following shop drawings as a minimum. These drawings shall be submitted in hard copy and soft copies in both PDF and AutoCAD versions. The drawings shall be submitted in sufficient time for the approval to be granted before starting installation at the site.

(i) Plans showing fire boxes, landing valves and hose reel locations.

(ii) General arrangement plans, layout and outline drawings of system components

(iii) Position plans and sectional installation details

(iv) Schematic diagrams and interconnection diagrams.

Signed and approved drawings shall not be deviated from unless a signed variation or a site instruction is issued in writing by the Engineer.

Amended or altered drawings shall show the nature of the amendment or alternation in a revision block on the drawing, together with the revision number or letter and the date of the revision.

The contractor shall be responsible for any discrepancies, errors or omissions in the drawings and other particulars supplied by him whether such drawings and particulars have been approved by the Engineer or not, provided that such discrepancies, errors or omissions are not due to in curate information or particulars furnished in writing to the Contractor by the Engineer.

1.3.3 Technical Literature of Equipment

Technical literature of all equipment proposed to be used in the system inclusive of dimensional drawings, capacity tables & other selection data, certificate of compliance, test reports and other relevant information shall be supplied in triplicate for the Engineer to determine the adequacy and suitability of the equipment for the proposed fire protection system.

All the documents shall be in language of **English**. Selection data shall consist of engineering selection tables provided by the manufacturer.

These documents in required number of copies specified should be handed over to the Engineer and Engineer required minimum **21 days** to check and give the approvals. So, by preparing the working schedule, contractor may consider that time period for submission.

1.3.4 Monthly Progress Report

Contractor shall submit a detailed report to the Engineer by presenting the progress of work at site for each and every month. The report shall include with photographs of site premises to validate the facts mentioned in the report.

Actual completion time for each and every task shall be analyzed with the scheduled time target stipulated in the Schedule of Contract Work. The contractor shall justify the reasons for lapsed tasks and shall submit a proposal to expedite the same work to aligned with the scheduled time targets.

1.3.5 Maintenance & Operating Manuals

Maintenance and operating manuals of all equipment supplied shall be furnished in triplicate with detailed diagrams of the equipment, piping & valve arrangements and instructions of the regular maintenance of the equipment.

Frequency of lubrication and specifications of the lubricants recommended shall also be provided. All manuals should be printed, and ring bound with a schedule which may be in the form of a material list giving all particulars together with ordering references of all replaceable parts for all the equipment which will be supplied.

1.3.6 Samples

Samples of all materials to be supplied under the contract such as pipes and multiple fittings such as valves, strainers, electric components shall be supplied to the Engineer for approval. Such samples shall be kept with the Engineer until completion of the Works and same will be released to the Contractor on completion of work. The items of supplies used for the project shall be at least equal in quality to the approved sample.

All the samples shall be clipped/ mounted on a timber board with white colour finished and each item shall be labeled in black colure, indicating equipment name, make, model number and serial number. The project name shall be mentioned at the top of the board and the details of the Contractor shall be mentioned at the bottom of the board.

1.3.7 As-Built Drawings

On completion of the installation, the Contractor shall prepare a set of As-built drawings incorporating all changes made to the original design and drawings, which drawings shall represent an accurate description of the installed systems. The drawings shall be submitted in hard copy and soft copies in both PDF and AutoCAD versions. These drawings shall be bound with covers into an album and handed over to the Engineer.

1.3.8 Handing Over Documents

The final handing over documents to be submitted by the Contractor on completion of the installation shall comprise the following:

a)	Operation and maintenance manuals	(3 copies)
b)	Commissioning sheets	(3 copies)
c)	Test reports	(3 copies)
d)	As built drawings	(3 hard copies and 1 soft copy in CD)

These documents, in required number of copies specified, should be supplied to the Engineer within 30 days on issue of taking over certificate.

1.4 Site Testing and Commissioning

Bidder shall submit with the Bid, a complete proposal with time schedule for testing and commissioning of the fire protection system. The program shall include a trial operation of all main equipment with any necessary adjustments to ensure that the system is working correctly. The Contractor shall provide all instruments and equipment together with commissioning engineers and adequate assistance for carrying out the commissioning and testing activity which shall be done in accordance with the recommendations of relevant Standards. Each pipe and fittings shall be tested under an internal hydrostatic pressure of 15 bar for a duration of 24 hours If any portion of the works fails to pass the tests, the Contractor shall, at his own expense carry out such alterations or replacements as are required to the satisfaction of the Engineer. The Engineer shall be at liberty to call for further commissioning when such alterations have been completed to their satisfactory. The Contractor shall provide commissioning spares at his own expense.

Spare parts earmarked for maintenance shall not be used during this period.

1.5 Training of Owner's Staff

Bidders shall submit with the bid, a full proposal of the recommended training necessary for the owner's personnel to attend to routine testing, maintenance service and minor repairs including an indication of the duration of such training.

The number of persons required to be trained shall be determined jointly by the Engineer, and the Contractor.

The scope of training shall include on-site training and such training shall be prior to hand-over of the system. Technical training and system operation instructions to the owner's personnel shall also be provided during the commissioning and performance tests phases of the system.

System operation instructions shall be given by an experienced and competent representative of the Contractor who is thoroughly conversant with the fire protection system installed.

1.6 Maintenance Contract

Bidder shall submit the terms and charges for service and maintenance contract along with the bid.

2 FIRE PROTECTION SYSTEM

Fire Protection System of the building shall consist of a Fire Hydrant System. The pumping set for the system shall be installed in the pump room. Water for the wet risers shall be fed from the water sump through the respective pump sets.

2.1 Scope of Work

Scopes of works are as follows but not limited the followings:

i. Supply and installation of all equipment and material required for Fire Protection system.

   a) Wet Riser System for the whole areas
   b) Fire Suppression system for the Equipment room.

ii. Providing required labour for installation of the complete system.

iii. Testing, commissioning and handing over the system on successful completion.

iv. Submitting sets of operation and maintenance manual and necessary software.

v. Maintenance during installation and defect liability period.

Submitting sets of As-Built Approved Drawings together with Operation and Maintenance manuals and necessary software on completion of work

2.2 Applicable Publications, Standards and Certification

All equipment and components of Fire Protection System supplied shall comply with the latest edition of the respective Standards below and amended thereof.

A. British Standards Institution
- BS 5306 Fire Extinguishing Installations
  - Part 1- Hydrant Systems, Hose Reels and Foam Inlets (Formally CP 402)
  - Part 3- Portable Fire Extinguishers
- BS 5041 Fire hydrant Systems Equipment
  - Part 3- Inlet Breeching for dry risers
  - Part 5- Boxes for foam inlets and dry risers
- BS 334 Fire Hose Couplings and Ancillary equipment
  - Part 1- Specifications for landing valves for wet risers
- BS 5274 Fire Hose Reels (water) for fixed installation

B. National Fire Protection Association (NFPA)
- NFPA 14 - Installation of Standpipe and Hose System
- NFPA 20 - Installation of stationary Pumps for Fire Protection System
- NFPA 22 - Water Tanks for Fire Protection Systems
- NFPA 24 -Installation of Private Fire Services Mains and Their Appurtenances
- NFPA 70 – National Electrical Code
- NFPA 232A - Guide for Fire Protection for Archives and record Centers
- NFPA 5000 - Building Construction and Safety Code

C. Fire Regulations issued by Construction Industry Development Authority of the Ministry of Housing, Construction and Public Utilities, Sri Lanka

D. Electrical & Mechanical works Regulations issued by Construction Industry Development Authority of the Ministry of Housing, Construction and Public Utilities, Sri Lanka

E. Requirements of Fire Service Department of Colombo Municipal Council.

2.3 Design Conditions

Fire Hydrant System

- Water quantity at furthest three hydrant connections - 25 l/s
- Pressure required at furthest hydrant -5 bar (max)
  Connection valve fully open 4 bar (min)

- Water quantity at furthest hose reel connection - 0.5 l/s
- Minimum pressure required at hose reel nozzle - 1.25 bar

- Required total flow rate for the wet riser system- 1500 l/min

2.4 Other Requirements

If the specification, capacities and sizes given are not adequate or have to be changed to suit an equipment of any manufacturer for producing required design conditions the Contractor shall include his charges for these with the quotation. Once the contract is awarded no extra cost will be made to the Contractor for such changes.

All the materials shall be new without any defects and to be approved by the Engineer.

All the approvals required to be obtained prior to the installation and after the completion shall be obtained by the Contractor from the respective Local Bodies.

All builders work required with respect to plinths and foundations, opening on walls (both concrete walls and brick/block walls) and floors and any additional provisions required shall be included in the Scope of Work.

2.5 WET RISER FIRE HYDRANT SYSTEM DESCRIPTION

2.5.1 Fire Sump

The fire water tank is situated at Ground Level closer to fire pump room. Water supply for the fire protection system will be drawn from the fire water sump. The fire sump shall be complete with all necessary provisions such as:

- Inspection hatches.
- Water supply connection connected to city main.
- Ladder.
- A level gauge shall be provided and install in an easily accessible location in the pump room so that the actual content of the water sump can be visually determined.

2.5.2 Wet Riser Fire Pumps

Wet riser Fire Pump set completely assembled shall consist of followings but not limited.

- 02 Nos. of Fire Pumps [one duty pump / one standby pump] with electric motors, 400V/50 Hz Capacity of each pump: **1500** l/min at **9.0** bar
- 1 No. jockey pump with electric motor,
  400V/50Hz, Capacity of pump: **60** l/min at **9.5** bar.
- ***Above Fire Pumps shall have positive suctions. If this is not feasible, vertical turbine pumps shall be used.***
- ***Fire Pump system shall be commissioned and the following performance parameters shall be tested,***
  - *Churn: Fire pumps shall be operating with no flow.*
  - *Rated capacity: The pump shall be discharging water at the specified pressure.*

- *Overload: The pump shall be discharged water at a rate of 150% of rated flow at a pressure of 65% of the rated pressure.*

- Pressure switches & flow switches for commanding the pumps.
- Pressure gauges dia. 63mm 0-16 bar.
- Pressure tank.
- Non return valves with coupling.
- Shut off valves.
- Priming arrangement.
- Suction header.
- Delivery header.

2.5.3 Pump Control Panel (Wet Riser System)

Control Philosophy

Fire Pump Set in Automatic Control Mode:

a. Jockey pump shall be maintained system pressure at 1.0 bar higher than design system pressure and shall cut in before main pump at low demands and cut off at 1.0 bar above cut in pressure.
b. Duty pump (main pump) shall cut in when the system pressure drops by 1.0 bar against pre-set pressure level as dictated by the system.
c. Standby pump shall cut in on failure of duty pump (main pump) or a pressure loss on the system.
d. Auto pump selector switch shall select lead fire pump alternatively.
e. Pumps shall run until they are manually shut off.

Fire Pump Set in Manual Control Mode:

a. Any pump shall be able to On / Off manually.
b. Lead / Lag pump selection shall be possible manually.

Indicator Lamps, Controls and Instruments on Pump Control Panel are as follows but not limited;

- L1, L2 and L3 phase indication with R, Y, B lamps.
- On / Off / Fault lamps for each pump.
- Indicator lamps and lamp test switches.
- Lead / Lag pump selector switch.
- Auto / Off / Manual mode selector switch.
- Main ON / OFF switch.
- Fail alarm and mute switch.
- Voltmeter with phase selector switch.
- Ammeters for each phase with maximum demand indicator.
- Water sump level indicator (Audio & Visual).

Protection only for the Jokey Pump and interfacing are as follows but not limited;

- Pump set dry run protection by float switch.
- Single phasing cut off.
- Thermal over load protection for each pump motor.
- Interfacing with fire detection and alarm system for status indication.

Control Panel construction and main components are as follows but not limited;

- Control panel shall be powder coated sheet steel panel rated IP 54 with lockable door.
- Star-Delta / DOL starters for pumps.
- Main incomer breaker.
- Breakers for all out going feeders to pumps.
- Main bus bars and earthling bus.
- Programmed switch for automatic change over and delayed cut-out signal.
- Contactors, relays, interlocks, CT's fuses, etc.

2.5.4 Fire Hose

In the fire cabinet located as indicated in the drawings synthetic fire hose of 65mm dia. ($2^1/_2$"), 3 x 15m length made of nylon and totally covered with PVC lining shall be provided along with rubber hose reel of 19mm dia. each 45m in length.

Fire hose shall be light weight and flexible with woven synthetic jackets and zone resistant, seamless rubber, smooth-bore lining suitable for fire brigade use. They shall be certified by makers to withstand an internal water pressure of not less than 40 bar without bursting. They shall also be capable of withstanding a working pressure of 16 bar without leakage or undue sweating.

The branch pipes shall be light alloy complete with spray/jet diffuser nozzle, 16mm (5/8") orifice and 2 1/2" male instantaneous British inlet.

Each hose length shall be indelibly marked to identify the fire station or wall to which it belongs and numbered. The precise marking shall be agreed with the Engineer.

Fire hose shall be confirmed to BS 336.

2.5.5 Landing Valves

The landing valves shall be of gunmetal construction with 2 1/2" BST flanged inlet and oblique 2 1/2" female British Standards instantaneous outlet to ensure compatibility with the Local Fire Department equipment. A blank cap also of gunmetal and a chain shall be fitted to each landing valve.

The landing valves shall be of the controlled pressure type designed to enable a uniform firefighting pressure to be maintained at any hydrant irrespective of its location in the building.

The valve shall be so designed that the seal may be replaced or the gland re-packed when under pressure with the valve fully closed.

The valve shall be provided with a means for attaching a strap so that the hand wheel is secured to prevent unauthorized use. A purpose-made strap made of leather or reinforced plastic material not less than 12mm wide nor less than 2mm thick and a small non-ferrous padlock to secure the two ends of the strap shall be supplied with each valve.

The manufacture of the valves shall provide a test certificate to conform that the valves have been submitted to the tests described in BS 5041 Part 1 and shall certify that they have satisfactorily achieved the performance required.

The landing valve shall be installed with its lowest point about **750mm – 1200** mm above the floor level.

2.5.6 Fire Hose Reels

Hose reels shall be provided internally at each fire cabinet as shown in the drawings.

Hose reel shall be of the Automatic swing type (according to location and as scheduled) complete with 45m of 25mm non-collapsible, non-kink reel hose and nylon spray/jet/shut-out nozzle.

To facilitate the ease of installation and maintenance, a gate valve and union shall be fitted between the rising main and the hose reel.

Pressure reducing valve shall be provided to branch pipe at each fire cabinet to maintain maximum allowable pressure of Fire hose reel and accessories.
The hose shall comply with the requirements for type A (design working pressure of 15 bar) hose specified in BS 3169.

Each length of hose shall be durably marked at the nozzle end and at intervals not exceeding 10m, with the following information:

(a) Manufacturer's name or identification
(b) The number of the specified BS with the type letter suffix e.g. BS 3169/A
(c) The nominal bore size, e.g. 19mm
(d) Month and year of manufacture e.g. 10/2007
(e) The design and working pressure

This information may be conveniently presented in the following manner.

MR/BS 3169/A/19mm/10/2007/15 bar

Hose reel brackets shall be firmly fixed to the wall so that casual knocks received during normal use of the building and the stresses incurred during use for fire-fighting will not prevent the unimpeded use of the hose reel.

2.5.7 Fire Service Inlet

The wet riser system shall be provided and fitted with **4-way** inlet type breaching connectors individually in the position shown in the drawings. The breaching inlet shall be of light alloy construction with gunmetal fittings, built in non-return valve and instantaneous inlet to match the requirement of the Fire Service Department of Colombo Municipal Council.

The breeching shall be accommodated in a recessed galvanized steel breeching cabinet complying with the requirements of BS 5141 Part 5. The door shall be fitted with a lock and wired glass panel lettered in red "BREECHING INLET"

The breeching shall be fitted with a drain valve in the form of a 1" gate valve complying with BS 5154, rating PN 20. The drain valve outlet shall be positioned so that it faces in the same direction as, and is at a lower level than that of the inlet connections to the breeching. The outlet of the drain valve shall have 1" male threads complying with BS 21 and shall be fitted with a female blank cap and chain.

A plastic or rubber cap shall be fitted to the inlet of the breeching attached by a suitable lug, S-hook and chain. The manufacturer of the inlet breeching shall provide a test certificate to confirm that it has satisfactorily achieved the performance required.

2.5.8 Pillar Fire Hydrant

The pillar hydrants shall be installed at the locations shown in the drawings.

The pillar should be made of cast iron to BS 1452 and the working parts should be made of gunmetal to BS 1400.

Isolation valves shall be provided for both outlet of the hydrant.

2.5.9 Fire Cabinets

Fire cabinets shall be located as indicated in the drawings. They shall be fabricated out of 1.5mm thick steel sheet and protected with a coat of epoxy-based zinc chromate enamel red paint. The doors shall have wired glass panel and shall be hung on piano hinges to be openable through 180º swing. The door shall also be fitted with a break glass type cubical and the key shall be kept in it.

The door should bear the word "FIRE HOSE CABINET" in red letters at least 50mm high on a white background.

Fire hose reel cabinet shall be Recessed/Embedded type of two compartments. Upper compartment shall be consisting of fire hose reel with accessories & Lower compartment shall be consisting of landing valve, fire hoses and Portable Fire extinguishers.

Dimensions - for upper compartment- Approx. 700 x 700 x 400 mm and for lower compartment approx. 700 x 700 x400mm.

2.5.10 Valves (Except Landing Valves)

All valves shall be new and of approved manufacture or as approved. Samples of valves proposed for use shall be submitted for approval. All valves and accessories shall comply with **PN16 (Pressure Rating)**.

All valves shall be placed in accessible positions for operation and repairs. **The connections between each valve and adjacent piping or equipment shall be made either with a flange (65 mm dia. and above) or a union (up to 50mm dia.)**.

The valves and glands shall be designed to withstand without leaks, the system pressures whether the pumps are in operation or not.

Each isolating valve shall be provided with a means for attaching a strap so that the hand wheel may be secured in any desired position to prevent unauthorized use.

A purpose-made strap of leather or reinforced plastic material not less than 12mm wide nor less than 2mm thick and a small non-ferrous padlock to secure the two ends of the strap shall be supplied with each valve.

Alternative means of securing the valves against unauthorized use may be offered.

Straight pattern valves shall be of the full-way gate type.

The bodies of valves up-to and including 50mm diameter shall be of cast gunmetal or bronze. Bodies of valves 65mm diameter and above shall be of cast iron. Casting shall be of good quality, clean and smooth and free from scale or falls.

The system drain valves shall be 25 mm diameter, key operated type with hose unions fitted to the discharge end.

2.5.11 Air Vents

Automatic air vents shall be used at the top of each rise.

They shall have gunmetal or brass bodies, non-ferrous or stainless steel floats and guides and non-corrodible valves and seats. An air outlet, tapped to accept a drain line should be provided.

A manual test cock shall be fitted to the automatic air vent so that it is possible to check the vent is not air bound due to the orifice being clogged and to enable manual venting should be automatic vent fail.

The automatic vent shall be isolated from the system with a gate valve to permit cleaning and repair if necessary.

Air release pipes shall be run to discharge at the nearest visible point to be agreed with the Engineer and where maintenance personal can regularly check for leakage.

2.5.12 Pressure Gauges

Pressure gauges 100mm dia. maximum, shall be installed in the following locations:

(a) Top-most point of hose riser

(b) In the positions shown in the drawings and where deemed necessary

The gauges shall be provided with a device to dampen pulsations and the fixing of the gauge shall be such that it may be removed and re-fitted without shutting down the line.

2.5.13 Pipes

Pipe material shall be ASTM A53 Schedule 40 Grade B, Type S (Seamless GI pipes) or Heavy-Duty GI Pipes complied to BS 1387/ BS EN 10255.
All pipes and fittings shall be new, of approved manufacture and the right grades. Each length of pipe shall be thoroughly cleaned and blown out to remove all scale and dirt before erection. Rusting pipes and fittings and piping and fittings of classes other than specified will be rejected.

2.5.14 Pipe Work Joints and Fittings

At dismantling points or where pipe work is connected to an appliance (e.g. hose reel), ground-in spherical seated unions shall be used.

Joints in pipe work shall be made with screw jointed or Victaulic grooved couplings or similar approved mechanical pipe couplings or welded pipe joints (Pipes of 65mm diameter and above shall not be screw jointed). If coupling is used, couplings shall be self-centering and engage and lock in place the grooved or shouldered pipe and pipe fitting ends in a positive watertight couple providing some allowance for angular pipe deflection, contraction and expansion. Coupling housing clamps shall place a composition water sealing ring so designed that the internal water pressure increases the water tightness of the seal.

The coupling assembly shall securely hold together by two or more track head, square or oval-neck, heat-treated carbon steel bolts and nuts requiring only a single spanner. All pipe fittings connected to mechanical pipe couplings shall have grooved or shouldered ends and shall be malleable iron castings. Flanged or threaded valves may be used with grooved adaptor.

Before grooved couplings are assembled, pipe ends and seal rings shall be lubricated as recommended by the manufacturers, to facilitate installation. Pipe grooving and the entire coupling installation shall be in accordance with the pipe coupling manufacturer's

specifications. Couplings and fittings shall be capable of withstanding a test pressure of 10 bar or 1½ times the working pressure, whichever is greater.

2.5.15 Pipe Supports

Pipe work shall be supported so as to permit free movement due to expansion and contraction. Pipework supports shall be arranged as near as possible to joints and changes in direction, and each support shall take its due proportion of the load. The spacing of the supports shall be in conformity with the recommendations of the grooved coupling manufacturer but shall not exceed the centers given below. Where there are two or more pipes, the spacing shall be based on the centers required by the smallest bore pipework.

Size of Pipe (mm)	Intervals for Horizontal runs (m)	Intervals for Vertical runs (m)
20	2.4	3.0
25	2.4	3.0
32	2.4	3.7
40	2.4	3.7
50	2.4	3.7
65	3.0	4.6
80	3.0	4.6
100	3.0	5.5
125	3.7	5.5
150	4.5	5.5
200	6.0	5.5

Vertical rising pipework shall be supported at the base to withstand the total weight of the riser. Branches from riser shall not be used as a means of support for the riser.

Brackets screwed to walls shall be secured by expanding plugs or other purpose designed fixing devices to suit the material of the wall (e.g. brick, concrete, hollow block etc.); Wooden or plastic plugs will not be permitted.

Pipework of 65mm size and above subject to expansion and contraction and hung from supports shall be suspended on swivel hangers unless otherwise agreed with the Engineer.
For horizontal pipelines, hangers shall be of split ring adjustable type hung on mild steel rods. Caliper hooks may not be used. Where pipelines run along walls, columns or ceilings, brackets may be used.

A support shall be installed not more than 600mm from each change of direction.

Special care shall be taken when making piping connections to equipment (e.g. pump set) to ensure that the connections are properly aligned and that no stresses and strains are imposed on the equipment.

2.5.16 Pipe work - General

The whole of the installation, including all valves and fittings, should be satisfactory to the fire department. Before any work starts, plans showing details of the arrangements proposed shall be submitted to the fire department and its approval obtained.

The design and installation of the hydrant and hose-reel system shall be closely correlated with all other services being provided in the building.

All fittings shall, as far as practicable, be the same size as the pipes connected to them. Bushed outlets will only be accepted if the required outlet size of a fitting is not standard manufacture.

All pipes laying over the ground level, pipe brackets and Fire Hydrants shall be apply 2 coats of anticorrosive paint and 2 coats of Post Office Red enamel paint.

All changes in the direction of a run piping shall be made with standard bends, springs or long turn fittings. Elbows may be used with the concurrence of the Engineer where space restrictions do not permit the use of easy bends.

Pipes shall be removed after cutting and shall be thoroughly cleaned before erection. Open ends left during the progress of work shall be temporarily closed with purpose-made metal or plastic plugs of caps, or blank metal flanges.

No pipe shall be installed so as to cause unusual noise from the flow therein under normal operation.

Joints and valves shall not be made in thickness of any wall, floor or ceiling or in any inaccessible space, and pipework shall not be embedded in the structure of floor unless otherwise instructed by the Engineer.

Where pipework passes through walls, floors or ceilings, sleeves shall be provided. Pipework passing through floors shall be provided with 3mm mild steel floor and ceiling plates fastened securely to the sleeve. Sleeves shall be formed from pipes of suitable larger diameter and the space between pipework and sleeves shall be plugged with an approved sealant, which will not cause hindrance to pipe expansion and contraction and will not run.

All piping shall generally be run parallel to the axes of the building, concealed in the false ceilings and ducting where possible, arranged to conform to the architectural and structural requirements and to suit the necessities of clearance for the work of other trades. The clearance between pipework and the wall and any other fixtures shall be not less than 25mm.

The pipe work shall be graded to ensure venting and draining.

Reinforced moulded bellows expansion joints with integral flanges shall be incorporated into the suction line between the pump set and the sump to prevent the transmission of vibration to the sump connection. The joints shall adequately be restrained and supported in accordance with the manufacturer's recommendations.

2.5.17 Trenches and back filling

Before backfilling, pipes shall be pressure tested to 1.5 times the working pressure and maintain that pressure 24 hours. The pipe shall be laid on 100mm thick fined sand layer. Soil around the pipe shall be plain and free of stones, well compacted and back filled up to minimum height of 150 mm from the top surface of the pipe and the rest shall be filled with Aggregate Base Coat (ABC) or sand as per drawings.
As a safety precaution, warning tape shall be buried at the half of the ABC backfilling.

2.5.18 Coating and Wrapping of Underground Pipelines

All underground pipes shall be HDPE pipe or ASTM A53 (Hot Dipped Galvanized), Grade B, Schedule 40, Type S (Seamless) pipes (including all the joints) wrapping with grease impregnated jute wrappings (Denso or equivalent) having minimum 50% overlap.

The work shall be generally performed in the following operations:

2.5.18.1 Surface Preparation

Surface Preparation shall be Power Tool Cleaning and Hand Tool Cleaning may be used for narrow sections. Bare pipe shall be free from mud, mill scale, mill lacquer, wax coal tar, asphalt, oil, grease, or any other foreign materials. All prepared surface shall be coated on the same day it was cleaned.

2.5.18.2 Liquid Adhesive (Primer) Application

Liquid Adhesive shall be thoroughly agitated in its container before application to the pipe. Liquid adhesive shall be either brush or spray applied to the cleaned pipe surface in a uniform thin film at a minimum coverage of approximately 7.4 square meter per liter. Prime coat shall be dry to tacky at the time the anti-corrosion tape is applied.

2.5.18.3 Tape Installation

The **grease impregnated jute wrappings** (Denso or equivalent) shall be applied directly onto the primed pipe surface. The anti-corrosion tape shall be spirally applied with minimum overlap of 50% of the tape width being used. The end of each new roll of tape shall overlap the end of the preceding roll by a minimum of 6 inches. This end lap splice shall be hand applied for a wrinkle free splice to maintain the continuity of the anti-

corrosion tape. The spiral angle of the new roll should parallel the previous roll's spiral angle.

2.5.19 Underground Valve pit

Outer surface of the walls shall be covered with waterproof material to prevent entering water inside the pit. There shall not any possibilities to enter the water through the top slab. Dimension of underground valve pit shall be complied with drawings.

At least 150 mm gap shall be maintained between the bottom of the pit and bottom surface of the pipes as per drawings. Side walls shall be constructed with brick and base of the valve pit shall be constructed with concrete with having minimum grading of 30.

2.6 Portable Fire Extinguishers

2.6.1 General

Portable fire extinguishers shall be of the re-chargeable, metal-bodied type containing and extinguishing agent expelled by the action of internal pressure. They shall be manufactured to BS EN 3 or equivalent and approved by the Fire Service Department of the Colombo Municipal Council, Sri Lanka.

The extinguisher shall be operated by piercing, opening and/or breaking a sealing device and thus releasing the contents. The method of operation shall be readily apparent. It shall not be necessary for any movement of the actuating mechanism or mechanisms to be repeated in order to initiate discharge of the extinguisher.

All portable Fire Extinguishers shall comply with BS Codes and extinguish shall be released by means of a lever-operated valve provided with a safety pin. The extinguisher shall be capable of controlled partial discharge.

All internal extinguishers shall be wall mounted and attached in a manner affording quick release from the supporting bracket. They shall be installed so that the top of the extinguisher is not more than 1500 mm above the floor and in no case shall the clearance between the bottom of the extinguishers and the floor be less than 100mm. The extinguishers shall be positioned so that the instructions for operation to face outward. The instructions for operations shall be written in English language.

The extinguishers shall be Color Coded to BS for easy identification and shall be fitted with a visual "discharged" indicator to prevent accidental use of an empty cylinder

The quantity, types, sizes and locations of the extinguishers to be provided shall be in accordance with the Drawings and Part II of the Specifications.

The following portable fire extinguishers shall be installed on the floors as shown in the drawings.

* 6 kg CO_2 fire extinguisher fully charged with metal bracket fixed on to the wall.
* 9-liter water fire extinguisher fully charged with metal bracket fixed on to the wall.
* 6 kg ABC Powder fire extinguisher fully charged with metal bracket fixed on to the wall.
* 9L Form fire extinguisher fully charged with metal bracket fixed on to the wall.

2.6.2 Mounting

All internal extinguishers shall be placed inside the fire cabinets. Where fire cabinet is available extinguishers shall be wall mounted and attached in a manner affording quick release from the supporting bracket. They shall be installed so that the top of the extinguisher is not more than 1.5m above the floor and in no case shall the clearance between the bottom of the extinguishers and the floor is less than 1m. The extinguishers shall be positioned so that the instructions for operation face outward.

2.6.3 Finishes

Valves, hose reels and similar manufactured item of plant and equipment shall be completely fitted and finished in the manufacturer's works. Any deterioration or damage to manufacturer's finishes during storage and installation shall be made good by the Contractor at his own expense, to the satisfaction of the Engineer.

The surface of all ferrous metal work including pipework brackets, hangers, steelwork etc. Which are not protected by galvanizing, works applied primer or protective paint shall be cleaned to remove all grease and rust and then given one liberal coat of anti-corrosive red lead primer and finished with two coats of approved quality signal red enamel.

Those parts of the installation required to be left unpainted (e.g. brass work) shall be so left.

Direction of flow shall be adequately indicated on all pipework.

2.6.4 Fire Pump Room Civil Works

The drilling of suitable holes on the floor slab/ walls for suction pipes and distribution pipes, construction of concrete plinths for fire pumps, etc. have to be carried out by the fire system contractor.

PASSENGER ELEVATORS

HEAVY DUTY PASSENGER ELEVATOR

3.7 THE WORKS

3.1.1 SCOPE OF WORKS

The scope of Works of this contract includes Supply, Installation, Testing & Commissioning of 01 (one) Heavy duty Passenger elevator. Passenger Elevator for the proposed Navigational service comlexAirport as described in the Drawings and documents comprised in the Contract.

3.1.2 SCOPE OF SPECIFICATION

1) The Specifications applicable to all Works to be performed under the Contract are included as follows.

   A. GENERAL REQUIREMENTS.
   B. HEAVY DUTY PASSENGER ELEVATOR

2) The specification documents (including "Technical Specifications") are referred to herein and in other document comprised in the Contract collectively as the "Specification" and/or "Specifications". The Specification shall be read in conjunction with all of the remaining documents forming part of the Contract.

3) Document SPECIFICATION: GENERAL REQUIREMENTS apply to and prevails over all of the above noted Specifications.

4) Any matter not provided in the Specification shall be determined through consultation between the Engineer and the Contractor.

3.2 WORKMANSHIP/PLANT/MATERIALS

3.2.1 RESPONSIBILITIES

1) No Plant or material shall be used until and unless approved by the Engineer and Plant and materials not approved shall immediately be removed from the Works at the Contractor's expense.

2) No approval by the Engineer of any work method statements, Plant or material, drawings, samples or documents submitted by the Contractor, will relieve the Contractor of any of his responsibilities and/or liabilities under the Contract.

3) The Contractor will remain entirely responsible for the proper execution, maintenance and completion of the Works and the remedying of defects therein, in accordance with the Contract.

3.2.1.1 GENERALLY

1) All workmanship shall be performed to the highest international standard.

2) All supervisors, foremen, artisans, craftsmen, technicians and the like shall be properly experienced and able in their respective skills. The Contractor may be called upon to demonstrate the experience and ability of any of his personnel. If such demonstration fails to satisfy the Engineer, the Contractor shall remove from the Site such person, or persons involved. The Contractor is to ensure that all Subcontractors observe and comply with these conditions.

3) All Plant and materials shall be of the highest international standard, new and the best of their respective kinds.

4) All Plant and materials used in the Works shall be of the qualities and kinds specified herein and equal to approved samples where samples are required by the contract or requested by the Engineer. Delivery shall be made sufficiently in advance to enable samples to be taken and tested if required.

5) The Contractor will produce as and when requested by the Engineer, certificates of origin, names and addresses of suppliers and proof of purchase of Plant and materials intended for incorporation into the Works.

6) Plant and materials shall be transported, handled, stored and protected on the Site or elsewhere in such manner as to prevent damage, deterioration or contamination all to the satisfaction of the Engineer. The Engineer reserves the right to inspect any Plant or materials to be used in the Works at any time and at any place of storage.

7) All Plant and materials which are required to conform to international standards shall bear the approved marks of the relevant standards or have certificates attached thereto, evidencing their compliance with the standards.

8) The dimensions in the Specification and Drawings conform to the metric system except where specifically indicated otherwise. If these dimensions fail to coincide with standard nominal sizes available, reasonable substitutions may exceptionally be authorized by the Engineer.

3.2.1.2 QUALIFICATION OF MANUFACTURERS AND SUPPLIERS

1) Manufacturers and suppliers shall have regularly manufactured materials and Plant of the same or similar type to that specified for at least 10 years in advance of the Tender closing date.

2) The particular types of material and Plant proposed for approval shall have been in commercial service for at least 2 years, with satisfactory performance evidenced if so required by the Engineer.

3) Manufacturers of specialty Plant or systems, shall retain full responsibility for entire systems produced by them or for which their Plant constitutes the essential operating part.

3.2.2 SUITABILITY

3.2.2.1 Generally

The Contractor shall immediately refer to the Engineer any requirement shown or specified which he considers or believes:

a. is not equal or equivalent to specified or normally accepted best industrial standards or does not achieving a good quality of installation as intended under the Contract; or

b. is below standards for proper enforcement of warranties or guarantees required; or

c. is at variance with governing laws, regulations, codes or standards.

3.2.3 SELECTION AND DESIGN CONDITIONS

3.2.3.1 Generally

All Plant and materials, which are specified by performance or similar requirements, including
all equipment and systems shall comply with the requirements below.

3.2.3.2 Design – Environmental Conditions

3.2.3.2.1 Atmospheric

The Equipment shall be fully tropicalized unless otherwise specified. There shall be no degradation in performance when the equipment and facilities are operated under the following environmental conditions:

1) Outdoor Facilities:

   a. Ambient temperature up to 50 degrees Celsius

   b. Relative humidity up to 100%

   c. Wind speed up to 136 km per hour, unless otherwise specified

   d. Salt laden air

2) Indoor Facilities:

   a. Ambient temperature up to 45 degrees Celsius

   b. Relative humidity up to 90%

3.2.3.2.2. Structural:

Seismic Base Shear 0.15 x Dead Load

3.2.3.2.3. Elevation:

0 to 200m above sea level

3.2.3.2.4. Power Supply:

The following power shall be employed:

1) When an AC power supply is employed, it shall be 400V, 50Hz, three-phase or 230V, 50Hz, single-phase.

2) The required performance of the equipment shall be satisfied, even if the specified voltage changes±10% and frequency changes ±5%.

3.2.3.3 Design and Manufacture

3.2.3.3.1 Generally

1) In complying with the requirements of the Specifications, both with respect to arrangements and details, the design shall conform to the best and most up-to-date engineering practice.

2) Plant, materials and systems shall be designed to take account of the standardization and interchangeability of components and parts, and interfacing with any existing Plant, materials or systems.

3) The essence of design shall be simplicity and reliability in order to give long continuous service with high economy and low maintenance and operation cost.

4) The design, dimensions and materials of all parts shall be such that they will not suffer damage or instability of performance, as a result of stresses under the most severe service conditions.

5) The materials used in the construction of the Plant shall be of the highest quality, compatible to each other and selected particularly to meet the duties required of them.

6) Subcontracted materials and equipment shall be of the same quality and compatibility.

7) Workmanship and general finish shall be of the highest class throughout.

8) All similar parts of the Plant or systems shall be interchangeable.

9) All Plant shall operate without undue vibration and with the least possible amount of noise and shall not cause nuisance.

10) All Plant shall be so designed and manufactured as to ensure safety for all personnel involved.

11) All Plant shall be designed to minimize the risk of fire and damage which may be caused in the event of fire.

12) All plant shall be designed to prevent ingress of all vermin, accidental contract with live parts and to minimize the ingress of dust and dirt. The use of materials which may be liable to attack by termites or other insects shall be avoided.

13) Keyed door locks, keyed electrical or equipment cabinet locks and the like, shall be designed to form part of one master key system for all Works and to match with any master key system specified for the remainder of the Project.

14) Sizes of equipment shall be not be significantly bigger than may be shown on the Drawings or otherwise shall generally be selected to fit into the space allocated therefore.

15) Lightning and power line surge protection shall be provided for all Plant and systems.

3.2.3.4. Plant/Equipment Design

3.2.3.4.1. General

1) The design to be used in the construction of Plant shall be as specified in the Drawings and detailed equipment specifications.

2) The following general specifications shall also be met:

   a. Reliability: Equipment shall be designed for continuous operation in the environment specified above. Equipment outages shall be held to the very minimum.

   b. Human Engineering: Designs shall take into account human Engineering considerations.

   c. Personnel Safety: Precautions shall be taken in the design of equipment to ensure the safety of personnel. These shall include, as a minimum the requirements of Safety Design specified below.

3.2.3.4.2. Safety Design

1) Personnel Safety

   a. Protection for human body shall be taken into consideration when designing, manufacturing and installing any Plant to prevent any accident.

   b. Guards shall be provided for moving mechanical parts such as gears, fans or belts to prevent accidental contact by personnel.

   c. Sharp projections shall be avoided on cabinets, doors and similar parts.

2) Power Disconnection

a. Disconnecting devices shall be provided so that power may be cut off while installing or interchanging any Plant or component thereof.

b. The main power switch or circuit breaker shall break the AC line immediately after it enters the equipment via terminal block or connection, before connection to fuses or other parts.

c. Under no circumstances shall the neutral side of the AC line be switched or fused.

d. Where a cabinet or rack contains more than one individual-powered equipment on the same AC branch circuit, each equipment shall have connector which will permit its removal without interrupting service to adjacent equipment.

3) Grounding

a. The outside cabinet, rack, equipment chassis, external which are accessible without opening interlocked access doors, shall be at ground potential when the equipment is installed and in operating condition.

b. Antenna and transmission line terminals shall be ground potential for DC and AC power line frequencies but shall permit normal passage of RF frequencies.

4) Interlock Requirements

a. Where cabinets or compartments of equipment contain voltage in excess of 250 volts to ground, access into these enclosures shall be through interlocked doors or covers, the opening of which shall remove the voltage.

b. Restoration of voltage shall not be automatic upon replacing covers. It shall be necessary to operate a "Reset" or "On" switch.

3.2.3.4.3. Maintenance

1) The Equipment shall be designed and constructed so that all parts, terminals, and wiring are accessible for circuit checking, adjustment, maintenance, and repair. Parts most likely to fail shall be easily replaced. The necessity for readjustment of the Equipment as a result of the replacement of any components shall be minimized.

2) The Equipment shall be designed for ease and simplicity of installation, adjustment, operation, maintenance and replacement.

3) The Equipment shall employ, to the greatest extent practicable, the use of plug-in modular construction. Plug-in units shall be mechanically secured in place to prevent being dislodged during shock and vibration.

4) Mechanical and electrical interchangeability shall exist between similar assemblies, sub-assemblies, and replaceable parts.

5) The case, units, air filters, motors, etc. which are to be detachable for maintenance, shall be designed for detaching by simple manipulation.

6) Equipment provided in duplicate to function as working and standby units shall be arranged, so far as possible, to allow either unit to be set up and tested independently of the other unit, to ensure that the equipment are in working order.

3.2.3.5 Electrical Design

1) Circuit designs shall assure conservative operation of electronics parts for long life and minimum maintenance.

2) Electromagnetic Interference (EM) Control: Plant shall be designed to prevent degradation of its own performance due to undesirable internal coupling, and to prevent radiation of undesirable signals which could degrade the performance of other equipment. Control of such interference shall include but not be limited to the following measures.

   a. Proper care in shielding of Plant compartments, cabinets and in the use of RF lines and connectors to ensure that they are RF tight.

   b. Operation of Plant in such a manner as to prevent the generation of transients and harmonics of the desired signal.

   c. Proper filtering of RF output circuit to suppress harmonics beyond acceptable levels, which are generated as a normal function of equipment operation.

   d. Observation of correct grounding practices to prevent undesirable coupling and cross-modulation.

3) Overload Protection: Protective devices shall be provided within the equipment for primary circuits and for protection of the equipment from damage due to overload or excessive heating. Equipment protective fuses shall be readily replaceable and shall be located directly on front panels or behind hinged doors on panels. All parts likely to carry an overload due to malfunction of circuits, poor adjustments, antenna failures, shall be designed to withstand the overload. Where this is impracticable, circuit breakers, relays, fuses or other devices shall be provided. The use of secondary protective devices shall be placed on the ungrounded side of the wiring. Overloads in one phase of multi-phase devices shall operate to remove power to the device from all phases.

4) Wiring and cabling shall be neat and sturdy, in accordance with the following criteria.

   a. Cables: Insulated wires shall be formed into cables, except where operation of the equipment is adversely affected, or where physically impracticable for example when resulting cables become so large as to interfere with the operation or maintenance of the equipment.

   b. Coaxial Cable and Optical Fiber Bends: Coaxial and twin-conductor RF cable bends shall be made high radius of bend as large as practicable. The radius of the bend shall always be greater than 10 times the outer diameter of the RF cable.

c. Solid and Stranded Wire: Stranded wire shall be used for wires and cables which are normally flexed in use and servicing of the equipment, such as cables attached to the movable half of detachable connectors, and hinging cables attached to removable or movable doors, shields, etc. In all other applications, either solid or stranded wire may be used, provided that stranded wire shall be used where so indicated by good Engineering practice.

d. Wire Identification: All insulated wire used in circuit connections shall be identified by color coding wherever this is necessary for the case of replacement of wires after removal.

e. Wiring Identification for Polarized Parts: Wires connecting to polarized part shall be secured or arranged so that when the part is installed according to the polarity markings it will be obvious technically how to connect the leads for proper polarity.

f. Standard Colour Code: A uniform code of standard colours shall be used in chassis wiring for the purpose of identifying circuits associated with electronic devices.

g. Panel-door Cables: Parts mounted on a hinged door shall be wired to the other parts by means of a single cable. However, if physical separation between wires is essential for electrical reasons, or if the number of wires involved is so great as to make a single cable impracticable, more than one flexible cable may be employed.

h. Connection Methods: Wires shall be secured by soldering, or by the use of solderless terminals, except that this is not mandatory in RF circuits provided the method of connection used insures uniformly secure and low resistance connections. Non soldered wrapped wire connections are not allowed in non-conditional environments.

i. Lugs Connected to Screw Terminals: Where wires are connected to solderless or solder lugs which are clamped under screw terminals so as to be removable by loosening or removing the screws, not more than one wire shall be attached to each lug. Not more than two lugs shall be attached to each screw terminal.

j. Connector Wiring: Not more than one wire shall be connected to each contact of cable connectors.

k. Shielded Wire Termination: Shielded wires and cables shall have the shield braid terminated so that the insulation is not damaged by soldering heat or mechanical pressure. Compression type sheath connector shall not be used for shielded wire termination in circuits operated above 100 MHz.

l. Splices: Wires and cables shall not be spliced, except where the wire or cable is longer than that of normally obtainable single roll, or unless otherwise specified.

5. Circuit Directories

a. Circuit directories shall be provided for each electrical panel or control cabinet. Directories shall be laminated in plastic and mounted in an approved frame inside the door.

3.2.3.6 Mechanical Design

3.2.3.6.1 Generally

1) Cooling means shall be employed to maintain the required performance, life and reliability of parts under any probable combination of service conditions specified herein or elsewhere in the Specifications.

2) Motors for ventilation and cooling systems shall be of the totally enclosed type and shall be designed for continuous duty. The design and quality of the motors shall be such as to ensure a life expectancy of 50,000 hours of operation. Commutators, or slip-rings, shall not be incorporated in the motors.

3) Centrifugal type blower units and motors driving propeller fans shall be mounted in a manner which will preclude or minimize transmission of vibration from the rotating equipment to the supporting structure.

4) When air filters are required, they shall be mounted in a manner, which will permit easy and quick removal and replacement. They shall not require replacement or cleaning more frequently than once in thirty days under normal operating conditions. The filters shall be of the maximum practical size.

5) The ventilation design shall be such that the ventilated space is maintained under a positive static pressure higher than the surrounding air pressure.

6) With the ventilated equipment operating under normal service conditions, the exhaust air temperature measured at just ahead of point of egress inside the equipment shall not exceed the input air temperature measured outside the equipment just ahead of the point of input by more than 15 degrees Celsius.

7) Brackets, lugs, flanges, inserts, bolts and other fixing, securing and mounting arrangements shall retain components and parts securely when the equipment is subjected to service conditions.

8) Parts made of aluminum, magnesium, plastic, or other soft materials shall be assembled parts made of aluminum, magnesium, plastic, or other soft materials shall be assembled or mounted by the following means:

   a. Metallic tapped bushing, nuts or inserts permanently secured to the structure, where frequent disassembly and re-assembly will be required.

   b. Through-bolt secured by a locknut: A flat washer shall be used under the head of the bolt.

   c. Tapped hole protected against wear by applicable thread insert.

9) Brittle castings, or parts made of ceramic or other brittle material, shall not be over - strained by the means used to secure them. Not more than three points of contact shall be used between the brittle part and the mounting surface, unless the mating faces are accurately machined. Mounting washers of suitable plastic, rubber, or soft copper, having slight compressibility, shall be provided to prevent local breakage or cracking of the parts. Lead washers shall not be used.

10) Screws or similar devices employed for retaining front panels or removable cover plates shall be preferably of captive types and shall employ knurled heads compatible in appearance with the general hardware. Quarter turn fasteners may be used as panel and cover plate retaining devices only for non-structural applications.

11) Bolts, nuts and screws shall conform to the metric thread of ISO (International Organization for Standardization).

12) Terminals, such as lugs, and binding posts shall support the wires connected thereto. Terminals shall not turn or loosen when the equipment is subjected to specified service conditions.

3.2.3.7 Painting:

1) Painting colour and material samples shall be provided when requested by the Engineer.
2) Surfaces of the Plant and materials shall be painted after rust-preventive treatment as required.
3) Moisture and fungus resistant paint treatment shall be provided where required by the conditions or if specified.

3.2.3.8. Identification Marking/Identification

1) All Plant: Equipment, panels, valves, parts and assemblies shall be marked for identification in a permanent and legible manner.

2) All markings shall be in the English language.

3) Identification shall generally be with nameplates which shall be of laminated plastic material of approved size, colour, shape and fixing.

4) Scribing and stamping colours shall generally be black, unless otherwise specified.

5) Identification plates shall be securely fastened to each complete equipment, and major component. The characters of Employer's name, item functional description, manufacturer's classification, type number, serial number, year of manufacture and manufacturer's name shall appear on the plate. Other useful information may also be included.

6) Cables: Each cable assembly shall be marked with its designation as it appears on wire-run lists or cable schedules. The marking shall be permanently affixed at each end of the cable. Connectors and check terminals shall be clearly labeled for proper connection of cables and wiring.

7) Parts Reference Designations: Each part having a function in an electric circuit shall be identified by an appropriate reference designation. The reference designation shall be marked on the chassis or other mounting surface in a visible manner. The reference designations shall be the same as those used for identifying parts on all types of data including drawings, diagrams, and spare parts lists prepared for the equipment.

Where space is at a premium reference designation need not be marked, provided that equipment handbooks include photographs or other media for circuit identification.

8) Panel Markings: The visible surface on panels, adjacent to panel-doors and connector panels, facilities such as connectors, controls, indicators, jacks, keys, switches and fuse holders shall be marked with a suitable abbreviation, indicating the use or purpose of the part. These markings shall be located so that the operator can readily identify the function of the panel facility. Continuously variable-operating controls shall be provided wherever applicable with markings that permit the operator to set the control easily and correctly to a predetermined point.

9) Adjusting Positions shall be marked with reference points or position numbers and markings shall be in sequence as much as possible. Positions that require special measuring instruments and tools for adjustment and thus cannot be adjusted at a place other than the factory shall be marked with "Factory Adjustment Only" in red characters.

10) Battery Circuit Marking: Components designed to operate form internal batteries shall be marked in a convenient form for use by operating or maintenance personnel. The markings to be applied shall include the battery type number, battery location and position, polarity, nominal voltage and interconnection between batteries, if two or more are used. The markings shall be applied on or adjacent to the battery compartment or holder, and on or adjacent to terminals, connectors, contacts, removable leads, etc., that are part of the battery circuit but not of the battery itself. When necessary for clarity a block or pictorial wiring diagram of the battery circuit and batteries shall be provided instead of, or in addition to, the markings. The diagram shall be located on, or as close as practicable to, the battery compartment. When batteries are used in a component, a notice shall be included in a prominent location to indicate that the batteries shall be removed when the component is out of service for an extended period of time.

11) Caution Plate: Each electronic component of the overall equipment having circuits which operate at potentials in excess of 220 volts with respect to ground shall bear sign with a red background and white letters and with the following marking: "Danger High Voltage". When the door handles of cabinets accommodating high voltage circuits are grooved and interlocked, they shall be so indicated by filling the grooves with red paint; non-interlock shall be indicated by filing the grooves with blue paint. Door panels that are interlocked shall be marked by a red arrow and an "S" character at the closed position of the switch.

12) Ampere Rating: The ampere ratings of fuses shall be indicated at mounting positions of fuse holders. A SB symbol shall also be marked if a slow-blow fuse is used.

3.2.3.9. System Certifications

3.2.3.9.1. Generally

Certification shall be provided for each item of Plant of System certifying compliance with the requirements of the Contract. At the discretion of the Engineer, these shall be provided either by the Contractor, the manufacturer or an independent testing agency.

3.2.4 AVAILABILITY OF PARTS/COMPONENTS

3.2.4.1 Generally

1) The Contractor shall select items of Plant and materials for which replacement parts or components will continue to be manufactured and readily available for a period of at least fifteen (15) years after the date of their incorporation in the Works.

2) The Contractor shall provide a written guarantee in support of this at the same time of submission of the request for approval of the respective items of Plant or material.

3.2.5 ALTERNATIVES

3.2.5.1 Generally

1) Plant and materials shall meet the quality and performance standards established by the Specification. If the Contractor finds it necessary to deviate from requirements involving one piece of Plant, material, equipment or a subsystem, he shall describe the proposed deviation there from; state the reason and the improvement to be expected. Acceptance or rejection of deviations shall be made in writing by the Engineer. If certain characteristics of equipment, such as dimensions, power requirements and external connections, etc., depend on the manufacturer, any requirement of the Drawings and Specification affected by such characteristics may be varied by the Contractor to suit the equipment proposed, but only subject to the prior approval of the Engineer.

2) Notwithstanding that the Contractor may have submitted with the Tender Documents, details of Plant and materials that are proposed in his Tender to be incorporated in the Works, the Engineer reserves the right at a later stage, to require the Contractor to replace any item of Plant or material that, upon subsequent examination, he considers does not fulfill the requirements of the Contract, at the expense of the Contractor.

3) The Contractor otherwise, as a general rule, shall not change or substitute the Plant or materials that have been proposed in his Tender for incorporation in the Works.

4) In exceptional circumstances, The Contractor may be given permission to use alternative materials and Plant if such material or Plant is, in the opinion of the Engineer, equal or superior to that proposed or specified.

5) If the Contractor wishes to use alternative materials or Plant he shall submit his proposal to the Engineer full documentary evidence that the alternative product is equivalent in respect of material, safety, reliability, function, compatibility with adjacent construction, availability of compatible accessories and, where relevant, appearance. This documentary evidence shall be with samples as required, in sufficient time for the Engineer to approve, or disapprove, the alternative materials or Plant, without causing delay to the Works.

6) Any proposal for use of an alternative or deviation must also include proposals for substitution of compatible accessory products and variation of details as necessary, with evidence of equivalent durability, function and appearance of the construction as a whole. If such substitution is approved, and before ordering such materials or Plant,

the Contractor shall provide revised drawings, specification and manufacturer's guarantees as required by the Engineer.

3.2.6. SUPPLIER'S AND MANUFACTURER'S GUARANTEES

3.2.6.1 Generally

1) The Contractor shall endeavor to obtain supplier's and manufacturer's warranties and/or guarantees for all items of Plant, materials and installations wherever possible. The Contractor shall ensure that these are obtained in such a form, that the benefits therein are passed to the Employer.

2) Wherever possible, these manufacturer's and supplier's warranties and guarantees shall be obtained and submitted as part of the Contractor's initial request for approval of the respective Plant or materials.

3) In support of these, the contractor shall provide to the employer, in a form approved by the engineer, a ten (10) year warranty, under which the contractor is responsible for any significant failure or substantial reduction in performance, in the systems, Plant, materials or any component thereof.

3.2.7 STANDARDS

3.2.7.1 Applicable Standards

1) The general minimum applicable standard for Works under the Contract shall be British Standard (BS), or other internationally accepted standards, which ensure equal or higher quality to BS.

2) Sri Lankan standards may also be used subject to the written approval of the Engineer, where same ensure equal or higher quality to BS where for reasons of compatibility with particular existing materials or Plant they are instructed or specified by the Engineer.

3.3 CONTRACTOR'S FURTHER SUBMISSIONS

3.3.1 OPERATING AND MAINTENANCE MANUALS

3.3.1.1 Generally

1) Before substantial completion and taking over of the Works, the Contractor shall prepare detailed operating and maintenance manuals systems and Plant and submit these to the Engineer for his review and consent.

2) The manuals shall be provided for all Sections of the Works as required by the Specification or as directed by the Engineer and shall be sufficient in detail such that the Employer shall be able to operate and systematically maintain and repair the Works after completion.

3) The manuals shall be securely and presentably bound by the Contractor into book form in separate volumes, with covers, index and contents pages and pages numbered. All shall be in the English language and relevant items or particular components within the text, shall be clearly highlighted.

4) Drawings and diagrams shall be reduced to a convenient size and bound into the volume.
5) The name of the Employer, Engineer and Contractor shall be inscribed upon the cover together with the title of the Works and content.

6) The manuals are to be divided into sections such that information can be easily accessed.

7) Separate manuals shall be required for each complete system and for all hardware and software components thereof.

8) Where one section of the Works comprises a number of separate items of Plant or equipment, the Contractor shall compile all information into one or more complete volumes, which cover the entire section.

9) The manuals shall contain, but shall not be limited to, the following:

   a. The purpose of the manuals and their composition;

   b. Complete and accurate technical description of the system and all Plant contained in the system describing the technical characteristics, operating conditions and performance, using both text and drawings. Manufacturer's technical literature may be included in the respective sections;

   c. The theory and function of each part of the system or Plant;

   d. Installation and adjustment procedures describing unpacking, mounting, wiring and method of adjustment of each component;

   e. Operating procedures from start-up to close-down with all intermediate stages;

   f. A numerical identification system for components, valves, control points and units,

   g. A description of normal value settings, flow diversions, and operational requirements

   h. Complete list of all modules, components and parts of all Plant within the system giving the original manufacturer's name, address and part number and type. Names and addresses of local firm(s) able to provide these parts shall also be given;

   i. Complete list of all consumables, and suitable alternatives, with the name and address of the original supplier and the name(s) and addresses of the local firm(s) able to provide these materials or alternatives;
   j. Maintenance instructions describing, in detail, the procedures and test equipment and tools required to properly maintain the performance of the equipment, repair and operate the Plant and equipment installed at the Site, including preventive maintenance schedule and check sheet samples;

k. Trouble-shooting symptoms list with chart and description of symptoms; aside from above list and chart, provide diagnostic procedures for trouble-shooting for each unit.

l. Safety measures to prevent accidents to persons or Plant;

10) Manuals must refer to the exact module, style and type of Plant provided. Manuals referring to similar but different models will not be accepted.

11) Two advance copies of the final draft manuals shall be provided to the Engineer for his review and consent, not later than 3 months before the scheduled date for commissioning of the relevant Plant or system.

12) After review and consent of the Engineer, the Contractor shall provide 6 copies of the final version incorporating all amendments and corrections, by no later than 1 month before the actual date for commissioning.

13) Copies of the final versions of the manuals shall be available by the commencement of employer training and 1 or 2 copies thereof shall be used as reference material at such training.

3.4 TOOLS/SPARE PARTS

3.4.1 MAINTENANCE TOOLS

3.4.1.1 Generally

1) Any tools, (including servicing or repair equipment) which are required to operate or maintain any system or any item of Plant supplied, shall be provided by the Contractor at his own expense and handed over to the Employer.

2) Two complete sets of such tools, in suitable containers adequate for the purpose, for each type of system or Plant shall be supplied.

3) Unless separate pay items are included, the cost of tools and containers shall be deemed to be included in the rates and prices for the Plant.

4) Lists of maintenance tools, servicing and repair equipment shall be submitted to the Engineer for review and approval, if possible at the same time as approval is being requested for the equipment itself.

5) The types and quantities so approved shall be handed over to the Employer, prior to substantial completion.

3.4.2. SPARE PARTS

3.4.2.1. Generally

1) The term “spare parts” shall be understood also to include “spare materials”.

2) The Contractor shall at his own expense, supply spare parts to assure efficient and continuous operation of Plant, equipment and for repair or replacement of damage to finishes or the fabric of the buildings.

3) The particular types and quantities of spare parts shall be required by the Specifications.

4) Where particular requirements or quantities for spare for Plant and systems have not been stated in the Specification, spare parts shall still be provided and the quantity shall be computed on the general criteria of the quantity required for five years operation of the Works, as recommended by the manufacturer and as reviewed and approved by the Engineer.

5) In addition to spare parts as above the Contractor shall provide;

a. Lubricants for all equipment as recommended by manufacturer sufficient for five years operation as recommended by manufacturer and as approved by the Engineer.

3.4.2.2. Listings

1) A detailed list of the spare parts proposed shall be submitted to the Engineer, for approval. The Engineer reserves the right to modify the list proposed at the expense of the Contractor to meet the above criteria.

3.4.2.3. Delivery and Storage

1) Spare parts shall be handed over to the Employer before substantial completion and taking over of the Works.

2) Spare parts shall be delivered and unloaded, in the place designated by the Engineer.

3) All spare parts shall be packed for long storage under the climatic conditions prevailing at the Site.

4) Each package shall be clearly and indelibly labeled with a description of the contents and quality.

5) Packages will require to be opened for inspection by the Engineer. All such opening and resealing shall be at the expense of the Contractor.

3.4.2.4. Use of Spare Parts

1) The spare parts which have been handed over to the Employer, are not available to the Contractor for the maintenance and repair services or for the remedying of any defects during the Defects Liability Period (DLP).

2) In exceptional cases the Employer may permit such usage but the Contractor shall immediately replenish any stocks used.

3.5 MAINTENANCE AND REPAIR SERVICES

3.5.1 MAINTENANCE AND REPAIR SERVICES DURING DEFECTS LIABILITY PERIOD

3.5.1.1 Services Generally

1) The Contractor shall be responsible for proving full maintenance and repair services during the Defects Liability Period all the equipment installed under the Contract.

2) The Maintenance Porgramme submitted as an Enclosure with the Tender Documents, shall form the basis of this service but the Plan shall be updated by the Contractor within 56 days of the Commencement Date to represent a comprehensive working plan, and submitted for the approval of the Engineer.

3) The maintenance and repair services shall include performance of the following activities by the Contractor:

   a. Regular daily, weekly and monthly maintenance and inspection as required by the Operation and Maintenance Manuals, or such other intervals as may be approved by the Engineer,

   b. Provision of all spare parts, replacement parts, lubricants and other consumables

   c. Repair services, including emergency call out within 12 hours of request from either the Engineer or Employer's Representative (to be designated in future for this purpose), to make necessary repairs,

4) The maintenance and repair services are to be carried out by a locally represented organization, officially established and certified by both the Contractor and manufacturer of the particular Plant, System or Part of the Works concerned.

5) The Contractor will remain responsible for the effective and efficient performance of the services so performed and all costs thereof shall be understood to be included in the respective rates of the Bill of Quantities.

6) The maintenance and repair services are required generally to be performed in the presence of the Employer's maintenance personnel and will also serve as longer term operational and maintenance training.

3.5.2 LONG TERM MAINTENANCE SERVICES

3.5.2.1 Services Generally

1) The same organization as referred to above shall be fully capable of providing Long Term Maintenance Services under separate annual agreement with the Employer for the above listed Parts/Sections of the Works, after the expiry of the Defects Liability Period.

2) The Long Term Maintenance Proposal submitted as an Enclosure with the Tender Documents, shall form the basis of this service but the Proposal shall be updated by the Contractor within 56 days of the Commencement Date to represent a comprehensive

working proposal and submitted for the approval of the Engineer. The updated Long Term Maintenance Proposal shall include a firm price proposal, if necessary with annual escalation mechanism.

3) The Proposal shall be optional for the Employer to accept or decline, at any time during the period of the Contract.

3.6 TRAINING

3.6.1 TRAINING OF EMPLOYER'S PERSONNEL

3.6.1.1 Generally

1) The Contractor shall provide training for the Employer's operational and maintenance staff to ensure that they are fully able and qualified to operate, repair and maintain all Equipment, supplied and installed under the Contract.

2) Training shall cover the following:

   a. Operation and process control,

   b. Equipment maintenance and repair,

   c. Recording and reporting,

   d. Emergency operation procedure,

   e. Maintenance management procedures,

   f. Inventory and store control systems,

   g. Safety

3) Site training shall be in a classroom fit for the purpose and provided by the Contractor either on Site or off Site, to the approval of the Engineer.

4) The Contractor shall prepare a comprehensive training programme for item or system with full course notes, reference material and timetable at least two (2) months before the particular training is to commence and submit this to the Engineer for review and consent.

3.6.1.2. Training Program

1) The training program shall include the following components:

   a. Courses on general principles with overall objectives for each section. The training shall be sequential and completed before moving to the next,
   b. Planned lessons with general guidelines for the items containing performance objectives,

   c. Lesson plan shall be divided into such major activities as operation, maintenance, and repair, laboratory testing and sludge disposal etc.,

d. Graphics shall be used as much as possible to minimize text books,

2) The Contractor shall use visual media as much as possible through out the training process.

3) Training on Safety Provisions shall include:

a. Safe working procedure

b. Housekeeping of the facilities

c. Identification of accident prone and hazardous conditions

d. Safety measure for individual equipment

3.7 PARTICULAR SPECIFICATIONS ON HEAVY DUTY PASSENGER ELEVATOR

3.7.1. SCOPE

The work to be executed by the Contractor under this Section shall include the following: -

a. Design, manufacture, supply, installation, testing and commissioning of 01 (One) Nos. Heavy duty Machine Room less (MRL) type Passenger elevator system in the proposed Navigational service complex and all ancillary equipment required for installation.

b. Provision of spare parts

c. Testing and commissioning

d. Training

3.7.2 ELEVATOR SCHEDULE

The Elevator System shall operate from Ground Floor (GF) to fifth Floor (5F) for moving passengers.

3.7.2.1. GENERAL FEATURES

a. Number : One (01)

b. Service : Heavy duty Passenger (Passengers)

c. Operation : Electric

d. Control : Automatic

e. Rated capacity: 1000 Kg

f. Rated speed : 1.5 mps

g. Total travel : 17500 mm (GF to 5th floor)

h. Landings : 6 total; GF, 1F,2F,3F,4F, 5F

i. Openings : 6 total; all in line

j. Hoist way doors : Manufacture's standard; SS type; Based on the car size

k. Car doors : Manufacture's standard; SS type; Based on the car size

Minimum Door size - 1500 mm(W) x 2200 mm(H)

l. Door opening size: Manufacture's standard; Based on the car size

m. Entrance frames : stainless steel; hairline finish

3.7.2.2. CAR ENCLOSURES

a. General: cars unless all otherwise noted

b. Entrance frames: stainless steel; hairline finish

c. Car doors: SS type

d. Car wall panels: standard steel face panels; baked enamel finish

e. Ceiling: standard steel face panels; baked enamel finish

f. Skirting: stainless steel

g. Floor covering: Manufacture's standard floor covering

h. Handrails: standard stainless steel pipe; hairline finish

i. Car accessories: light fixtures, emergency light, car operating panel, car position indicator, interphone, etc.

3.7.2.3. CAR OPERATING PANEL

a. Floor call buttons

b. Panel direction indicators

c. Door open/hold button

d. Door close button

e. Interphone

f. Emergency stop switch

g. Ceiling light switch

h. Fan switch

i. Overload buzzer

j. Provisions for future additions; as specified

k. Identification plate; clearly stating:

- Type of service
- Maximum number of persons permitted
- Maximum load permitted

3.7.3 WORK REQUIREMENTS

a. Requirements herein describe equipment, accessories and operations in general terms only. Manufacturer shall be responsible for all design and fabrication details necessary to provide work and operations as intended under and required by these Specifications.

b. Operating characteristics, physical features, finishes and other requirements shall be as scheduled herein.

3.7.3.1. PERFORMAN REQUIREMENTS

3.7.3.1.1. Elevator Rated Speed

a. Defined as speed of elevator travel in up direction when under full capacity loading as scheduled.

b. Speed variations: Not exceeding plus or minus 5 percent of rated speed when under any loading conditions and when traveling either Up or Down.

c. Up and Down speeds: Uniform between steps for full height of travel.

3.7.3.1.2. Elevator Rated Capacity

a. Defined as full weight of dead load to be carried within car at scheduled speed, exclusive of weights of scheduled speed, exclusive of weights of cars and other elevator equipment and accessories.

b. Elevators capable of lowering, stopping and holding cars when 125 percent of scheduled capacity.

3.7.3.1.3. Stop level accuracy

Any variation between car floor or sill and landing floor or sill not exceeding plus or minus 10 mm when car is under any loading conditions.

3.7.3.2. OPERATIONAL REQUIREMENT

a. Starting and leveling: Smooth, comfortable without obvious steps or accelerations.
b. Stopping: Smooth and without jars or jumps.
c. Riding under full speed: Free from vibration or swaying.
d. When stopped and doors standing open: Car firmly held at landing level and free from teetering or rocking under varying distributions of loadings throughout cars.
e. When doors open and close: Cars free form noticeable sway.
f. Emergency stopping: Rapid but comfortable to occupants.

3.7.3.3. STRUCTURAL REQUIREMENTS

3.7.3.3.1. Rails, brackets and spreaders

1) Assemblies for cars and counterweights designed and selected to safely resist loads imposed, including dead, live and seismic.

2) Assemblies or units designed to resist vertical and horizontal seismic acceleration not less than 0.5 gravity unit.

3) Counterweight spreader brackets:

   a. Fabricated from structural steel plate; thickness of steel angles as per the manufacture's standard.

   b. Spaced sufficient that at least 2 spreaders occur in length of counterweight frame when in any position within height of hoist way.

   c. Also spaced to meet requirements specified for rail brackets.

4) Car rail brackets: one each rail each location as follows:

   a. Near pit floor; at bottom floor of building; and midway between first and second floors and vice versa.

   b. Near each of all other floors

3.7.3.3.2. Car and counterweight retainers

1) Fabricated from structural steel plate; thickness not less than 6 mm or manufacture's standard construction.

3) Designed to span guide rail tongue not less than 50 mm and to extend to within 10 mm of rail clips or as per the manufacture's standard.

4) Required for sliding shoe mountings at top and bottom of counterweight frames and top of car frames.

4) Retainer to clear rails under normal operations.

3.7.3.3.3. Machine beams

Designed and anchored against shifting or tipping; reinforced as necessary; and to safely resist seismic acceleration not less than 2.0 gravity unit.

3.7.3.3.4. Elevator Machines:

1) Restraining members on 4 sides of each unit; designed to safely resist vertical and horizontal seismic acceleration not less than 1.0 gravity unit.

2) Restrainers equipped with hard neoprene isolators; thickness not less than 25 mm or manufacture's standard; positioned between restrainer and equipment.

3) In addition, anti-tip protection consisting of horizontal members extending over each foot or bed plate.

4) Restraining and anti-tip members securely and adequately anchored to structure.

3.7.3.3.5. Controllers and selectors

Securely and adequately anchored to structure; designed to safely resist over-turning under seismic acceleration not less than 1.0 gravity unit.

3.7.3.3.6. Car platform

Shall be designed to safely carry rated capacity when loading is either uniformly distributed or concentrated at relatively small area at center.

3.7.3.3.7. Engineering designs and calculations

Shall be prepared and signed by licensed structural engineer retained by the contractor.

3.7.3.4. ANTI-SNAG PROTECTION

Methods as proposed by the Contractor and approved by the Engineer.

3.7.3.5. SAFETY GUARDS

a. Required for all sheaves, couplings and other running equipment which could cause physical injury on accidental or inadvertent contact.

b. Required to cover counterweights at pit areas; to heights shown.

c. Removable units securely supported and fastened in place; constructed using mesh in steel angle or flat bar frames.

3.7.3.6. SHEAVE GUARDS

a. Required for all sheaves; designed to prevent cables or ropes from leaving sheaves in event of earthquake or otherwise which might cause any loosening.

b. Methods as proposed by the Contractor and approved by the Engineer.

3.7.3.7. PAINTING

3.2.3.7.1. General

a. All surfaces clean before painting.

b. Do not paint governors.

3.7.3.7.2. Finish Painting

a. Provide for exposed ferrous steel surfaces and not otherwise scheduled.

b. Fill, smooth and bonderize.

c. Spray paint not less than three coats; last two baked.

d. Finish colours as selected by the Engineer.

3.7.3.7.3. Protective Painting

a. Provide for ferrous steel surfaces throughout where not exposed to corridors or car interiors.

b. Touch-up as required after installation.

c. Colors as selected from manufacturer's standard.

3.7.3.8. ELECTRICAL WIRING

1) Wiring: Sheathed types only throughout; installed in conduit or other approved wire ways; all complete with boxes, covers and devices and accessories necessary to complete work as required.
2) Terminal blocks: Permanently tag and label each terminal for ready identification of circuit or service; in Control Panels and elsewhere required.

3) Car fan and light circuits.

   a. Circuits separate from power source to motor.

   b. Circuited for automatic transfer to essential power source, in case of failure of normal.

3.7.3.9. ELECTRICAL SERVICE REQUIREMENTS

a. Power supply: 400 Volt, 50 Hz, 3 phases, 4 wires, AC.

b. Lighting supply: 230 Volt, 50 Hz, single phase, single wire, AC.

3.7.3.10. LUBRICATION FACILITIES

a. Required for all parts involving friction and wear, other than where suitably covered by neoprene or plastic as specified.

b. Include all necessary grease fittings, oiling cap, wicks, etc. as required to maintain equipment properly protected; and all essentially identical for all elevators.

c. Locate lubrication facilities where readily visible and position where easily accessible.

d. In addition, provide for each elevator one set of lubrication hand tools of adequate type and size; contained in suitable box or panel.

3.7.3.11. SIGN AND IDENTIFICATON REQUIREMENTS

1) Motor and other electrical apparatus: label and identify per requirements therefore specified under electrical requirements.

2) Automatic starting equipment: post with signs stating: WARNING – THIS EQUIPMENT MAY START OPERATING AT ANY TIME; or similar wording as approved, in English.

a. Devices operated by public:

b. Languages: English.

c. Numbers: latin.

d. Styles: manufacturer's standard block series or other as selected.

e. Sizes: large as practical and reasonable or uses required.

f. Embossing or engraving: treated for permanency and in color contrasting with base material to facilitate ease or reading.

g. Applied devices: secured free from exposed fastenings unless otherwise approved.

4) Hoist way floor identification numbers

a. Identify each area between landing levels with floor number respective to landings immediately above and below; using number agreeing with those used on devices or car operating panels.

b. Arranged to be readable from car should car stop and doors open at any location between normal landing stop levels.

c. Provide above and below pairs of numbers neatly hand painted; in color contrasting with background color; each number not less than 100 mm high.

d. For excessively high distances between landings, provide additional numbers and spaced at locations to effect results intended.

3.7.3.12. FACE PLATE REQUIREMENT

1) General: applicable to all to panel or fixture face plates where exposed to public areas and inside of cars.

2) Designs

   a. Plain and free from striations, grooves, decorative patterns or other embellishments.

   b. May be manufacturer's standard pattern series when otherwise essentially satisfying other specified requirements.

3) Materials: Stainless steel or aluminum; type or alloy suitable for general architectural purposes.

4) Finish: Satin or achieved by final belt sanding in one direction using grit, or hair line finished aluminum.

5) Each unit neatly and accurately fabricated: corners square; cutouts accurately formed; edges by light sanding; all areas free from burrs or any superfluous marks.

6) After fabrication, exposed surfaces protected using strippable pressure-sensitive adhesive paper sheets.

3.7.3.13. KEYED LOCKS AND SWITCHES

1) All keyed locks and switches required for elevator work, including entrances to elevator machine rooms, keyed to one key only.

2) Provide duplicate sets; to be maintained at all times under security of Employer's security personnel.

3.7.3.14. PRODUCT REQUIREMENTS

Elevators shall be as designed and fabricated by a single manufacturer and installed by himself or his authorized agent.

3.7.4 COMPONENTS

3.7.4.1. OPERATING EQUIPMENT

3.7.4.1.1. Machines

a. Type: Manufacturer's standard type; designed for passenger elevator service: brake mounted.

b. Brake shall be of direct current magnet type or manufacture's standard construction.

c. Bedplate: Continuous under each machine; built-up structural steel or cast iron; with isolation pads for machines.

3.7.4.1.2. Motors, Controllers and Selectors

a. Type: Manufacturer's standard type

b. Overload relays: Thermal or manufacture's standard type

c. Controller and selector enclosures: Per requirements of referenced electrical division, as applicable; with doors equipped not to fly open during earthquake.

d. Motors: 60 minute rated; temperature rise not exceeding 50 degrees C.

e. Starting switches; horsepower rated.

f. Controllers shall be of VVVF (Variable Voltage, Variable Frequency) inverter type or manufacture's standard.

3.7.4.1.3. Beams

a. Structural Steel: designed for all loads imposed and to meet structural requirements; securely anchored to structure.

b. Provide for machine, dead end hitches and elsewhere required for elevator work.

3.7.4.1.4. Guide Rails

a. Type: Standard steel Tee rails; weight not less than 8 kg/m; for cars and counterweights.

b. Intermediate joints; to Engineer's approval; with backs machined for splice plates.

3.7.4.1.5. Sliding Guides

a. Type: Manufacturer's standard swivel type.

b. Required for top and bottom of each car and counterweight.

c. Car and counterweight guides: Designed to clear rails to permit proper actuation of safety devices and to restrain car from leaving guides in event of earthquake.

3.7.4.1.6. Over-Speed Safety Devices

a. Governor: Centrifugal speed type; with ratchet or tied down type tension frame and switches; located in and securely anchored to floor of machine room.

b. Safety Shoes: Designed to brake car travel due to over-speed; mounted on bottom of cars.

c. Governor and safety shoes interconnected by cable passing over governor sheave and under idler sheave mounted in and securely anchored to pit floors.

3.7.4.1.7. Counterweights

a. Weights: sectional carryings or as required; designed to be positively retained by frame.

b. Frame: structural steel; securely attached to and controlled by hoist ropes.

c. Retainer rods: steel; manufacture's standard diameter.

3.7.4.1.8. Buffers

a. Type: spring type or better.

b. Cars: spring type or better.

c. Counterweight: spring type or better

3.7.4.1.9. Ropes and Cables

a. Hoist: Traction ropes, durable and flexible.

b. Governor: Wire rope; manufacture's standard diameter.

3.7.4.1.10. Traveling Electrical Cables

a. As required-between cars and hoist way outlets; with sufficient number of individual conductors for services required; plus not less than 2 spares each car.

b. Flexible type designed for elevator service; resistant jacketed; with conductor sizes proper for services required.

c. All conductors necessary combined in one traveling cable where possible; otherwise in least number of cables feasible and possible.

d. Locate in front section of hoist way where possible; to avoid contact with counterweights, spreaders, etc.

e. Secure to cars and outlets in manner to not exert any strain on any individual or small group of conductors.

3.7.4.1.11. Power Panel

a. As required for each elevator system; for handing and control of all incoming electrical power.

b. Include all necessary enclosures, positive cut-off switches, fuses, etc. required.

3.7.4.2. ELEVATOR CARS

3.7.4.2.1. Requirements

Herein applicable to all cars, unless otherwise specified or scheduled.

3.7.4.2.2. Cage Frames

a. Designed as necessary to safely resist contact loads; reinforced and braced to securely support enclosures and accessories; and with adequate factors of safety.

b. Rolled or formed structural steel members; assembled into rigid units by welding or bolting.

3.7.4.2.3. Platforms

a. Steel frame; steel or wood stringers

b. Plywood subfloor; underside covered with sheet steel; manufacture's standard thickness; top surfaces smooth and level.

c. Resilient pads between cage frame and platform; designed to isolate transmission of sounds and vibrations.

3.7.4.2.4. Car Enclosures

1) Walls and ceiling:

   a. Manufacturer's standard construction for type of materials and finished as approved.

   b. Panel adequately reinforced and secured.

   c. Rivet fastenings exposed inside cars not permitted.

2) Base: recessed type; formed stainless steel.

3) Entrance frames

   a. Hollow metal type; material and finish as approved.

   b. Profiles as shown or approved; each jamb and head member in single unit only for full length required.

c. Frame corners and joints accurately cut and machined for neat hairline fit.

d. Jambs designed to securely anchor to car enclosure framing; with brackets and bolts as required; and securely anchored to sills.

e. Concealed surface coated with sound deadening materials as specified for cars exteriors.

f. Exposed fastenings not permitted.

4) Entrance Sills:

a. Extruded hard aluminum; with grooves accurately formed for minimum clearance with door guides; each member in single unit only for full length required.

b. Built-up or multiple members and exposed fastenings not permitted.

c. Securely anchor to platform as approved; level and free from movement when in place as required.

3.7.4.2.5. Emergency Exit

a. Provide flush mounted door in ceiling to match finishing.

b. Door to be acceptable from top of car.

c. Size and position of door to allow for handing of a ladder minimum 3 m long.

3.7.4.2.6. Ventilation

a. Ducts, vents and blower necessary to evenly distribute air within car.

b. Blower: Single speed type of sufficient capacity controlled by switches in car panel; quiet and free from vibration.

3.7.4.2.7. Lighting

a. Fixtures, lenses, lamps, etc. complete as required.

b. Type and details as approved.

3.7.4.2.8. Emergency light

a. With automatic recharging battery.

b. Automatically turned on and off when power fails and power resumes respectively.

a. Battery capacity more than 30 minutes lighting.

3.7.4.2.9. Convenience Outlets:
Standard singleplex type; set flush in base below inspection switch; one each car.

3.7.4.2.10. Handrails:
Continuous 3 sides each car where scheduled; material and finish as approved.

3.7.4.2.11. Car Wall Protection:
Padded blankets fabricated for specified car; with metal hanger grommets; supported by sufficient number of stainless steel hanger brackets attached to walls near ceiling to meet Glass panels.

3.7.4.3. HOIST WAY AND CAR DOORS
Requirements herein applicable to both hoist way and car doors, except as particularly specified otherwise.

3.7.4.3.1. Doors

a. Manufacture's standard side centre opening glass panel type; material and finish as scheduled; standard thickness, exclusive of any applied finishes or treatments.

b. Bottom edges provided with non-metallic and replaceable door guides sized to suit grooves in sills.

c. Leading edges provided with matching non-vision wings as required.

3.7.4.3.2. Track

a. Roll-formed or cold drawn steel.

b. Sheave bearing surfaces rounded; and with non-metallic covering when not so provided from sheaves.

c. Single length unit each opening.

3.7.4.3.3. Hangers

a. Sheaves type suitable for operation required; two per door panel; designed for Up and Down loadings.
b. Grease packed ball bearing wheels.

c. Wheel tires with non-metallic covering when not so provided for track.

d. Units adjustable by means of eccentric stud or other approved device.

e. Wheel diameters; Manufacture's standard for car doors and hoist way.

3.7.4.3.4. Door Operators

a. Electric motors high speed, type; designed to operate car and hoist way doors simultaneously at any landing.

b. Door speeds: Manufacture's standard opening and closing time.

c. Door power opening; power closing.

d. Door movements electrically or otherwise positively controlled to provide uniform, smooth and quiet operation.

e. Door movements cushioned at both limits of travel.

f. Motors mounted on separate structural means; not on car enclosures.

3.7.4.3.5. Interlock and Unlocking Devices

a. Required for hoist way doors.

b. Approved type interlocks designed to prevent car operation until doors are in locked position; and to prevent opening doors from corridor side unless or until car is within leveling zone at same landing.

c. Approved type mechanical unlocking mechanisms designed to permit authorized access to hoist way at any time and regardless of car location; each such device concealed or in location not readily visible.

3.7.4.3.6. Contact Devices

a. Required for car doors.

b. Approved type contacts design to prevent car operation until doors are fully closed.

3.7.4.3.7. Door Safety Device

1) Required for car doors.

2) Device shall be multi-beam door sensor type; comprising multiple infrared light beams extending full height of the door.

3) Door safety device shall be arranged to operate,

   a. When doors are closing, will cause doors to reverse and travel to full open position; and reclose after predetermined time interval.

   b. When doors are standing full open, will cause doors to remain open until completion of the predetermined time interval.

4) Said reopening/ reclosing operations shall repeat as long as any obstruction remains in doorway; and remain full open for as door hold push button is manually held back.

5) Time delay between reopening and start of reclosing is 5 second or manufacture's standard.

6) When device is actuated, door travel shall not exceed 40 mm before reversing

3.7.4.4. HOIST WAY ENTRANCES AND SAFETY FACIA

3.7.4.4.1. Entrance Frames

a. One side metal type; material and finish as scheduled.

b. Profiles as shown or approved; each jamb and head member in single unit only for full length required.

c. Frame corners and joints accurately cut and machined for neat hairline fit.

d. Jamb designed to securely anchor to structure; with brackets and bolts as required; and securely anchored to sills or structure floors.

e. Where shown solidly filled with cement grout; otherwise concealed surfaces coated with sound deadening material as specified for cars exteriors.

3.7.4.4.2. Entrance Sills

a. Extruded or bar hard aluminum; with grooves accurately formed for minimum clearance with door guides: each member in single unit only for full length required.

b. Built-up or multiple member and exposed fastenings not permitted.

c. Securely anchor to structural support as approved; level and free from movement when grouted in place as required.

3.7.4.4.3. Door Hanger Supports

Formed from rolled or formed steel shapes with manufacture's standard thickness; securely bolted to structure as required.

3.7.4.4.4. Cover Plates

Sheet steel; manufacture's standard thickness; extending full door travel; removable for ease in servicing hangers; fastenings arranged to permit removal of cover without removing fastenings from header.

3.7.4.5. AUXILIARY FEATURES

3.7.4.5.1. Car-Top Inspection Station

a. Required on top of each car; to permit operation of elevator for inspection purposes.

b. Inspection station consisting of special unit containing master keyed ON-OFF switch, continuous pressure type buttons for UP and DOWN travel and emergency STOP button.

3.7.4.5.2. Car Maintenance Stations

a. Required for top and bottom each car.

b. Each station consisting of toggle switch controlling lamp with wire guard; and standard duplex type, grounded convenience outlet; in outlet box or boxes with suitable covers or plates.

3.7.4.5.3. Pit Car Stop Buttons

a. Required in pit area for each elevator.

b. Momentary contact switches; located to prevent inadvertent actuation.

c. Circuiting arranged such that, upon actuation of switch, car will stop immediately regardless of position in hoist way.

3.7.4.5.4. Car Interphones

1) Required inside each car; accessible by person in wheelchairs; located where approved; incorporated as part of car operating panel; unless otherwise approved.

2) Interphones: any standard type or style suitable for 2-way voice communications, between Car and the Control Room in the building.

3) Panels

a. Metal enclosure for recess mounting.

b. Door skin material and finish to match panel face plate as specified under clause 3.12 herein; each equipped with matching pull or handle and friction catch; and mounted using concealed pivots or hinges.

c. Doors embossed INTERPHONE or similar wording as approved.

3.7.4.5.5. Interim Power Source

a. Separate and independent from either normal or emergency sources, other than any charging from normal power sources.

b. Capable of automatically and instantly starting and maintaining operative all elevators lights, and bell during any period between shutdowns of normal power and starting of emergency power.

3.7.4.5.6. Car Load Weighting

a. Required for each elevator; to predetermined monitor car loading of 110%.

b. Sensing device mounted on car platform; interconnected to car overload buzzer.

c. To automatically and continuously emit warning signal during all times car is overloaded.

d. For purposes herein, overload is any loading exceeding 5 percent of rated capacity.

3.7.4.6. EMERGENCY POWER REQUIREMENTS

1) Requirements: Herein applicable to all elevators, except certain interrelated but different operational requirements as specified.

2) System: for transfer from normal to emergency power conditions completely automatic.

3) Coordination

a. Contractor shall coordinate and make arrangements for all necessary facilities, wiring, connections and related work to be provided under Electrical works.

b. As part of work under this section, the Contractor shall provide all other wiring, circuitry, interconnections and related work necessary to meet requirements herein.

4) In Event of Outage of Normal Power Source

a. All elevator cars shall Couple with an individual Auto Rescue Device (ARD) & travel to the nearest Landing Door enabling Safe auto rescue operation.

b. Lights shall immediately resume operation; via interim power sources specified.

c. Special signals in Car Operating panels shall flash on and off, in red letters: EMERGENCY POWER.

d. After predetermined delay sufficient to permit emergency generator to effect power required, each elevator shall start in sequence intervals not sooner than 10 seconds.

e. Elevators shall be operative for Firemen's Service upon command by actuation of respective control switches, In car operating panel.

f. In event of outage when car is standing shut-down at other than car operating panel landing, system to start-up and car to lower same as specified herein above; and in proper sequence.

3.7.4.7. CAR OPERATING / SIGNAL FEATURES

3.7.4.7.1. Floor Call Buttons

1) Micro click type which require momentary contact but positive mechanical pressure for actuation; with integral illumination; either square or round style; size not less than 25 mm across.

2) One button each floor served; each engraved in button face with respective floor number.

3) Each number clearly readable, whether or not illuminated.

3) Automatically illuminated in response to call placed from either car or hall buttons; automatically extinguished upon arrival of car at respective floor level.

4) Each set of numbers in orderly sequential and vertical arrangement in panel face plate.

3.7.4.7.2. Door Close Buttons

1) Description similar to Car Floor Call Button, except:

   a. Non-illuminating.

   b. Face engraved: CLOSE.

2) Interconnected with door operator circuits; to over-ride normal door closing time sequences to permit doors to close after predetermined interval following actuation of button.

3) Time interval: 5 seconds.

3.7.4.7.3. Door Open / Hold Buttons

1) Description similar to Car Floor Call Button, except:

   a. Non-illuminating.

   b. Face engraved: OPEN.

2) Interconnected with door operator circuits; to over-ride normal door closing operations to permit, upon actuation of button:

   a. While doors are closing, instant re-opening of doors to full open position; and thereafter to reclose after normal predetermined time delay.

   b. While doors are standing open, to hold doors fully open for as long as pressure is applied to button;

3.7.4.7.4. Panel Direction Indicators

   a. Digital dot matrix LED in panel face plat; with translucent window inserts of neutral color when not illuminated.

   b. Illumination colors: orange.

   c. Automatically illuminated to indicate respective direction of travel while traveling; or, if not traveling, direction in which car is to travel in response to prior calls placed; or, if no prior calls have been placed, direction in which car will next travel respective to first call next placed.

   d. Automatically extinguish when all calls in respective of travel have been answered.

   e. Automatically reverse to opposite indicator when last has been answered for one direction of travel and will next travel in opposite direction.

3.7.4.7.5. Status Display Screens

a. Rectangular cutout in panel face plates; with translucent screen window of neutral color when not illuminated.

b. Equipped to illuminate wordings in red colors as specified under Emergency Power Requirements.

3.7.4.7.6. Alarm Bell Buttons

a. Single buttons of types which require positive mechanical pressure for actuation; integrally colored red; Manufacture's standard size across.

b. Identified in adjacent location by permanent engraving in panel face plates: IN EMERGENCY-PUSH; or similar wording as approved.

c. Interconnected to actuate bell and signals as specified under Hoist way Alarm Bell.

3.7.4.7.7. Emergency Stop Switches

a. Single types of either toggle or rocker switch or push-pull switch require positive position change for actuation; integrally colored red; size adequate for service required.

b. Side guards provided to prevent inadvertent operation.

c. Identified in adjacent location by permanent engraving in panel face plates: EMERGENCY STOP; or similar wording as approved.

3.7.4.7.8. Car Position / Direction Indicator

1) Required for each elevator car.

2) Separate fixture mounted over door head; containing Up and Down direction arrows and set of floor numbers.

3) Direction indicators.

a. Digital dot matrix LED in face plates of fixtures; with translucent window inserts of neutral color when not illuminated.

b. Illuminations Colors: Up-Green; Down-Red or manufacture's standard.

c. Functions: Same as specified for Panel direction indicators.

4) Floor number indicators

a. Standard or digital dot matrix LED in face plates of fixtures: with translucent window inserts of neutral color when not illuminated.
b. Illumination Color: Manufacture's standard.

c. Automatically illuminated to indicate zone of respective floor where car is located; and when traveling, automatically progress as successive floors are neared or passed.

d. Remain illuminated for respective floor as long as car remains at that floor level.

5) Face plates: As specified under clause 3.12, herein.

6) Electrical chime mounted in the ceiling

3.7.4.8. CAR OPERATING PANELS

1) One set for each elevator, comprising Main Panel; each panel containing items scheduled herein.

2) Function/operation of various items contained as individually specified elsewhere herein.

3) Panels:

a. Metal enclosures for recess mounting.

b. Face Plate: Material and finish as specified under clause 3.12.

3) Locate panels as approved; Main car operating panel to right side of and when facing car doors.

3.7.4.9. HALL OPERATING / SIGNAL FEATURES

3.7.4.9.1. Car Call Buttons

a. Micro click type which require momentary contact but positive mechanical pressure for actuation; integral illumination; either square or round style; size not less than 25 mm across.

b. Types based upon principal of heat or variations of capacitance or induction will not be permitted.

c. Single buttons in one face plate at top and button terminal landing; two buttons in one face plate all landings in between; all arranged and to appropriately indicate directions to be called for.

d. Each button automatically self-illuminating upon actuation; orange when illuminated.

e. Automatically extinguished upon arrival of car at respective floor level when car is traveling in same direction called for.

f. Face plates: As specified under clause 3.12, herein.

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3.7.4.9.2. Hall Position / Direction Indicators

1) Fixtures, features and functions same as specified for Car Position/Direction Indicators, except as specified.

2) Required for and mounted adjacent to each hoist way entrance door each elevator.

3) Face Plates: as specified under clause 3.12, herein.

3.7.4.9.3. Door Reopen Feature

1) Feature operative only:

   a. When doors are in closing phases; and until doors are fully closed and respective doors to reverse to full open position.

   b. By Hall Call buttons at landing respective to where car is standing.

2) Button actuation to automatically cause doors to reverse to full open position.

3) When no prior calls have been registered in car, doors to open or reopen by actuation of any hall button at respective landing or by any car button.

4) When any yet unanswered prior calls remain registered for the car, doors will reopen only by the actuation of button respective to direction in which car is next to travel.

3.7.5 SERVICE REQUIREMENT

3.7.5.1 GENERAL

3.7.5.1.1 System Description

   a. Automatic type; consisting of all mechanical, electrical and electronic equipment, devices, controls, signals, accessories and arrangements necessary to operate, govern, control and indicate elevator activates as specified or scheduled.

   b. Functions and operations instantaneous and automatic, except as necessarily otherwise to effect proper sequences and times meeting specified requirements.

   c. Basic operational system per requirements specified herein for normal services; circuited and otherwise arranged to integrate other services complying with specified requirements.

3.7.5.1.2. Basic Operation

   1) Start up

      a. Automatic; upon receiving any one signal from Hall Call button, Car Call button, Emergency Switch or actuation of keyed switch in car operating panel to positions other than OFF.

      b. Energizes machinery: car lights and fan turn on; all controls and signals operative.

2) Shut down

a. Automatic; after predetermined time delay after car doors have closed at landing of last registered call.

b. Door remains closed; lights and fan turn off; machinery de-energizes.

3.7.5.1.3. Car Leveling

a. Automatic self-leveling system; for all required stops; to stop or maintain car at landings to within specified leveling tolerances.

b. Landing error: Shall be less than 10 mm.

c. When traveling, to de-accelerate and stop car level with landing; without overrun (run by) and return to effect leveling.

3.7.5.1.4. Car Direction Reversal

a. Automatic; to reverse direction of travel when all registered calls in one direction or trip phase have been answered and other calls remain registered or are so registered after car stops.

b. When standing at landing of last call for that direction and as passenger unloading progresses; direction change to register on hall, car and panel position/direction indicators; doors to remain open and reclose under normal time delay; then car to travel in reversed direction.

3.7.5.2. NORMAL (BASIC) SERVICE

3.7.5.2.1. Car Standing

a. Car to remain standing at ground floor; system shut down.

b. When call is placed from any floor doors to close, if open; car to start and travel toward that landing.

c. When call is placed from ground floor door to open if closed or remain open if still open; close after normal time delay period; car to start and traveling direction respective to hall call as placed at that landing.

3.7.5.2.2. Door Operation

a. Hoist way doors to operate simultaneously with car doors.

b. Doors to open automatically when car has reaches proximity of landing leveling zone; and close automatically after predetermined time interval.

c. Doors to fully close before car starts to travel.

d. Whether car stop is responding to hall call or car call, time delay between door opening and closing for predetermined interval;

e. When standing open, leading edges of doors flush with entrance jambs.

f. When closing, doors to respond immediately in response to actions as specified for safety device, door Open/Hold button and Hall button reopen feature.

3.7.5.3. CAR EMERGENCY SERVICE (INITIAL OPERATONS)

a. Effected by actuation of emergency stop switch to ON position.

b. Car to immediately but comfortably stop travel, regardless of direction or location; registered calls for stops to cancel; system to remain operative; lights and fan to remain in operation.

c. Hall Call buttons inoperative; car under control of occupant only until arrival at base landing; but only by constant pressure maintained on button selected.

d. Car travel down only.

e. Requirements for Door Interlocks to remain in effect; hall and Car Direction/Position Indicator to remain active.

f. Car to travel non-stop down and stop at landings selected; doors to remain closed until actuation by constant pressure on Door Open Hold button; doors to reclose upon momentary actuation of Door Open button.

g. Until doors are fully closed, doors to reclose upon release of pressure on Door Open button.

h. Automatic door reclose feature inoperative.

i. Upon arrival at base landing, car to stop; doors to open and remain open; system, lights and fan to remain in operation.

j. No further car operations effective until appropriate adjustments have been made via key switches or reset buttons.

3.7.5.4. HOIST WAY INSPECTION SERVICE

3.2.5.4.1. Inspection Operations

a. Effected by actuation of Hoist way Car-top Inspection switch.

b. Car-top Switch ON; Hall and Car Call buttons inoperative; car operative only by constant pressure on inspection station buttons operative; and system otherwise fully operable.

3.7.6 INSTALLATION

3.7.6.1 GENERAL

a. Install elevators and related and associated work per approved shop drawings and per applicable requirements specified or referenced.

b. Erect components at times required; in advance where necessary; all fixed items accurately positioned and rigidly secured to structure.

3.7.6.2 TESTING REQUIREMENTS

3.7.6.2.1 General

a. Three (3) people from the Employer shall be available for the factory inspections of Elevators. one Mechanical Engineer, one Electrical Engineer and One architect or civil Engineer
b. Required for all elevator work, except as specified for Loading Testing.

c. Test elevators and equipment in presence of and as directed by the Engineer.

d. General testing of elevators shall comprise not less than full and complete operation of elevators to demonstrate satisfactory performance of all features an services.

e. Test cars for speed, performance times, leveling accuracy; and test for performance under half-load and full load conditions.

f. Test operations required for emergency power operations and using emergency power.

g. All general testing complete prior to overload testing.

3.7.6.2.2 Overload Testing

1) Required for all elevators.

2) Overload testing requirements

a. Elevator weighted to not less than 125 percent of rated capacity.

b. Operate elevator continuously Up and Down; in rated load stopping not less than 10 seconds at each landing and in each direction.

c. Measure temperature of hoist motor or relevant motors and generator motor before, during and after testing; using well shielded thermometers.

3) Evaluation

a. Elevator to successfully carry overload Up and Down.

b. Temperature of motors not to exceed 50 degrees C above ambient just prior to start of test.

3.7.7 TRAINING REQUIREMENTS

Operation and maintenance training shall be carried out as follows:-

1) In manufacture's factory

a. Number: four (4) people

b. Duration: minimum five (5) days per each person

c. Location: prepared by the Contractor

2) In the Site

a. Number: sixteen (16) persons

b. Duration: minimum five (5) days per each person

c. Location: prepared by the Employer

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ELECTRICAL WIRING
&
INSTALLATION

ELECTRICAL WIRING AND INSTALLATIONS

DIVISION 1 – ELECTRICAL WIRING AND INSTALLATIONS

1.1 SCOPE OF WORK

a) Contractor shall design (where applicable), supply, install, test & commission the electrical system of Navigational Services Complex (NSC) to comply with the specifications here in under section "Electrical Wiring and Installation".

b) Electrical Installation consists of following systems,

i) LV incoming power supply and associated works

ii) Power Generator system and associated works

iii) Construction of Power House with fuel storage facility

iv) LV distribution system

v) Lighting and general power outlet system

vi) Grounding and lightning protection system

c) Contractor shall design & install the protection & metering equipment for the above systems and provision of connections to Building Management System (BMS) with remote energy metering system.

1.2 GENERAL:

a) The Electrical Installation shall be for 400V, 3P+N, 50Hz, AC supply. All accessories used in the installation, shall be suitable for the appropriate working voltage.

b) The positions of electrical fittings shall be decided at the site under the supervision of AASL representative.

c) The execution of the work in every respect shall be to the satisfaction of the Engineer and confirm to the latest edition of IET Wiring Regulations. (18th Edition)

d) All materials used for the work on this contract shall be of the highest grades of their respective kind and shall conform to the latest British/IEC Standard Specification where such standards exist.

e) The complete electrical installation shall be fully re-wireable type and on a perforated cable tray and/or in a rigid steel/uPVC conduit system embedded in the walls/slab unless otherwise specified.

f) No extra payment will be made for accessories for cable trays & ladders, conduits & accessories, earth electrode & earth continuity conductor, other associating accessories and any of extra requirements. Hence the contractor is requested to include such materials, labour and any extra cost to be incurred in the rates for respective item in the BOQ.

g) The latest colour code according to BS7671-2018 shall be adhered to entire wiring items.

h) The phase wire shall be terminated on the right hand side of socket outlets and other fixtures where applicable. No joints are allowed in the runs of cables. Flexible cords (if required for pendants, LED fittings etc.,) shall be of a minimum size of 32/0.20 – (3core 1.0 mm^2) Cu/PVC/PVC unless otherwise specified.

i) Manufacturers shall have regularly produced the same or similar equipment, materials and/or systems for more than ten (10) years prior to tender opening, Possess necessary certificates and licenses for the manufacture and sale of required products, Be capable of providing spare parts and technical support for respective products for at least ten (10) years, Be capable of providing the Maintenance and Repair Services specified herein including

j) Quality of products shall be of the highest international standard used for similar type of Project.

k) Technical Literature

Catalogues indicating the Technical Specifications of all Electrical Equipment and fittings shall be submitted with the offer.

L) Samples

Samples of all electrical fixture/equipment and material intended to be used by the contractor shall be submitted to the Engineer for the approval before ordering them or before commencing work with such equipment and material.

m) Fixing Guidance

i) All switches to be 1370 mm above finished floor level.

ii) All socket outlets to be 400 mm above finished floor level.

iii) Wall Mounted Distribution Boards containing switch gear items to be 1830 mm above finished floor level.

iv) Consumer Units to be 1830 mm above finished floor level.

v) All other fittings such as LED luminaries etc., to be mounted directly on to the slab soffit/ ceiling, cable trays or walls where applicable.

vi) Contractor shall obtain directions from the Engineer if he needs further advice on this.

vii) Contractor shall provide the necessary support of suitable strength to carry the weight of the fixtures in respect of fixing of light fittings.

n) Shop Drawings

i) The Electrical Drawings [three copies each on A2 size papers (A3 if required) and in soft form (in AutoCAD)] of the Electrical Installation shall be submitted for the approval of the Engineer before commencing any work. Such drawings shall indicate the location of lamp points, switches, socket outlets, Main Distribution Board and other Distribution Boards, Conduit/ cable tray paths , sizes & number of each of the above etc., and the Single Line representation of all the Electrical Panel Boards with all dimensioning.

ii) All drawings shall be prepared in an acceptable manner conforming to good drawing office practices on A2 size paper.

iii) These drawings shall be submitted in sufficient time for approval to be granted prior to any works commencing on site or manufacturing of any equipment, or item.

o) As Built Drawings:

i) The As Built Drawings (four copies each) of the Electrical Installation shall be submitted to the Engineer after completion of the work. Such drawings shall indicate the location of lamp points, switches, socket outlets, Main Distribution Board and other Distribution Boards, locations of, conduit/ cable tray paths, sizes & number of each of the above etc., and Single Line representation of all the Electrical Panel Boards.

ii) All drawings shall be prepared in an acceptable manner conforming to good drawing office practices on A2 size paper.

p) Testing & Commissioning

i) The contractor shall submit a testing and commissioning report with certification of a Chartered Engineer, upon the completion and commissioning of the project, c/w the relevant technical details, drawings, manufacturer's catalogues for the items of equipment forming the installation and warranty certificates.

1.3 LV INCOMING POWER SUPPLY:

a) Main source of power shall be obtained from the utility service provider (Ceylon Electricity Board- CEB) according to their standards.

b) Capacity of LV power supply transformer shall be suit to 1200kVA demand load, consists of Delta / Star windings of Primary / secondary respectively with solidly earthed grounding system. Transformer LV star winding shall be grounded separately from the other frame earthing system and grounding resistance shall be less than 1 Ohm and comply with IEC 60076-11 or latest.

1.4 POWER GENERATOR SYSTEM:

1.4.1 The Generator

a) The contractor shall provide the Generator system incorporating fuel storage day tank having capacity for over 8 hours continuous full load operation.

b) The Generator shall be brand new, 400 Volts, 3 phases, 50 Hz, Prime rated at 1500 RPM, to the designed capacity of 800 kVA. The generator shall include Brushless Alternator with Automatic Voltage Regulator (AVR), close coupled to a turbo charged, water-cooled diesel Engine.

c) The generator shall be supplied as a whole on a heavy duty fabricated welded steel base frame and comprise:

- Enclosed with original factory fitted soundproof canopy.
- Generator control system shall be remotely controlled and of having a monitoring system with graphical user interface over PC monitor and the system shall consist with the facility of an event logging as well as status monitoring.
- Surge protection system shall be provided and not limited to the
  - Utility power incommer
  - ATS/AMF,
  - Control system
  - Distribution system
  - Remote control and monitoring station
- Diesel engine and alternator set.
- The generator and associated systems shall be located in a dedicated room having sufficient operational and maintenance spaces in the proposed power house.

- Cooling system with radiator and cooling fans complete with protection guards.
- Heavy-duty industrial capacity stainless steel exhausts system c/w heavy-duty non-corrosive flexible fittings where necessary.
- Anti-vibration mounts fitted between engine/alternator feet and the base frame ensuring complete Vibration isolation of the rotating assemblies.
- 24V starter system with battery charging alternator, axial type starter motor, high capacity maintenance free starting battery.
- A base frame mounted engine and alternator control panel shall be provided. The control panel shall be isolated from vibration and shall comprise instrumentation, controls and protection in accordance with the standards and specifications.
- The generator room shall be provided with a CO monitoring system. The system shall provide continuous monitoring of the atmosphere inside the generator room.
- In the event of a hazardous atmosphere being detected, an alarm shall be generated. The alarm shall take the form of an internal sounder, supplemented by an amber colored beacon inside the building. Additionally, alarm bells shall be provided both externally on the respective building, and in the main site control room. A mute facility shall be provided.
- The smoke exhaustion system / Noise emission levels of the proposed diesel generator shall be complied with the latest edition of the relevant IEC standard and for international airport environment.
- The exhaust chimney shall be sized to cater backpressure constraint and exhaust shall be discharged over roof level opposite to the NSC building considering air flow direction without disturbing other structures around.

d) The generator shall start soon after mains power (CEB) failure (Preferred within 10Sec.) and the proposed generator shall operate & deliver power only to the standby power requirement of proposed NSC building & Hangars until the CEB power restore. Required LV control signals shall be provided via ATS and the ATS operation shall be so designed to cater this requirement.

1.4.2. Auto Transfer Facility

a) The mains and generator Auto Changeover

- The mains and generator incomer sections shall be equipped with rated Air Circuit Breakers (ACBs).
- An auto transfer facility shall be provided for an automatic changeover between the ACBs (mains and generator). The auto changeover will take place whenever there is a power supply failure and when CEB power is restored following a failure. The Contractor shall develop a scheme based on the following principles.
- If there is a power failure detected on the mains incomer, the auto transfer scheme will open the main incomer breaker and initiate an automatic start impulse signal to the generator control panel to start up the generator.
- On detection of the generator terminal voltage and frequency reaching its nominal values the generator control panel shall initiate an automatic closing impulse signal to the generator incomer breaker.
- Reverse operation will be initiated by the auto transfer scheme when CEB power is restored.

- The auto transfer scheme will prevent the paralleling between the ACBs (mains and generator). Mains incomers and generator incomer shall always be electrically and mechanically interlocked.
- The interlock and automatic change over system shall be proprietary and any relays, controller and accessories shall be from the same manufacturer supplying the ACBs.
- All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations or instruction manuals.

1.5 CONSTRUCTION OF POWER HOUSE:

Power House shall design and construct near NSC building to accommodate Power Generator and associated panel boards, to cater the power requirement of NSC & Hangar area, according to the given guidance in specifications.

a) The generator room shall have proper ventilation.

b) Panel Room & Technician Duty Room shall be air-conditioned.

c) The bidder shall include of underground fuel storage tank sufficient to store 2,000 gallons of auto diesel fuel for the proposed generator, fuel transfer facility c/w gear pump incl. motor and associated piping, fittings, valves, floats etc. to pump Diesel fuel from proposed UG fuel storage tank to the day tank of proposed generator. The proposed fuel storage tank shall meet the recommendations given in the latest editions of the IEC and BS standards.

d) Bidder shall submit a detailed design proposal for construction of power house incl. detailed shop drawings to suit the proposed transformer, generator and associated panel boards.

e) Power house building, panel boards, cable ducts, trenches, trays or ladders shall be designed having ample space to cater present and future demand.

f) Concrete slab shall be as the roof with proper water proofing.

1.6 LOW VOLTAGE DISTRIBUTION SYSTEM:

1.6.1 Scope of Work

The scope of works for the LV Distribution System includes but shall not be limited to the following

i) Generator system (sound proof canopy mounted) and associated works including Generator room.

ii) Automatic Transfer Switch (ATS)

iii) Main and secondary LV distribution boards

iv) Transformer outgoing feeders shall be connected to the main LV bus bar.

v) LV Cable feeders.

vi) Final sub-circuits

vii) Energy metering.

viii) Power factor correction, Power conditioning and harmonics filters

ix) Control and monitoring systems, including equipment, devices, panels, cables/wires, conduit, wire-ways, trunking, ducts, trays, ladders and all accessories, security and interlocking devices.

x) Cables/wires, cable rack, cable trunking, ladders, trays, conduit and all accessories including the design and provision of the Common Use Cable Rack, Cable Ladder, Cable Tray and Trunking System to be shared and coordinated with all Divisions of the Electrical works and other Sections/Divisions of the works under the responsibility of the Contractor.

xi) Interfaces with Building Management System and other Systems.

xii) Lightning & surge protection

1.6.2. LV Electrical System Characteristics

a) Voltage Insulation: 1 kV AC Rating 600 VAC

b) Distribution: as per IEC

c) Conductor: Copper only

d) Grounding: All equipment to be properly grounded according to the relevant IEC standard

e) Nominal Voltage: 400 V between phases 3φ/ 50 Hz, while single-phase load shall be 230 V /1Φ/ 50 Hz.

f) The maximum acceptable voltage fluctuation will be +/-5%

g) Total Harmonic distortion (THD): ≤ 5% according to the relevant IEC standard.

h) Maximum voltage drop permitted will be 5% (from secondary of a transformer to final load)

i) Frequency: 50 Hz (the maximum acceptable frequency fluctuation will be +/- 2Hz)

k) Protection Index: Minimum IP shall be as follows:

- Indoor: IP 42
- Toilet and Kitchen : IP 44
- Outdoor: IP 54

1.6.3. LV Distribution

a) Main Feeder System

Supply and install all main feeders of the size and type shown on the drawings with all accessories for their proper installation, mechanical protection, support, termination, etc.

b) Distribution Wiring System

Supply and install all power wiring of the size and type shown on the drawings with all accessories for their proper installation, mechanical protection, support, termination, etc. of the type and size shown on wiring system drawings.

c) Cable Route

The routing for LV distribution shall be strictly segregated. Main cable routing shall always be of ducts, cable trays or cable ladder type. Rigid steel conduits or Fire retardant uPVC are only accepted for secondary routing. Fire retardant type uPVC conduit & necessary accessories comply with IEC 61386 standards, shall embed in concrete slab and wall only with the Engineer's approval.

1.6.4 CABLES for LV Power, Lighting and Internal Wiring.

1.6.4.1 Cable Specifications

a) Standard: XLPE 0.75kV grade cable shall comply with (IEC-60332-3), (BS 6387:2013) or equivalent. PVC 0.75kV grade shall comply (BS 6004: 2006)

b) Nominal voltage 450/750V

c) Conductors: Stranded copper wires

d) Insulation: XLPE. Insulation shall be free from flaws, bubbles and other defects, unless otherwise specified.

e) Maximum allowable temperature of conductors, in normal condition shall not exceed 70ºC.

f) Outer Sheath: Polyvinyl chloride extruded sheath applied over insulated conductors.

g) Fire and heat resistant cables shall be selected and used according to the criteria specified herein.

h) Low smoke Zero halogen cables shall be used for the LV power distribution and final sub circuit system.

i) Cables shall be single core (only accepted in conduits) or multi-core according to the circuits.

j) A separate single core cable shall be used for the earth connection, unless otherwise specified.

k) Conductors of up to 1 mm^2 shall be made of solid copper where applicable with approval of the Engineer.

l) Conductors of 1.5 mm^2 and larger shall be made of stranded copper.

m) All cables having conductors of 2.5 mm^2 up to 95mm^2 shall be made of multi-core, unless otherwise specified.

n) LV cables having conductors 95 mm^2 and larger shall be made of single core, unless otherwise specified.

o) No cable less than 1.5 mm^2 shall be used for lighting circuits & No cable less than 2.5 mm^2 shall be used for socket outlet circuits and/or for earth connection and all cables for power circuits shall be stranded copper.

p) All cables/wires shall be rodent proof.

q) LV internal cable route shall install without any contact with ELV cables and water pipes.

1.6.4.2 Colour Coding & Wiring

a) All Power cable conductors shall be identified by colour-coding and designation letters as indicated in the following.

4 Wire Cable Symbol Project Colour

Phase 1 - L1 Brown

Phase 2 - L2 Black

Phase 3 - L3 Grey

Neutral - N Blue

5 Wire Cable Symbol Project Colour

Phase 1 - L1 Brown

Phase 2 - L2 Black

Phase 3 - L3 Grey

Neutral - N Blue

Ground - G Green / Yellow

b) Colours for cables use in final wiring shall be as Brown for Phases and Blue for Neutral in 3-phase and Brown for phase and Blue for neutral in Single phase. Green/Yellow for Earth and it shall be adhered throughout the installation.

c) Separate earthing cable shall be of yellow/green colour.

d) Colour coding for other cables/wires shall be as approved by the AASL Engineer.

e) The Contractor shall exercise due care to prevent damage to conductors, insulation or sheathing.

f) The Contractor shall furnish and install all supports, fixings, hangers, cable cleats and supports required to make a neat and substantial cable installation.

g) Any cable exposed to occupants/users of the Buildings, within 2 meters from floor level or which gives any risk of shock shall be mechanically protected with conduit or trunking.

h) Cable identification numbers shall comply with cable schedules which shall be prepared by the Contractor according to cables as actually installed.

i) The cable schedules shall indicate circuit numbers, cable numbers, cable sizes, voltage, number of conductors, conductor size, termination and connections at each and cable route. In addition to preparing as a hard copy drawing, the Contractor shall prepare and submit the cable schedule in Microsoft Excel format.

1. 6.4.3 Main Cables

Cables {Cu/XLPE/SWA/PVC} or {Cu/XLPE/PVC} shall be as described in the BOQ & Drawings, which are to be laid within & from Power House supply terminals and Main Switch Boards to the Main Breaker of the Main Distribution Boards/ Sub Distribution Boards. Cables shall be laid direct in underground, trench, duct or perforated cable trays/ladders where as necessary.

1. 6.4.4 Sub Main Cables

Cables {Cu/XLPE/PVC} or {Cu/PVC/PVC} shall be as described in the BOQ, running from sub Distribution Board to Final Distribution Boards. Cables shall be laid in conduits/ cable trays, unless otherwise specified.

Cables {Cu/PVC/PVC} shall be as described in the BOQ, running from the Final Distribution Board/s to lighting point or Socket outlet. Cables shall lay in embedded conduits and/or on cable trays.

1. 6.4.5 Earth & Earthing Conductors

a) For the earth conductor, same size of PVC insulated copper cable shall be used in places where the phase conductors are less than or equal to 16 mm^2. For phase conductor sizes higher than 16 mm^2 appropriate sizes shall be used as per the guidance given in the IET Wiring Regulations (BS 7671: 2018). Earthing in every respect must be in accordance with IET Wiring Regulations and the expected value of Earth Resistance shall be less than 1 Ohm.

b) The design drawings shall be marked the number of earth electrodes according to the BOQ & specifications and positions of earth electrodes shall decide by the Contractor at the site (with AASL Engineer's approval) and a Test Clamps to be provided in an earth pits for authorized persons to check the Earth Resistance when required. Copper tape shall be used as the earth conductor between earth electrode and the MSB/MDB.

c) All earthing systems and conductive parts & exposed metal works shall connect to the earth continuity conductor with equipotential bonding.

1. 6.5. Conduits

a) Conduits shall be minimum 25 mm diameter & shall be of high quality confirming to BS 4607(Revised) for Non-metallic conduits, BS EN 50086, BS EN 61386 & SLS 993 for rigid conduit systems for cable management inclusive metallic conduits.

b) Generally conduits shall be used for final sub-circuits embed in concrete slabs.

c) Conduits shall install as complete systems, with all field bends or modifications so made that structural integrity and electrical continuity is maintaining.

d) Conduits shall be installed and supported in a rigid and satisfactory manner to the approval of the Employer.

e) Unless cast into structural concrete, conduits shall generally be installed at right angles or parallel, to building lines

1.6.6 Cable Trays/ Ladders

a) GI perforated Cable Ladders (300mm wide) shall install throughout the vertical electrical installation (shaft) from ground floor electrical panel room to fifth floor electrical panel room with branches for the electrical panels, for the installation of main supply cables from MDB to SDBs and in the powerhouse where applicable. For horizontal distribution 300mm and 150mm cable trays shall be installed where as necessary. Cable trays/ ladders shall c/w all accessories such as brackets, supports/spacers, bends, tee branches & drops, crossings, reducers, fixed, adjustable & angle connectors, clamps, drop-out and corner plates etc.

b) The trays shall be fabricated from minimum 1.6 mm plain-steel sheet perforated to between 25% and 50% of the total area. The tray shall have returned edges. After fabrication, the trays and accessories shall be, **hot-dip galvanized** according to BS 729 and shall have returned flange.

c) Support brackets for cable trays shall be fabricated and finished as for the tray and provided at intervals not exceeding 1200 mm with 2 bolts to each bracket. Bracket shall be fixed with not less than 2 bolts to the wall or other available and approved supports. End covers of manufacturer's standard and grounding terminal at the end of Tray/Ladder. All ladder sections & trays shall be interconnected and connected to the earth systems by breaded copper earth conductors

d) Multi-tier cable tray shall have a minimum spacing of 300 mm between trays

e) All Main & Sub Main Cables and wiring leading to lighting fixtures and socket outlets shall lay on these cable trays.

1.6.7 Cable Trunking

a) Cable trunking shall manufacture from high impact Halogen free fire retardant type material. Cable trunking shall be Three-compartment all insulated system. A separate compartment of each for power, telephone and data cables shall be used. Cable trunking for desk top level

mounting (dado height) shall have a chamfered top and chamfered bottom section. Cable trunking for skirt level mounting shall have a chamfered top section and square profile base.

b) It shall be possible to fix wiring accessories with mounting boxes, which are fitted in to the centre compartment, anywhere along the trunking flushed with the trunking. Cable trunking system shall accept all leading wiring accessories including one gang faceplates and two gang faceplates.

c) All accessories such as couplers, end caps, tees, internal bends, external bends, intersections etc., shall be purpose made by the manufacturer of the trunking.

d) Width and depth of cable trunking, on which power socket outlets, telephone and data outlets are to be mounted, shall be not less than 165mm (W) x 50mm (D) for 3-compartment trunking.

1.6.8 Under Floor Ducts / Junction Boxes / Service Outlet Boxes

a) Underfloor ducts shall manufacture from minimum 1.6 mm plain-steel sheet. After fabrication, the ducts and accessories shall be **hot-dip galvanized** according to BS 729. Under floor ducting shall be two-compartment and minimum size to be 200mm (W) x 35mm (D).

b) Junction boxes shall be suited for under floor duct with heavy duty lid to easy access.

c) Service outlet box shall be manufactured/ moulded in polycarbonate or heavy duty non-corrosive material. Samples shall be provided for Engineer's approval. Lid shall be reinforced with minimum 3mm thick steel sheet. Size shall be suit to the under floor duct having space minimum for four service outlets with ample space for wiring having at least 25% free space. Minimum depth shall be 85mm.

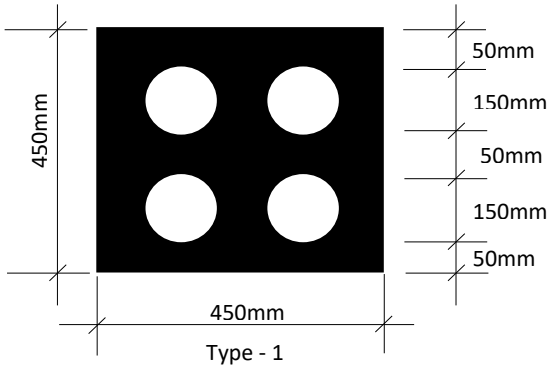
1.6.9 Under Ground Cable Ducts & Trenches

1.6.9.1 Under Ground uPVC Cable Ducts & Concrete Man Holes

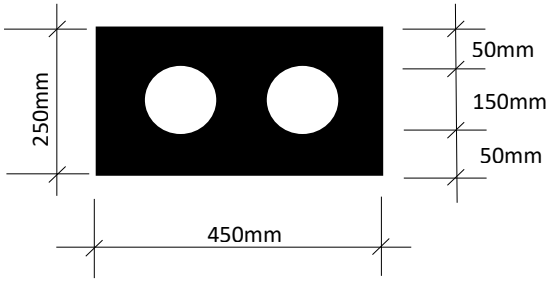
1. Two Types as per drawings given below. Rate to be included all accessories/ material and civil & mechanical works.

   Type-1: Concrete encased 4 Way/ 150mm Under Ground (Type 1000) uPVC Cable Duct (450mm x 450mm cross sectional dimension) from powerhouse to ground floor switch room

   Type-2: Concrete encased 2 Way/ 150mm Under Ground (Type 1000) uPVC Cable Duct (450mm x 250mm cross sectional dimension) at ground floor switch room

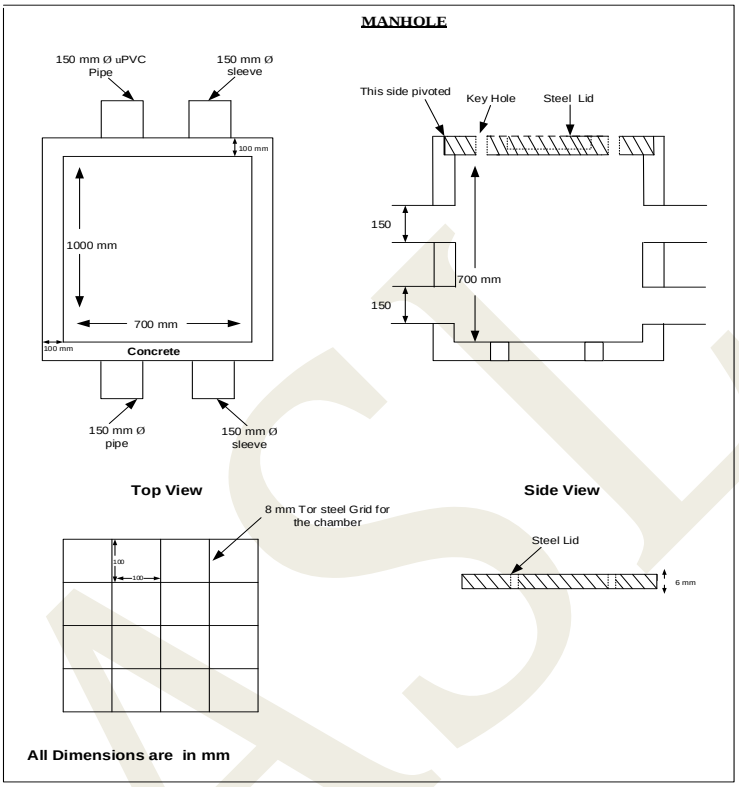


Type - 1



Type - 2

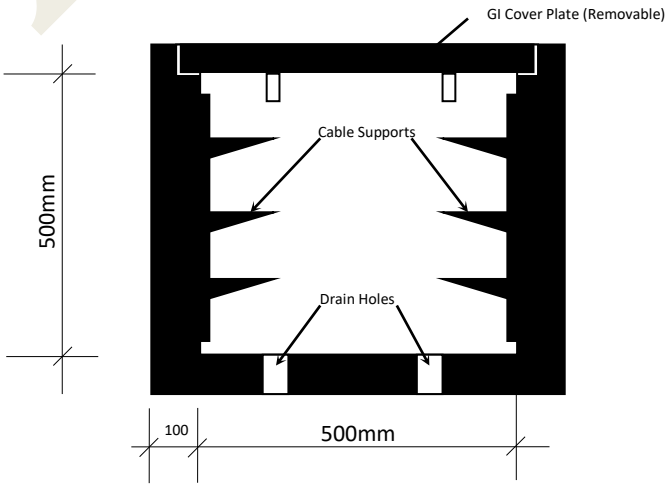
2. Supply & construct of reinforced Concrete Man Holes [1000mm (L) x 700mm (W) x 700mm (D) inner dimension for Type-1 ducts and 750 (L) x 500 (W) x 400mm (D) for Type-2 ducts] for above UG cable ducts (c/w E600 cat. Covers with tilled floor finish), from Power House to ground floor Switch Room and in GF switch room & UPS Room, as per drawings given below. Rate to be included all accessories/ material and civil & mechanical works.



1.6.9.2 Concrete Cable Trench & Man Holes

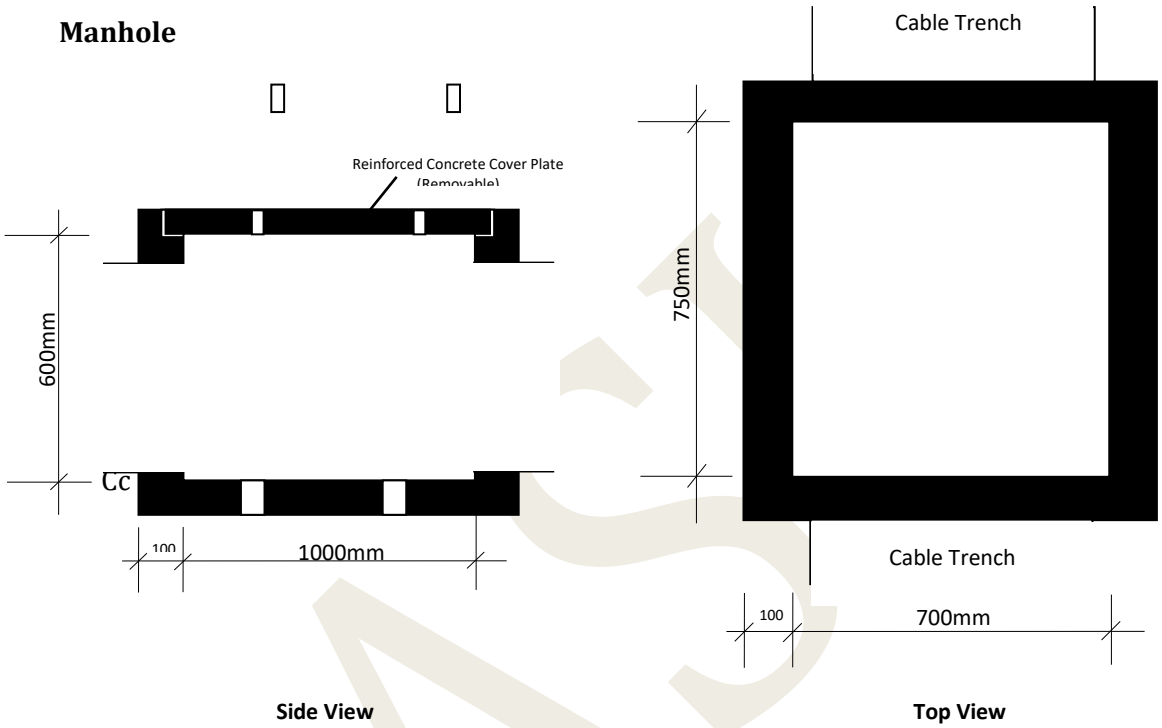
1. Supply & construct of reinforced Concrete Cable Trench (600mm x 600mm inner dimension) for indoor installation of main supply cables at powerhouse and ground floor of NSC building (switch room) as the diagram given below. GI cover plate (Checkered Plate) shall be removable for easy installation and access for maintenance. Surface of cover plate shall be finished floor level. Rate to be included all accessories/ material and civil & mechanical works.

Trench



2. Supply & construct of reinforced Concrete Man Holes (750mm (L) x 700mm (W) x 600mm (D) inner dimension) for above cable trench, as per diagrams given below. GI cover plate (Checkered Plate) shall be removable for easy installation and access for maintenance. Surface of cover plate shall be finished floor level. Rate to be included all accessories/ material and civil & mechanical works.

Manhole



1.6.10 Circuit Protection

a) Circuit Breakers (CB) will protect the entire power distribution system and the different branch circuits against short-circuit and overload. Circuit breaker protection scheme shall be properly coordinated one, with discrimination and with different tripping times. All panel boards should be protected by a main CB (with adjustable tripping time) as to ensure a proper time vertical selectivity.

b) All Incoming Cables (Power and Data) have to be protected against voltage surges resulting of direct or indirect lightning strike as to avoid damage to electronic equipment.

c) All main LV panel boards will include such general protection against voltage surges; further all electronic system shall be equipped with additional voltage surge protection.

d) All circuit breakers greater than or equal to 800 Amp shall be of ACB and all ACBs and MCCBs shall be 4-poles unless otherwise specified.

e) Protection for final sub-circuits shall be provided by miniature circuit breakers (MCB) and residual current device/circuit breakers (RCD/RCCB) for individual circuits.

1.6.11 LV Air Circuit Breakers (ACB)

a) Air circuit breakers (ACB) shall comply with standards IEC 60947-1 and IEC 60947-2 and be of a type tested and reputable make. Utilization category of ACB shall be Category B. Air circuit breakers shall have a rated operational voltage of 690 VAC (50Hz). All circuit breakers shall be fully tropicalized as standard. Air circuit breakers shall be suitable for isolation according to IEC 60947-1 and –2 for the rated insulation voltage.

b) Air circuit breakers shall be of the automatic, metal clad, with drawable isolating, removable type having provision for safe & easy replacement and maintenance.

c) Provision shall be made to padlock the circuit breaker in the isolated / withdrawn position and to padlock the automatic shutters covering the live contacts when the circuit breaker is removed from its housing.

d) Interlocks shall be provided to prevent movement of the circuit breaker within the housing when it is in the 'closed' or' service' condition and automatic shutters shall be provided to cover all live contacts when the circuit breaker is isolated or withdrawn or is removed from its housing.

e) Mechanical indicators shall be incorporated to indicate breaker OPEN, CLOSED and TRIPPED status, and spring CHARGED and DISCHARGED status.

f) Shunt trips and other required accessories shall be provided for the breaker. Auxiliary switches shall be fitted to provide illuminated indication of circuit breaker ON/OFF status.

g) ACB shall be provided with a Digital Intelligent and modular type (Micro-Processor) Control Unit which shall provide the following protection, measurements and maintenance functions.

i) Protection: The ACB control unit shall offer the following protection functions as standard:

- Long-time (LT) protection with an adjustable current setting and time delay;
- Short-time (ST) protection with an adjustable pick-up and time delay;
- Instantaneous (INST) protection with an adjustable pick-up and an OFF position.
- Current and time-delay settings shall be indicated in amperes and seconds respectively on a digital display.
- Earth-fault protection with an adjustable pick-up and time delay shall be provided.
- Function shall be provided to disable the earth fault protection if necessary.
- Shall be equipped for neutral protection as standard with a 3-position setting
  - Neutral not protected
  - Neutral tripping threshold equal to half the phase value
  - Neutral threshold equal to the phase value or LT protection for Neutral could be set separately up to 1,6xIr_phase
- Motor protection (unbalance, locked rotor, long start, under load) and Generator
- Protection shall be available where necessary.
- Electronic trip units with measurement and communication capability shall offer operating assistance function, indication of fault types (LT, ST, instantaneous, ground fault) faulty phases, interrupted current, trips history, alarms history and events history (setting changes, test…) These functions and indicators shall be available by ACB itself, remote display and BMS.

ii) Measurements

- A LED bar-graph shall simultaneously display the load level / Energy measurement V, A, kW, kVA, kWh, THD etc.; on the three phases.

- Currents, voltage, power, Energy, Total Voltage Harmonic distortion, Total current harmonic distortion. Accuracies of the entire measurement system, including the sensors shall be
- Current: Class 1 as per IEC 61557-12
- Voltage: 0.5%
- Power and energy: Class 2 as per IEC 61557-12
- A maxi meter shall store in memory and display the maximum current value observed since the last reset. Communication port shall be available on the front panel to communicate with remote operation, control and monitoring.

iii) Maintenance

- The last ten trips and alarms shall be stored in registers that may be consulted locally (date and time, type of fault or alarm). Maintenance indicators shall be displayable on request on the front panel.

iv) Auxiliaries and accessories

- ACB shall be designed to enable safe on-site installation and equipped with auxiliaries such as voltage releases (shunt and under voltage releases) and indication switches as required.
- ACB shall equipped with auxiliary contacts for signal to different functions, such as open/ closed position, fault signal, electrical fault (including electrical leakage) signal, all auxiliaries shall be common for the entire range.
- Auxiliaries shall be separated from power circuits.
- All electrical auxiliaries shall be of the snap-in type and fitted with terminal blocks, the addition of auxiliaries shall not increase the volume of the circuit breaker.

1.6.12 LV Moulded Case Circuit Breakers (MCCB)

a) Moulded Case Circuit Breaker (MCCB) shall comply with IEC 60947-2 and be of type tested and reputable make and manufactured by original equipment manufacturer.

b) MCCB Shall be of Plug-in (Withdrawable) Type and latest version of the product range from the reputed manufacturer.

c) MCCB shall be of current limiting type with Utilization Category A or of Utilization Category B as required. MCCBs shall have a rated operational voltage of 690V AC (50Hz). All circuit breakers shall be fully tropicalized as standard. MCCBs shall be suitable for isolation according to IEC 60 947-1 and –2 for the rated insulation voltage.

d) The operating mechanism shall be of the quick-made, quick-break, trip-free type with the speed of operation independent of the operator. The mechanism shall be designed to operate all poles simultaneously during opening, closing and tripping conditions.

e) Utilization category A breakers shall be provided with thermal bi-metallic elements for an inverse time-current trip characteristic to protect against sustained overloads and instantaneous magnetic trip elements for short circuits protection.

f) Thermal trips and magnetic trips shall be adjustable. A single adjustment shall ensure the setting of all poles in a multi-pole breaker simultaneously.

g) If the breaker is of Utilization Category B, then such a breaker shall be provided with an intelligent and modular type micro-processor control unit for tripping which shall provide the following protection and measurements functions.

i) Protection

The CB control unit shall offer the following protection functions as standard:

- Long-time (LT) protection with an adjustable current setting and time delay;
- Short-time (ST) protection with an adjustable pick-up and time delay;
- Instantaneous (INST) protection with an adjustable pick-up and an OFF position.
- Current and time-delay settings shall be indicated in amperes and seconds respectively on a digital display.
- Earth-fault protection with an adjustable pick-up and time delay shall be provided if indicated on the appended single-line diagram or Bill of Quantities. It shall be possible to deactivate the ground fault protection.
- Four-pole devices shall be equipped for neutral protection as standard with a 3-position setting
  - Neutral not protected
  - Neutral tripping threshold equal to half the phase value
  - Neutral threshold equal to the phase value or LT protection for neutral could be set separately up to 1,6xIr_phase
- Motor protection (unbalance, locked rotor, long start, under load) and Generator protection shall be available where necessary.

ii) Measurements

- A LED bar-graph shall simultaneously display the load level / Energy measurement V, A, kW, kVA, kWh. on the three phases.
- Currents, voltage, power, Energy, Total Voltage Harmonic distortion, Total current harmonic distortion. Accuracies of the entire measurement system, including the sensors shall be
  - Current: Class 1 as per IEC 61557-12
  - Voltage: 0.5%
  - Power and energy: Class 2 as per IEC 61557-12
- A maximeter shall store in memory and display the maximum current value observed since the last reset. The data shall continue to be stored and displayed even after opening of the circuit breaker. Communication port shall be available on the front panel to communicate with remote operation, Control and monitoring. Interface protocol shall be selected according to the control and monitoring devices of this project
- Electronic trip units with measurement and communication capability shall offer operating assistance function, indication of fault types (LT, ST, instantaneous, ground fault) faulty phases, interrupted current, trips history, alarms history and events history (setting changes, test…) Theses functions and indicators shall be available by MCCB itself, provision for remote display and BMS.

iii) Motor Operator

- A motor operator shall be equipped with the MCCB where necessary to operate on remote control. An "auto/manual" switch in front shall, when set to the "manual" position, lock out electrical control; when set to "auto", lock out the manual control; remote indication of "manual" or "auto" mode shall be possible. It shall also be possible to seal the access to the "auto" control.
- Closing and opening shall take place in less than 80 ms and 600ms respectively.
- Tripping due to electrical faults (over - load, short-circuit, earth fault), remote reset shall be inhibited. It shall however be possible if opening was initiated by a voltage release.
- The operating mechanism shall be of the stored-energy type only.
- Stable tripping mechanism positions (ON, OFF and TRIPPED) shall be possible with the motor mechanism.
- Isolation shall be provided by positive contact indication (ON and OFF) in front of the motor mechanism module.
- Motor mechanism module shall not mask or block device settings.

iv) Auxiliaries and accessories

- MCCBs shall be designed to enable safe on-site installation and equipped with auxiliaries such as voltage releases (shunt and under voltage releases) and indication switches as required.
- MCCB shall equipped with auxiliary contacts for signalizing different functions, such as open/ closed position, fault signal, electrical fault (including electrical leakage) signal, all auxiliaries shall be common for the entire range.
- Auxiliaries shall be separated from power circuits.
- All electrical auxiliaries shall be of the snap-in type and fitted with terminal blocks, the addition of auxiliaries shall not increase the volume of the circuit breaker.

1.6.13 Miniature Circuit Breakers (MCB)

a) MCB shall be of four-pole, triple-pole, double-pole or single-pole as specified. Overall dimensions and fixing centres for the same range of MCB shall be identical and suitable for fixing individually to a metal back plate or directly mounted inside a manufacturer's designed distribution metal box.

b) Cable terminals of the MCB shall be at top and bottom of the units with access from front, and suitable for terminating the size of solid or stranded conductor in accordance with Table 4 of IEC 60898.

c) The operating mechanism of a MCB shall be thermal-magnetic, designed to give a fixed, stable, inverse time-current characteristic in accordance with Table 6 of IEC 60898. The calibration temperature shall be 30'C.

d) MCB with current carrying contacts of plug-in type shall not be accepted. Contacts of the MCB shall be of non-weld type. The miniature circuit breakers (MCB) shall comply with IEC 60898 & 60947-2 and shall have a Type 2 Classification or equivalent IEC classification. MCBs shall be of type tested and reputed make.

e) The current rating and short-circuit breaking capacity shall be as indicated in the drawings and/or bill of quantities. If the short-circuit breaking capacity is not specifically indicated in the drawings and/or bill of quantities a minimum short circuit rating of 10kA shall apply.

f) The frame size of all MCBs shall be the same so that they can be easily interchanged.

g) Circuit breaker dollies shall be of the trip-free pattern to prevent closing the breaker on a faulty circuit and they shall be engraved to indicate the ON/OFF position.

1.6.14 Residual Current Devices (RCD)

a) Residual current device (RCD) shall provide accident protection by interrupting dangerous contact voltages, which may be present in faulty electrical appliances as a result of frame faults, insufficient insulation or misuse. They shall provide a high degree of protection against earth faults, fires and electric shock.

b) RCD shall conform to IEC 61008-2 and shall be Category - A in generally.

c) RCDs comply with IEC 61008-2, Category - B sensitive to pulsating DC fault current shall be used for the socket outlet circuits connected with generator backup and circuits which is connected to loads with switch mode power supply where applicable.

d) Each RCD shall consist of a current transformer, a tripping coil with contact assembly, main supply contacts, ON/OFF switch, a test button and a trip-free mechanism, all mounted on robust body of all insulated material. RCD shall be suitable for operation on 400V, 3-phase or 230V, 1- phase and 50 Hz supply and shall give trouble-free service in the locally prevailing climatic conditions.

e) Residual Current devices shall be provided for each socket outlet circuit separately.

f) The tripping current shall be 30mA unless otherwise specified.

1.6.15 Panel Boards

1.6.15.1 Low Voltage Panel Boards

a) The Panel Boards shall consist of completely enclosed, self-supporting vertical structures bolted together to form a Modular type (where applicable) rigid single sheet metal enclosure. Boards shall be provided with front and rear channels. The end, top and rear shall be covered with removable screw-on-steel plates of minimum 1.6 mm thickness. The whole assembly shall have an epoxy/ polyester powder coated finish. The door shall be lockable with 180 degree opening. Panel Boards shall include all protective devices and equipment as necessary for interconnection, instrumentation and controls and terminal blocks with mechanical type solder less connector for terminals.

b) Panel Boards shall be fully Type Tested Assembly (TTA) according to IEC61439-2 or BS and design shall be type tested for “Seismic” conditions and type tested certificate issued by the ASTA accreted laboratory to the relevant current capacity in the name of the panel builder.

c) Form of internal separation of low voltage main distribution panel boards shall be Form 4b Type 4 as specified in IEC 61439-1. For the other low voltage panel boards it shall be Form 3b Type 1 or higher. However the MCB compartments of the LV panels shall comply with Form 2b if necessary with approval of AASL Engineer.

d) The front panel shall be equipped with digital power analyzer complete with remote monitoring facility and shall be capable of interfacing with power monitoring system, luminous sign: Power ON, failures, current, voltage and in general any indication needed for easy operation and maintenance.

e) Protective devices shall have individual drawers or compartments, and necessary bus connection straps. Devices shall be modular-sized and so arranged as to be individually removable and readily interchangeable. Each device shall be provided with cardholder and card for identification.

f) The panel boards of all types shall be designed to ensure that at least 20 % of the finished space remains free for future connections upon Substantial Completion and Taking Over of the Works.

g) Panel board shall be consists of and not limited to the circuit breakers, ACB type Automatic Transfer switch (ATS) protection devices, control components etc.

h) A compartment shall be available inside to locate a set of "As Built Drawings", as well as operation conditions related to this panel board.

i) Panel boards shall be completely assembled with all switchgear and wired at the factory. Thorough inspection shall be made before and after assembly to ensure correctness of design and workmanship.

j) All cable entries shall be with cable glands or any other system fully reviewed and approved by the Engineer, to provide secure fixings without stress on cable cores and prevent the intrusion of objects or rodents.

k) Bus structure shall be arranged to permit future expansion. It shall be mounted on insulator supports or high impact, non-tracking high quality insulation material and adequately braced to withstand the mechanical forces exerted during asymmetrical short circuit. Bus bars shall be Tin plated copper. Purity of copper shall be 99% or better. Branch circuit bushing shall connect directly to the bus structure. All bus work shall consist of sufficient copper to limit temperature to 40°C ambient temperature.

l) Engraved metal nameplates shall be provided for each device. The letters or numerals on the nameplate shall be a minimum of 5 mm in height, with light coloured, enameled characters on a dark background. All elements and functions shall be clearly labeled, in English.

m) Cable terminal mounting bolts and cable clamps to appropriate cable size shall be provided.

n) To facilitate installation and maintenance of cables and bus bars, the top and rear covers shall be removable.

o) Digital Power Analyzer meter incl. kWh/kVA, shall be available for energy measurements as necessary.

p) All MSB & MDB Enclosure protection class, including cable connection chamber shall be IP 42 as a minimum should have valid tested certificate for complete assembly from recognized laboratory.

q) All Distribution panels (MSBs, MDBs and SDBs) shall include necessary built-in interfaces to coordinate with Building Management System (BMS).

r) LV Main Distribution Boards shall be designed, built and installed to allow Automatic operation (PCMS), it shall also allow full manual control. It is the duty of the Contractor to

ensure full compatibility with the BMS, ensuring automatic Power Control capability and allowing several monitoring functions.

s) LV secondary panel boards shall be designed, built and installed to allow interface with the BMS, allowing for remote control operation and monitoring of several Circuit breakers or contactors. The interface shall also allow several monitoring functions.

t) Main Circuit breakers protecting panel boards shall always be 4 poles types, according to IEC Standard. CB (all sizes) connected to equipment's or areas with specific danger of fire, or related to humid areas, should be earth leakage protected (300 mA). If not otherwise specified, average CB should allow for easy installation and replacement on standard support rails etc.

u) A vertical cabling compartment, separated from volume and bus-bars, shall be available with its own access door for easy and safe cabling and maintenance.

v) Main Low-Voltage Distribution Panel shall be equipped with the necessary built-in ventilation.

w) SPD for MSB and MDB (feeding power to outdoor equipment/loads) Class I

x) SPD for SDB and FDB (feeding power to indoor equipment/loads) Class II

y) All withdrawable units (if any) shall have front operation control and indicators.

z) Panel boards shall also allow full control and monitoring in Manual mode.

1.6.15.2 Main Switch Boards (MSBs)

a) The Main Switch Boards (MSBs) at power house shall be floor mounted free standing type with composite modular design incorporate generator ATS panel with by-pass switch and bus-bar system.

b) MSBs shall include built-in controllers (PLC etc.) for power control and monitoring.

1.6.15.3 Main distribution boards (MDBs)

a) The Main Distribution Boards (MDBs) shall be floor mounted free standing type with composite modular design incorporate with other associated panels.

1.6.15.4 Sub Distribution Boards (SDBs)

a) The SDB's shall be free standing modular design or wall flush mounted type where as necessary

1.6.15.5 Final Distribution Boards (FDBs)

a) The FDB's shall be Wall Flush Mounted type.

1.6.15.6 Panel Keys

a) Provide labels, in English, to all panel boards, distribution boards and equipment supplied.

b) Provide 2 keys for each panel board, distribution board, transformer, switchgear panel and other electrical equipment.

1.6.16 Motor Control Centers (MCC)

a) Intelligent motor control centre devices (MCC) may be proposed by the Contractor as an alternative at shop drawing stage for the review and approval of the Employer at no extra cost.

b) Properly rated high performance variable speed driver (VSD) shall be used to control motors of a capacity larger than 2.2 kW as specified locations in the drawings to minimize energy consumption.

c) MCC's shall house circuit breakers; motor circuit breakers, magnetic contactors, VSDs, thermal overload relays, signal relays and auxiliary contacts. The overload devices shall be sized to operate satisfactorily with the current rating shown on the motor nameplate and ambient conditions. Contactors shall be suitable for the rated currents with suitable type. Contactors shall be 3 phase with one overload device per phase.

1.6.17. Power Analyzer

a) General requirement:

i) The Static Power Analyzer/Energy Meters shall of Panel Mount Type, Digital type with communication port

ii) Static Power Meter shall have Active Energy Accuracy of 0.2S with IEC 62053-22 and ANSIC 12.2

b) Measure values:

The power analyzer shall provide the following, true Route Means Square (RMS) metered quantities. In addition, the power meters shall record and save in non-volatile memory the minimum and maximum values of all listed values since last reset. The power analyzer shall also record and save in non-volatile memory the minimum, maximum, and average of any of the values pre-defined over a user specified interval.

c) Meters:

i) Real-time reading

- Current (A) (per-phase, 3-phase average, % unbalanced)
- Voltage (V) (L-L per-phase, L-N per-phase, 3-phase average, % unbalanced)
- Active power (kW) (per-phase, 3-phase total)
- Reactive power (kVAR) (per-phase, 3-phase total)
- Apparent power (kVA) (per-phase, 3-phase total)
- Power Factor (3-phase total)
- Frequency (Hz)
- Total Harmonic Distortion (THD) and Individual Harmonics up to the order of 15th

ii) Energy values

- Active power (kW)
- Reactive power (kVAR)

iii) Demand values

- Active power (kW): present and maximum values.
- Apparent power (kVA): present and maximum values and kVA Demand which shall be able to reset at a pre programmed time.

1.6.18. Bus Duct

a) General Requirements:

Bus Duct shall be designed and manufactured and type tested in ASTA accredited laboratory to comply with BS EN 61439 (IEC 61439). The rating of the bus duct shall be 3 phase 4 wire 400V, 50 Hz. The continuous current ratings shall be shown on the drawings.

b) Housing:

i) The housing shall be of 14 Standard Wire Gauge sheet steel of minimum thickness of 2mm bolted on to an angle iron/structural steel framework.

ii) The housing shall be painted after suitable pre-treatment of all structural steel and plates with anti-corrosive epoxy base primer paint and two coats of anti corrosive epoxy base paint.

iii) The degree of protection shall be not less than IP 52, as defined in BS EN 60529.

c) Bus-bars:

i) The bus bars shall be of hard drawn high conductivity electrolytic grade copper flats. All contact surfaces shall be silver plated copper to ensure high energy efficiency.

ii) The bus bars shall be insulated in materials with temperature ratings not less than 130ºC, except at tap-off points and joints areas.

iii) The neutral bus-bar shall be of the same size as the phase bus-bars.

iv) The earth conductor shall run through the length of the bus-bar and the whole system shall be bonded to earth

d) Jointing

The electrical joint between the elements shall be made by a one bolt joint system. All screws, bolts nuts and washers shall be protectively plated to prevent rusting.

1.6.19. Electrical Panel Rooms at Each Floor Level

Electrical panel rooms shall be designed in a manner to accommodate Electrical Panel boards relevant to each floor level c/w cable trenches, ducts, ladders, trays or embedded conduits as appropriate. The panel rooms shall be located vertically inline at each floor with openings to erect cable shaft from ground floor to fourth floor level. Cable ladder (Perforated) shall be erect from ground floor electrical room up to fourth floor roof level through openings of the panel rooms at each floor levels as cable shaft to run main cables from MDB to SDBs in electrical rooms at each floor level.

1.6.20. Power Factor Correction, Power Quality and Harmonics Filtration

a) Main Low-Voltage Distribution Panel shall be equipped with microprocessor based Automatic LV Power factor correction, Power Conditioning and Harmonics Filtration equipment. Conventional type capacitor banks shall not be used for power factor correction. The Power factor correction, Harmonics and Power Quality filters shall be connected with the main LV distribution bus-bar.

b) These equipment shall be industrial/commercial type and comprise of expandable modular units suitable for installation inside powerhouse.

c) These equipment shall be equipped with the necessary auxiliary contacts and high level interface modules to allow the direct interface for control and monitoring purposes.

d) Power Factor Correction equipment shall include a control system in order to automatically connect or disconnect the necessary amount of kVAR capacitors, filter the system harmonics and improve the power quality and the load balancing between phases and neutral according to operating condition to maintain a proper power factor programmable from 0.6 (inductive) to 0.6 (capacitive).

e) The equipment shall comply with BS 1650 and the admissible ambient temperature shall be ranged from 0'C to 45'C.

f) In order to adjust the power factor to an appropriate value, Power factor correction unit shall be monitored and control in such a way with the measurement value of reactive power.

g) Compensation method of the system shall be closed loop and reaction time shall be less than 1ms instantaneous response.

h) Several groups or steps shall be able to be switched in simultaneously without having a delay between each step.

i) The controller shall have, but not limited to, following control, measure and display functionalities.

- Target power factor setting
- Real time instantaneous power factor of the system
- Harmonic content in the system up to at least 11^{th} harmonics
- Total harmonic distortion (THD in %) of the system voltage and current
- Number of capacitor groups connected at anytime
- De-tuned type power factor correction unit shall be adopted to avoid harmonic resonance.

j) The capacitors shall be of low loss dry-type, metalized polypropylene (MPP) film type with self-healing properties and fitted in a sheet steel plate enclosure filled with non-inflammable medium. The capacitor units shall be hermetically sealed and manufactured from continuous metal foil and low loss high quality dielectric material. The total capacitor losses shall not exceed 0.5 Watt per kVAr. The capacitors shall comply with the requirement of IEC 60831 and IEC 60070.

k) The capacitors shall be provided with directly connected discharge resistors which shall reduce the residual voltage from the rated peak alternating voltage to 75V or less measured at the capacitor bank terminals within 3 minutes after disconnection from the source of supply. The discharge resistors shall be protected by an insulating cover.

l) Power conditioning equipment and harmonic filters shall be used to maintain quality of power at highest level. This equipment shall be designed to operate reliably and continuously.

m) This unit shall conform to IEC 61000 or other similar recognized international standards on Electromagnetic Compatibility (EMC) compliance for industrial or commercial applications and shall be manufactured to ISO 9001. Certificate of compliance shall be issued for each standard rating after being fully tested at the manufacturing facility.

n) Active harmonic filter (AHF) shall be used to eliminate harmonic currents circulating across the installation so that the Total Harmonic Distortion (THD) may be limited to a given percentage as specified in the Specification.

o) Active harmonic filter shall be installed in parallel with the distribution system, i.e. shunt connected, wherever attenuation of harmonic current is needed. Preferably, active harmonic

filter shall be located close to those loads generating harmonic currents in order to avoid circulation of the harmonic currents along the cables.

p) Harmonics filter range shall be from 2nd to 50th according to relevant IEC standard to improve the power quality of the system.

q) The operating principle of AHF shall be based upon the injection of a harmonic current with appropriate phase shift corresponding to the harmonic current drawn by the load which shall be analyzed by the AHF continuously. Consequently, the current supplied by the source shall remain sinusoidal under the effective operating range of the AHF.

r) AHF shall be compatible with any type of load, and shall guarantee efficient compensation, even when changes are made to the installation. The AHF shall also be capable of delivering its rated output harmonic current to the point of connection irrespective of load condition.

s) If the compensation of neutral harmonic current is required, in the neutral conductor, the AHF shall be capable of compensating the harmonic current three times greater than the phase current, particularly to compensate harmonic current of order 3 and its multiples.

t) Should the AHF be overloaded during transient operation of certain loads or permanently, this should not affect the reliability of its operation. Under such circumstance, the AHF shall operate in a current limiting mode and still deliver to the network its rated harmonic current or better adaptation to any installation, AHF shall be capable of operating in association with other harmonic reduction systems. It shall also be possible to associate 2 or more AHF's in parallel to increase the compensation capacity, or to enhance dependability, i.e. redundant operation.

u) AHF shall be equipped with built-in RS 485/232 serial communication ports for control, programming and monitoring of the AHF by PC, or other user interface. Communication protocol shall be open standard.

1.6.21 Non-Compliance

a) Failure of work to pass required tests or which otherwise does not meet specified requirements, as indicated by test records, shall result in rejection by the Employer and the work shall be replaced or corrected by the Contractor as directed by the Employer at the expense of the Contractor.

b) Failure of work to pass required tests shall be sufficient reason for considering work as non-compliant and thus subject to disapproval or rejection of entire work up to the point of rejection.

c) The Contractor's failure to make required tests shall be considered same as for work not in compliance and shall be sufficient reason for rejecting entire work not so tested.

d) Required tests may be performed by the Employer, or by duly qualified testing agency or other personnel retained by the Employer, all at the Contractor's risk and expense.

1.6.22 Quality Test Requirements

a) Quality testing shall mean and consist of all such examinations, measurements, inspections, by visual, mechanical, instrumental or other means, as is necessary to show and prove that work so tested does in fact meet all quality requirements and performance characteristics as shown or specified.

1.6.23 Measurement of Grounding Resistance

a) Grounding resistance shall be less than values stipulated in these Specifications, or in accordance with IEC when not so specified, or manufacturer's recommendations.

1.6.24 Demonstration Test Requirements

a) Demonstration test requirements shall include and consist of operating systems under various and varying condition as is necessary to show and prove that work so tested does in fact operate and function as intended under these Contract Documents.

b) Techniques or methods for quality testing shall be employed as may be necessary for certain demonstrations.

1.7 LIGHTING & GENERAL POWER OUTLET SYSTEMS

1.7.1. All lighting systems shall be of high performance LED.

a) All lighting fixtures shall comply with BS, IEC, or equivalent regulations.

b) All lighting fixtures shall be compatible with the Safety and Protection Constraints in accordance with IEC 529. Fixtures shall be suitable for their intended purpose and environment, e.g. ambient temperature and humidity, vandal resistant, etc. Table E9320.2 – IEC 529 Constraints.

c) All lighting fixtures and housings shall be designed, constructed and assembled so that all electrical components are easily accessible for maintenance, repair and replacement. Housings shall be removable without removing fittings from their mountings, or disassembly of adjacent construction.

1.7.2. The scope of works for the internal / emergency lighting system is as follows:

a) Supply & installation of all lighting fixtures and accessories for interior use including those lighting fixtures mounted on the exterior surfaces of the building.

b) Supply & installation of all lamps and switches of internal & emergency lighting systems.

c) Supply & installation of all essential / emergency lighting, exit signs, directional and information lighted signs.

d) Supply & installation of all delivery points requested for small receptacles.

e) Supply & installation of final distribution and sub-circuit cables/wires, conduits, wire ways, cable tray/ ladders/ trunking and all accessories.

f) Design, supply & installation of all necessary panel boards.

g) Design, supply & installation of all supports, fixtures, fixings and accessories.

h) Design & installation of control and monitoring systems, including equipment, devices, panels, cables/wires, conduit, wire ways, trunking, all accessories, security and interlocking devices.

1.7.3. The scope of work of the power outlet system is as follows:

a) Supply & installation of receptacle outlets/power points including indoor type and outdoor type, flush mounted type or surface mounted type.

b) Supply & installation of all supports, fixtures, fixings and accessories.

c) Supply & installation of final distribution and sub-circuit cables/wires, conduit, wire ways, trunking and all accessories.

d) Supply & installation of all necessary panel boards.

e) Supply & installation of all supports, fixtures, fixings and accessories.

f) Design & installation of control and monitoring systems, including equipment, devices, panels, cables/wires, conduit, wire ways, trunking, all accessories, security and interlocking devices.

1.7.4. The provision of the Common Use Cable Rack, Cable Tray/ Ladder and Trunking System to be shared and coordinated with all Divisions of the Electrical works under the responsibility of the Contractor.

1.8 System Design/ Performance Requirements

1.8.1. Interior Systems

a) The system shall be in accordance with the following conditions:

i) Operating ambient temperature and humidity: 0° to 50°C & 95%.

ii) Enclosure: 0° to 60°C.

iii) Operating voltage for all luminaires: 230 volts at 50Hz.

b) The Internal Lighting and Receptacle System shall be designed in accordance with the applicable requirements of the latest edition of IET wiring regulations, Code of practices of Energy efficient building Sri Lanka, and other Sri Lankan regulations, IEC and/or other internationally accepted standards to the approval of the Employer.

c) All general purpose socket outlets only be 13A square pin and to comply with BS 1363.

d) All special socket outlets and receptacles except general power shall be identified with proper colour coded identification system for easy identification of the type of power supply, UPS, Emergency power etc, with the approval of Engineer.

e) 3 core fire retardant type flexible cables with not less than 1.5 mm^2 shall only be used for connecting luminaires.

f) The Contractor shall be responsible for checking the design of the Lighting System to ensure that the System as constructed achieves at least the specified illumination levels, deriving from this check and the approval / comment of the Engineer.

g) All devices such as lamps and control gears from a single manufacturer and luminaires/fixtures shall be assembled and tested by the manufacturer at the factory only.

1. Power supply units to be tested and recommended by the lighting manufacturer only

- All light fixtures of a given type shall be supplied by the same manufacturer to the approval of the Engineer.
- All lighting fixtures shall be compatible with the Safety and Protection Constraints in accordance with IEC 60529 as indicated in the following table. Fixtures shall be suitable for their intended purpose and environment, e.g. ambient temperature and humidity, vandal resistant, etc.

Location	**Minimum IP** (Protection Index)
Average indoors	IP 20
Toilets and Kitchens	IP 34

Outdoors	IP 54
Water features	IP 67

2. The LED driver shall comply to the below listed standards:
   - BS EN 55015
   - BS EN 61547
   - BS EN 61000-3-2
   - For Luminous efficiency and light output, Photometry Test of the Luminaires to be submitted as per LM 79 standard.
   - Lifetime declared shall be calculated as per the following certificates;
     (i) IES LM-80-08 Approved Method: Measuring Lumen Maintenance of LED Light Sources.
     (ii) IES TM-21-11 Projecting Long Term Lumen Maintenance of LED Light Sources.
3. The manufacturer shall have an in-house Photometry Laboratory and quality assurance Laboratory where luminaires shall be tested against IEC 60598.
4. Operating temperature data of LED module shall be submitted with an indication on how they are related to the junction temperature, the expected light output and lumen output.
5. To control glare, high quality glair free optic shall be used in the luminaires.
6. All the luminaires shall comply with "Restriction of Hazardous Substance (RoHS)" compliance.
7. Luminaires shall have a full set of photometric data to CIBSE TMS or IES format.

h) LED fixtures shall have the following features

1. Life Time - LM 79 and LM 80 Compliant (50,000 – 70,000hrs). LM 80 compliance certificate to be adhered by the LED manufacturer. LED data sheet shall comprise of lumen output, junction temperature, thermal resistance, and LED drive current.
2. Color Temperature (LED Chip Selection) - McAdam's Ellipse Criteria – 2Steps
   a. For Office / Public areas: 3500-4500 K
   b. Utility / operational area: 4000-4500 K with prior approval from the Employer
3. Voltage Tolerance - 24 VDC (23 V to 25 VDC) or 48 VDC (47 VDC to 49VDC)
4. CRI (Color Rendering Index) - Must be 80+ (Preferable is 85)
5. Heat Dissipation - Heat Sink Design
6. Glare Control - Glare Control Shield
7. Efficacy (Efficiency) - Preferable 100 – 150 lumens / W (Priority given for higher efficacy)
8. Shadow - No multiple shadow effect
9. The make of LED chips shall be a reputed brand.
10. LED chips used in the luminaires shall comply to photo biological safety requirements of the LED's and shall be submitted as per IEC 62471

i) Control gears of fixtures shall have following features.

1. Comply with UL or EN Compliant / EMC norms.
2. Protection Class II (IEC61000-4-5).
3. Efficiency -90%
4. Lifetime (hrs) - 50,000hrs or higher
5. Power Factor Correction - 0.95 or higher
6. Surge protection (IEC / EN 61547) - 0.5kV for devices with power lower than 25W; 1kV for devices with power higher than 25W
7. Thermal Cut-off Protection
8. Temperature controlled power de-rating protection against over temperature.
9. Self-restoring protection against over temperature, overload, open circuits and short circuits on the output line.

1.8.2. Emergency Lighting and Exit Sign

a) Emergency Lighting provided with LED down lights. Emergency Lighting and Exit Signs powered by a central UPS power supply panel installed in the electrical rooms at each floor level of NSC building.

b) Emergency lighting shall be designed to energize the emergency light and exit sign circuits by UPS output power supply DB only on failures of the mains power supply. (Contractor to be submitted proposal for the Engineer's approval).

c) Powerhouse Generator room, Panel room and Duty room emergency lighting and exit signs shall provide with individual built-in battery back-ups for minimum 2.5 hrs (± 10%) operation.

d) All products should be TUV Certified. Certificate should be submitted to the Engineer's approval.

e) The system shall be designed and installed in such a way to allow easy and secured inspection by the related national security agency, fire brigade, or any other official authority, strictly according to the national regulations and laws to been forced.

Emergency Light Fixtures

a) The Emergency lighting System shall be in accordance with IEC 60598-2-22.

b) In case of power failure, a minimum lighting illumination level will be immediately available from designated emergency light fixtures.

c) The emergency lighting system shall provide illumination in equipment areas, public areas & escape corridors at 10 lux average on the walking surface of the escape route and minimum 1 lux at any point on the escape route. The high panic areas (staircases etc.) shall be provided with an illumination of 10.8 lux average on the walking surface.

Exit Light Fixtures

a) Self-contained Exit Sign LED luminaires shall be designed and specially equipped to provide functionality of AC power and monitoring through a High intensity green monitoring LED.

b) Exit signs shall be installed in selected places to allow for safe evacuation as indicated on the drawings. The Contractor shall be responsible for the installation of the properly required quantity and type of fixtures and signs according to the regulation of the relevant authority.

c) Exit Light Fixtures shall be installed tested and maintained in accordance with IEC EN 60598-2-22, EN 50172 and IEC EN 62034 which specifies the provision and illumination of escape routes and safety signs in the event of failure of the normal supply.

d) The Contractor is responsible for the definition of typical arrows or signs to be used with guiding the layout diagrams, in full coordination and under the strict supervision with the AASL Engineer.

e) Exit signs shall have the following features:

i) Faceplate: Single face or double face with or without directional signs.

ii) Lamp LED.

iii) Mains Supply: 230 Volts, 50Hz.

iv) Diffuser: Fire retardant IP 44 or higher as necessary.

UPS - 4KVA (Online) for Emergency Lighting Power Supply

General Features

a) Power Range : 4kVA
b) Topology : Online
c) Noise : Shall be less than 45 dBA
d) Shall be installed in Emergency Lighting DB at Electrical room at each floor level

Input Characteristics

a) Voltage : 220/230 V
b) Voltage Range : +/- 15 %
c) Frequency : 50Hz/60 Hz
d) Frequency Range : 47 Hz – 63 Hz

Output Characteristics

a) Output Power : 4kVA
b) Voltage : 220/230 V
c) Voltage Range : +/- 5 %
d) Frequency : 50/60 Hz +/- 0.1%
e) Waveform : Sinusoidal
f) Bypass : Built-in Static Bypass
g) Power Factor : 0.75 or above
h) Output socket : IEC SOCKET 320 C13

Battery

a) Battery Type : VRLA, shall be replaceable, standard 12V/7Ah Battery
b) Battery Test Type : Manual & Automatic
c) Runtime at Full Load : Not less than 15 Minutes

Communication & Management

a) Audible Alarms : Shall be available
b) Display Type : LED Display
c) Emergency Power Off : Shall be available
d) Communication : USB / RS232
e) Software and Cable : Shall be provided

Operating Conditions

a) Environment : 0 - 40 °C
b) Relative Humidity : 0 - 95%
c) Storage Temperature : -20 - 45 °C

Standards

a) EMC : IEC 62040-2 or equivalent
b) Safety : cUL Listed, UL 1778

Technical Literature

The supplier shall provide the original technical broachers or technical literature of the offered UPS for evaluation purposes.

1.8.3. Exterior Lighting System

a) The External Lighting Systems shall be in accordance with IEC or other internationally accepted Standards to the approval of the Engineer.

b) Contractor shall prepare revised lighting layout and detail drawings as part of the Shop Drawing submission showing recommended numbers and types of luminaires necessary.

c) The Contractor shall provide and install all necessary Lighting fixtures, supports, circuits, control Panels related to the following External Lighting Systems in accordance with the instructions of the Engineer:

i) Building Decorative lighting.

ii) Surrounding illumination/ security lighting

iii) Roof top terrace lighting)

iv) Street/yard lighting

1.8.4. Receptacles (Socket Outlets)

a) Socket Outlets - Flush Type Socket outlets shall be switched, 3-pin (phase, neutral & earth), shuttered, flush mounted type rated for 13A, 250V complying with relevant BS 1363, unless otherwise specified.

b) Socket Outlets - Flush Type integrated with USB ports Socket outlet shall be 13A universal type Single or Twin switched, universal 3- pin (phase, neutral & earth), shuttered, flush mounted type rated for 240 V complying with relevant IEC standard and integrated two numbers of USB ports for charging mobile equipment.

c) Socket Outlets - Industrial Type socket outlets (If any) shall be not less than IP 54 or higher as required, splash proof surface mounting type. Single phase socket outlets shall be 250 V,

3-flat pin (P+N+E), and shuttered type. Three phase socket outlets shall be 400 V, 5-flat pin (3P+N+E), and shuttered type. Industrial socket outlets shall comply with IEC 60309-1. Each unit of industrial type socket outlet shall be supplied with a matching plug with mechanical interlock protection.

d) Live parts shall not be exposed.

e) Mountings and wiring to terminals shall be firmly attached and secured.

f) Socket outlets shall be of high quality brand.

1.8.5. Power/Communications Connection to Control Room Desks, Check-In Desks

a) The control room shall be provided with Special Modular Trunking allowing the routing of power and communication wires and containing a sufficient quantity of cables/wires, power socket outlets and RJ 45 outlets (for LV and ELV cable routing, voice, data, images). The work shall be executed carefully to avoid all damage to the fittings and furniture

b) Special Modular Trunking shall be fire retardant type prefabricated trunking system with all necessary accessories such as "Marsell Tufflex/ Legrand DLP adaptable trunking" or at least equivalent. The Contractor shall propose a minimum of 2 different types and manufacturers of Special Modular Trunking for the selection and approval of the AASL Engineer.

1.8.6. Lighting Switches

a) Small air break switches for general use in circuits of 50 Hz and 230 V and under.

b) General Lighting switches shall be rated for 10 A, flush mounted and high quality brand.

c) Contacts and finger switches shall stop at "on" and "off" positions.

d) Switches shall not arc in switching operation.

e) Mountings and wiring to terminals shall be firmly attached and secured.

f) Before mounting manual lighting switches the Contractor shall check the swing of the doors and shall ensure that the switch is located on the side away from the hinge & shall be of high quality confirming to BS 3676.

1.8.7. Outlet Boxes

a) All flush or surface mounted outlets and switches shall be mounted on galvanized flush boxes or fire retardant material with following dimensions

L - 100mm, W - 100mm, H - 50mm

b) Unless otherwise specified, the maximum number of conductors, excluding number of fixture wires, permitted in standard boxes shall be according to BS or IEC standards.

1.8.8. Fused Connection Units

Fused Connection units (if any) shall be Flush type, 1-Gang, 15 A, Double Pole rated for 230V, 50Hz and shall incorporate a Neon Indicator lamp. Supply to Automatic Electric Hand Dryers (where power consumption over 13A) etc., shall be made through these Fused Connection Units.

1.8.9. LED Aviation Obstruction Light

International Standards	-	ICAO (Annex 14)/ FAA (L864)
Light source/ Colour	-	High intensity LED/ Red

Flashing Rate	-	20-30 times/ min
Viewing angle	-	Horizontal: 360°; Vertical: ≥ 10°
LED lifetime	-	> 100,000hrs
Power consumption	-	< 20W
Intensity	-	>200Cd
Solar Panel	-	Power & Type to be specified
Operation	-	Dusk to dawn auto operation (Optional: remote control by TOWER)
Temperature Range	-	+10° to + 70°C
Humidity	-	10% to 95%
Wind speed	-	80 m/S or higher
Index of Protection	-	IP65 or better
Material	-	Base: Die-cast Aluminium alloy; Globe: Polycarbonate Enclosure: Powder coated steel or any other non-corrosive material

1.8.10. AERODROME IDENTIFICATION BEACON

Type	-	Omni directional medium intensity Airport Beacon
Compliance	-	FAA: L-802A A/C 150/5345-12 (Current Edition) ICAO (Annex 14)/ para 5.3.3
Photometry Requirement	-	360 Degree in azimuth
Signal format	-	L 801A or L802A Alternative White and Green
Flash Rate	-	22 to 30 FPM
Visual Range	-	Not less than 45km
Vertical Beam Intensities	-	At least 40000Cd at 3 to 7 degrees above horizon
Optic Lens	-	One clear filter and one green filter
Lamp Type	-	400W to 1000W Metal Halide (or Ultra high intensity LED), Pl. specify
Lamp Life	-	Not less than 25000hrs for MH (100000hrs for LED)
Environmental Factors	-	Temp.: 0ºC to 55 ºC, Humidity: up to 100%, Wind speed up to 100mph, Salty Laden
Fixture Colour	-	Aviation Orange
Other Requirement	-	Corrosion protection, input power, RPM, electrical protection systems, lamp monitoring method, weatherproof powder coated steel cabinet and mounting tower. (Pl. specify)

1.8.11. Hand Dryers

a) Hand Dryers shall be operated by 230V/ 50Hz AC Power and the capacity shall be less than 2.5 kW including Fan Motor power.

b) Air flow shall be minimum 155 m^3 per hour and shall incorporate an infrared sensor for automatic operation.

c) Type of the heater shall be spiral wound supported element with Thermal over load and the outer casing shall be ABS or metal clad. Colour of the outer casing shall be white/cream.

d) The proposed hand dryer shall comply with the IEC-60335 or BS 3456 or equivalent standard.

1.8.11. Ceiling Fans (If Any)

a) Ceiling fan shall be 1400mm fan sweep, >290m^3/min air delivery and operated by 230V/50Hz AC power. The fan motor shall be single phase, totally enclosed, continuously rated, double bearing, capacitor run type with following specs. Power consumption shall be less than 75W.

b) Fan blades shall be Aluminium or Mild Steel coated with anticorrosive paint to make rust free and dynamically balanced. Fan hooks shall be permanently fixed to the slab soffit while slab concreting.

1.8.12. Exhaust Fans

a) Wall Mounted

Exhaust Fans shall be 200 - 250 mm fan diameter, at least 650 m^3/h air volumes and operated by 230V/50Hz AC Power. The Fan Motor shall be of continuous rated, double bearing induction type and shall be of reputed make. Power consumption shall be less than 50W

b) Duct Mounted - Inline Type

1. Duct mounted exhaust (Extract) fan shall be at least 650 m^3/h air volumes operated by 230V/ 50Hz AC power. The fan motor shall be single phase, totally enclosed, continuous rated, double bearing type with following specs and control by light switch. Power consumption shall be less than 130 W.

2. Ducting for the Toilets shall be suited to above fan assembly and made out of GI sheets coated with H-primer/ anticorrosive paint to make rust free & wall colour surface finish (for exposed ducts) c/w white powder coated Aluminium louvers, suitable return air grills. Motor assembly shall be dynamically balanced and dampers to be fixed to motor assembly to minimize the vibration & noise.

1.9 GROUNDING AND LIGHTNING PROTECTION SYSTEM

a) The complete installation consists of

i) Grounding System.

ii) Lightning Protection System.

b) These two systems are completely interconnected. The Contractor shall coordinate these two systems as well as all other systems in the works, which require grounding.

c) The scope of works for the Grounding and Lightning Protection System is as follows

i) Supply & installation of protective equipment, nearby antennas of TV, radio communication and on the roof of the buildings.

ii) Supply & installation of multiple air termination network (meshed conductor arrangement), down conductors, joints and bonds, test joints with earth inspection pits, earth termination network and earth rods (Grounding rods in mesh/ring or lattice formation).

iii) Supply & installation of all supports, hangers, fixtures, fixings and accessories.

iv) Supply & installation of cables/ wires, conductors, ground bars, cable rack, cable trunking, trays, conduit and all accessories.

d) The Grounding and Lightning Protection Systems shall comply with BS EN/IEC 62305 series regulations as well as other national requirements when necessary.

e) The Grounding and Lightning Protection Systems shall be designed to ensure the complete safety of both persons and equipment throughout the airport facility complex and facilities.

1.9.1. Grounding System

a) Equipment grounding shall be designed and installed so that all metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, equipment/ machine frames, portable equipment and other like conductive items in close proximity with electrical circuits, operate continuously at ground potential and provide a low impedance path for possible ground fault currents.

b) Similarly all structural steelwork and reinforced concrete structures shall be designed and executed to ensure ground continuity.

c) The grounding of metal parts, mechanical, plumbing and electrical equipment and systems will be executed as follows:

i) Directly: by connection between the grounding network junction points available near the equipment.

ii) Indirectly: by use of additional grounding copper wire separated from the electrical distribution, or included in every multi-core distribution cable (yellow/green isolated wire).

d) The grounding copper net shall be laid at the bottom of the excavations before pouring of structural concrete.

e) The longitudinal grounding conductor and the lateral grounding conductor shall be bound in a latticed form to the grounding copper net with copper wire.

f) Grounding resistance reduction material shall be embedded on the grounding wire for reducing the resistance effectively.

g) Surveying and analyzing for ground resistivity of the site shall be executed in advance of the grounding system work.

h) The grounding network conductor shall comprise bare copper conductors in the form of stranded circular or flat tape with a cross-sectional area not less than 50 mm^2.

i) The conductor shall be protected by concrete and connected by welding to the reinforcement steel of columns, ground floor bed, suspended floors and the like.

j) All welds shall be adequately prepared and painted to ensure proper protection against corrosion.

k) When grounding interconnection between metal parts of a different nature, it shall be made in such a way so to avoid galvanic couple creating corrosion and ultimately destruction of the connection. In such case tin plated connectors shall be used. It is the duty of the Contractor to demonstrate the method and equipment to be used, in order to receive the necessary approval from the Engineer.

l) Cable tray shall be considered as "Earth Conductor" and therefore electric continuity must be provided to ensure continuity. This shall be achieved through the use of flexible tin plated copper straps of an approved size, securely provided between all cable tray elements.

For each electrical system the Contractor shall ensure proper grounding for the following:

i) Neutral point of transformer.

ii) Generator

iii) Earth conductor of LV systems.

iv) LV switchgear frame work.

vi) Shielding of Power cable.

vii) IT & Communication systems

vii) All other electric equipment frames and metal elements.

1.9.2. Lightning Protection

a) The Lightning Protection System of the Airport Facility Complex shall include air terminals mounted on the Control tower and also on the roof of the building, together with down conductors, clamps and auxiliary equipment as required for a complete operational lightning protection system.

b) Each lightning arrester shall be connected to a set of at least three (3) earthling electrodes to ensure direct connection to earth of any stroke current before interconnection with the general grounding system.

c) All systems shall be designed to avoid any dangerous voltage surge to the general earthling network after a direct lightning strike.

1.9.3. Surge Protective Device

i) Surge Protective Device (SPD) is a device intended to limit transient voltages and divert surge current.

ii) For equi-potential bonding, a lightning current SPD is required at the service entrance (i.e. SPD meeting class I tests). This is mandatory for structures with a LPS (Lightning Protection System).

iii) For protection against lightning to the service, SPDs are also required at the service entrance (i.e. SPD meeting class I tests or class II tests)

iv) For internal equipment protection, in most cases additional SPDs need to be located in sub distribution panels or closer to, or within, the equipment. These SPDs are considered to be secondary protectors, and their operation needs to be coordinated with the service entrance protection. SPDs meeting either class II tests or class III tests are suitable.

v) The IEC 62305 series refers to the following surge protection standards:

- IEC 61643-1 Surge protective devices connected to low-voltage power distribution systems
  - Requirements and tests (Part1)

- IEC 61643-12 Surge protective devices connected to low-voltage power distribution systems
  - Selection and application principals (Part2)

vi) Three types of SPDs are defined, each having a specific test regime (the class of test) and specific marking requirements. The manufacturer of the SPD can elect to test the SPD to one or more class of test, allowing the SPD to be used in multiple applications.

1.9.4. Air Termination

i) Arcing is not to be continuous and shall only occur during the progress of the lightning leader. Arcing shall not occur solely due to electro-static field when a thunderstorm is overhead, except when there is leader activity in the region.

ii) The air termination shall not cause high frequency radio interference except during the millisecond intervals associated with the progress of the lightning leader and during the main return strike of lightning events in the region.

iii) The air termination shall be non-radioactive and require no special licensing.

iv) The external shape of the AFC building shall be such as to significantly reduce the buildup of sharp point corona discharge under static field thunder storm conditions.

v) The air termination shall not be dependent upon batteries or external power supplies for any part of its operation. It shall have no moving parts. The materials of the air termination shall be non-corroding in normal atmosphere. The center grounded finial shall be made of electrical grade non-ferrous material.

vi) The air termination shall be insulated from the protected structure under all conditions.

vii) The size of the collection volume and attractive radius of the air termination shall be traceable to known and acceptable lightning research and statistics.

viii) The air termination shall be installed strictly to the manufacturer's instructions with the approval from the AASL Engineer. It shall not be installed in corrosive environments or atmospheres.

1.9.5. Air Termination Support

i) Supports shall be securely bolted to other mast materials to enable the air termination and mast system to withstand maximum locally recorded wind velocities.

ii) The supports shall have sufficient rigidity to ensure that the maximum deflection of the termination under such extreme wind conditions shall not exceed 100 mm. The support arrangement shall have a first natural frequency for oscillation occurring at a wind speed at least twice the maximum design wind speed for the region.

1.9.6. Down-Conductor

i) Typical spacing of down conductors and equi-potential bonding rings shall be15m.
ii) In between the connecting part of a reinforced concrete structure and steel structure shall be bonded electrically.
iii) Steel frame and reinforcing rod shall be used as a lightning conductor.
iv) Down conductors shall be connected via a test joint to the earth termination network.

1.9.7. Earthing System

a) The earth system shall not exceed 2 ohms static impedance except with prior approval by the Employer or manufacturer of the lightning protection system.

b) Everything will be done by deep driven earth rods especially designed for electrical earthing. In all cases the earthing system shall be electrically connected to the centre earth rod which shall be securely clamped to the down-conductor system.

c) Bonding to the earth system of all buildings is required. The value of the resistance (1 Ω or less) shall be achieved before such bonding is done.

d) Electrically conductive, non-soluble Earth Enhancing Compound may be used to help achieve low earth resistance provided the materials are mixed and installed strictly in accordance with the manufacturer's instructions.

e) Grounding electrodes shall be cone-pointed copper bonded steel ground rods of sufficient length and number to achieve the specified performance. Rods shall be driven full depth plus 150 mm installed when indicated to provide an earth ground of the appropriate value for the equipment being grounded.

f) All exposed metallic elements on the roof located within 1800 mm of the system shall be bonded thereto. These bonds shall include but are not limited to exhaust fans, vents, railings, ladders, metal screens and panels, ventilation and air conditioning units, hatches, etc., or any large metal body subject to direct strike or which exceeds the height of adjacent air terminals.

1.9.8. Equi-potential Bonding

a) Equi-potential bonding shall be required for all newly installed electrical power consumer's installations.

b) Equi-potential bonding according to IEC 60364 series removes potential difference, i.e. prevents hazardous touch voltages between the protective conductor of the low voltage electrical power consumer's installations and metal, water, gas and cooling water pipes, for example.

c) According to IEC 60364-4-41, equi-potential bonding consists of the main equi-potential bonding and the supplementary equi-potential bonding; every building shall be given a main equi-potential bonding.

d) The supplementary equi-potential bonding shall be intended for those cases where the conditions for disconnection from supply cannot be met, or for special areas which conform to IEC 60364 series part 7.

e) The bonding bar shall be located as close as possible to, and connect to, all external metallic service.

f) At ground floor level, a bonding bar shall be required to be installed and connected to the LPS (Lightning Protection System) earth electrode system. The bonding bar shall be located as close as possible to, and connect to all external metallic services entering the facility (gas pipes, water, power, telephone, etc.). In large facilities, Interconnection shall be via a dedicated internal ring (or partial ring), or via the internal reinforcing of the concrete construction.

g) All services shall be brought into the structure in close proximity to each other to simplify bonding requirements, and to minimize voltage differentials between each service. This is especially important for the protection of sensitive equipment such as computers and communication equipment, which may interconnect to both services.

h) Services and metallic items entering items entering the facility shall include:

- Telephone and telecommunication lines
- Cable TV circuits (If any)
- Antenna feeders
- Power lines
- Pipe work (water, air, gas,etc.)
- Metal ducts

i) Where permitted, these items shall be bonded directly to the bonding bar. In the cases of electrical, electronic and Tele / Data communications services, bonding shall be via SPD (surge protective devices).

1.9.9. Field Test

a) The Systems shall be tested to assure continuity and that the resistance to ground is not excessive. Resistance measurements shall be taken in normal dry weather, not less than 48 hours after rainfall.

b) Written results of each test shall be submitted to the Engineer for approval.

c) Grounding rods shall be tested for ground resistance values before any wire is connected. The test shall be performed in normal dry weather, not less than 48 hours after rainfall.

d) Ground resistance shall also be measured for each piece of equipment to the ground electrode. Testing shall be with a portable ground testing device for each ground or group of grounds by an approved independent agency. The instrument shall be equipped with ammeter reading directly in Ohms or fractions thereof to indicate the ground value of the ground electrode under test.

e) All test equipment including test meter shall be provided by the Contractor and one copy of the ground testing device manufacturer's directions, indicating the method shall be provided.

f) Ground resistance test shall follow the "3 electrode methods" or the "Fall of potential methods"

1.9.10. Lightning Event Counter

a) The lighting Event Counter (LEC) is a device for registering and recording the number of lightning strikes intercepted. The LEC shall be mounted in a secure area that is not prone to contact by moving items, theft or vandalism. However, it shall be mounted in a location that allows safe access to inspect the display

b) The LEC is fixed to the isolated Down -conductor, and does not require additional fixing to the structure. Additional down-conductor fixings shall be installed directly above and below the LEC.

c) Main Specification elements are described as follows:

- Censor: Split Type Current Transformer or Rogowskii coil
- Measurement Current Range: 0.5 kA~40 kA
- Record Data: Frequency of Lightning Strike, Date of Lightning Strike (Year, Month, Day, Hour, Minute, Second), Current Peak Value, Polarity

- Data Display Device: LED
- Enclosure Rating: IP 67

d) All Record Data shall be sent to BMS via an Interface unit.

1.10. Roof-top Solar PV System

a) Solar PV system shall be designed and installed on the Roof top concrete slab of proposed NSC building, and concrete rooftop (approx.. floor area 360m^2) shall be designed to suit for install complete solar PV system.

b) The suitable capacity Solar Inverters shall be installed in the allocated room (tentatively in AHU equipment room) and the system shall be designed and installed with properly rated DC & AC cables, breakers and safety equipment.

c) Supply & installation of all supports, hangers, fixtures, fixings and accessories.

d) The Grounding and Lightning Protection Systems shall be designed to ensure the complete safety of solar PV system, persons and equipment throughout the installation.

e) Contractor shall pay special attention for the installation of solar panels with coordination of Engineer, to avoid glare and ensure view of the ATC operators in Tower Control Cabin.

f) Proposal for Solar PV system shall be submitted to the approval of Engineer.

1.11. Availability of spares

The seller shall guarantee the availability of all spares for a minimum period of 10 years

1.12. Manuals

The supplier shall provide a set of operation & maintenance manuals with the relevant circuit diagrams for each & every system.

1.13 Factory Acceptance, Testing and Training

1.13.1 Factory Acceptance Test

a) Provision should be arranged for two AASL Engineers to witness Factory Acceptance Test of Generator at the manufacturer's facility. All expenses shall be born by the Contractor.

b) Standard generator performance and protection tests to be done for Generator at manufacture's facility.

C) Commissioning load test shall be carried out at the site in presence of AASL Engineers.

1.13.2 Factory Training

a) Provision for four (04) AASL technical personnel for training at the manufacturers' training facility, on special features and differences, testing and commissioning etc. of the latest equipment to be procured of Manufacturer's facility Centre as specified below not less than 24 hours theoretical and practical. All expenses shall be borne by the Contractor

b) Provision of training to recommended AASL staff based on the followings.

- Installation, Operation & maintenance.
- Specific protection functions
- Fault diagnosis & rectification.

1.14 Maintenance Tools for Generator and Electrical System Maintenance

a) Three sets of Maintenance tools shall provide with the generator, inclusive of spanners, Filter removal wrenches, pipe wrenches, and other special tools such as battery tester & hydrometer etc., required for testing or dismantling such items of equipment as engine, alternator, power & control panels and battery maintenance etc.

b) Generator room shall be provided with a set of tools, together with suitable wall mount tool cabinet arranged for wall fixing for one set and a padlocked box for the other two sets.

1.15 Spare Parts for Generator Equipment

a) Spares to be supplied with the Generator equipment

The Contractor shall supply spare parts with the generator for each item of the equipment to provide maintenance for two years after the warranty period, inclusive following spares (all in accordance with the recommendations of the manufacturer of equipment Detailed list of spare parts shall be furnished.

Automatic Voltage Regulator (AVR) cards	- 02Nos.
Rotating diode assembly (Complete set)	- 01No.
ATS PCB	- 02Nos.
Governor control PCB (if any)	- 01No.
Generator control PCB (if any)	- 01No.
Control Relays	- 02Sets
Generator Filters (Oil, Air, Fuel, Coolant & any other)	- 02Sets (For two services)
Belts (Fan, Alternator, Water pump etc.)	- 01Set
Any other (Pl. specify)	

b) List of recommended spare parts

A comprehensive price list of the recommended spares (with part number) for major overhaul of the generator should be submitted.

c) Availability of spare parts

Bidder shall guarantee the availability of spares for a period of ten years from the commissioning.

1.16 After Sales Services / Repair Workshop Facility

a) Contractor shall provide an efficient after sales service including attending to breakdown on a 24/7 hrs basis within short notice.

b) Contractor shall have a engine manufacturer accredited workshop facilityto handle a major overhaul of the generator.

c) The first two mechanical services shall be done by the contractor, inclusive all the consumables and cost to be borne by the contractor.

1.17 Warranty

a) Warranty for Generator

i. The Bidder shall guarantee for the equipment (Generator set and all parts) to be brand new and to be free from defects in material, workmanship and satisfactory functioning under normal use & service.

ii. Warranty for the Generator shall offer for a period of forty eight (48) months or 2000hours of operation, which ever occur first from the date of issuance of provisional acceptance certificate (PAC) after completion of commissioning test. PAC will issue within 14 days after commissioning test.

iii. The engine, alternator shall be of a reputable make and proven in Sri Lanka. Documentary evidence shall be provided.

iv. The complete generator set including the sound attenuated canopy and ATS panel shall be manufactured in the country of its principal manufacturing facility and factory fitted.

b) Warranty for Other Items

All materials, items of equipment and workmanship furnished shall carry one year warranty against all defects in materials and workmanship. Defecting or improper material, equipment, workmanship or design shall be made good buy and at the expense of the contractor including all consequent damages to area, material and other systems resulting from this failure. Warranty shall be effective from date of the issue of the certificate of acceptance for all the works, upon completion.

1.18 STATEMENT OF COMPLIANCE WITH THE SPECIFICATIONS

01. The Electrical system to be installed shall conform to the Specifications given.
02. The Bidder shall comment on the compliance of the item offered against each numbered clause in the specifications and list his comments in the numerical order of the specifications.
03. Should the Bidder be unable to meet a particular clause of this Specifications then he shall state his non compliance in his bid.
04. In the absence of a statement making specific exception to any of the requirements, the bidders shall be deemed to have accepted them as a part of this bid.
05. If there is any incompatibility between the comments made by the bidder in the statement of Compliance and the Specifications of Electrical item indicated in the Technical Literature, the latter shall be deemed to override the comments in the statement of compliance. Bidders shall complete the statement of Compliance and duly Signed

Specs. Ref. No.	Description	Offered Specs. Complied/Not Complied	Remarks
	General		
1.1	Scope of works for electrical wiring & Installations		
1.2	General		
1.3	LV incoming power supply		
1.4	Power generator system		
1.4.1	The Generator		
1.4.2	Auto transfer facility		
1.5	Construction of power house		
1.6	Low voltage distribution system		
1.6.1	Scope of work		
1.6.2	LV Electrical system characteristics		
1.6.3	LV distribution		
1.6.4	Cables for LV power, lighting and internal wiring		
1.6.4.1	Cable specifications		
1.6.4.2	Colour coding & wiring		
1.6.4.3	Main cables		
1.6.4.4	Sub main cables		
1.6.4.5	Earth & Earthing conductors		
1.6.5	Conduits		
1.6.6	Cable trays/Ladders		
1.6.7	Cable trunking		
1.6.8	Under floor ducts/ Junction boxes/ Service outlet boxes		
1.6.9	Under ground cable ducts & trenches		
1.6.9.1	UG uPVC cable ducts & concrete man holes		
1.6.9.2	Concrete cable trenches & man holes		
1.6.10	Circuit protection		
1.6.11	LV Circuit breakers (ACB)		
1.6.12	LV MCCBs		
1.6.13	MCBs		
1.6.14	RCDs		
1.6.15	Panel boards		
1.6.15.1	Low voltage panel boards		
1.6.15.2	Main switch boards (MSB)		
1.6.15.3	Main distribution boards (MDB)		
1.6.15.4	Sub distribution boards (SDB)		
1.6.15.5	Final distribution boards (FDB)		
1.6.15.6	Panel keys		
1.6.16	Motor control centres (MCC)		
1.6.17	Power analyzer		
1.6.18	Bus duct		
1.6.19	Electrical panel rooms at each floor level		
1.6.20	Power factor correction, power quality and harmonics filtration		

1.6.21	Non-compliance		
1.6.22	Quality test requirement		
1.6.23	Measurement of grounding resistance		
1.6.24	Demonstration test requirement		
1.7	Lighting & general power outlet system		
1.7.1	High performance LED		
1.7.2	Internal/ emergency lighting system		
1.7.3	Power outlet system		
1.7.4	Coordination with all divisions		
1.8	System design/ performance requirement		
1.8.1	Interior systems		
1.8.2	Emergency lighting and exit sign		
1.8.3	Exterior lighting system		
1.8.4	Receptacles (Socket outlets)		
1.8.5	Power communications correction to control room desks		
1.8.6	Lighting switches		
1.8.7	Outlet boxes		
1.8.8	Fused connection units		
1.8.9	LED aviation obstruction lights		
1.8.10	Aerodrome identification beacon		
1.8.11	Hand dryers		
1.8.12	Ceiling fans		
1.8.13	Exhaust fans		
1.9	Grounding and lightning protection system		
1.9.1	Grounding system		
1.9.2	Lightning protection		
1.9.3	Surge protection devices		
1.9.4	Air termination		
1.9.5	Air termination support		
1.9.6	Down conductor		
1.9.7	Earthing system		
1.9.8	Equi-potential bonding		
1.9.9	Field test		
1.9.10	Lightning event counter		
1.10	Rooftop Solar PV system		
1.11	Availability of spares		
1.12	Manuals		
1.13	Factory acceptance and training		
1.14	Maintenance Tools		
1.15	Spare Parts		
1.16	After sales services / Repair workshop facility		
1.17	Warranty		
1.18	Statement of compliance with the specifications		

QUALITY OF EQUIPMENT, MATERIAL & WORK OFFERED

(TO BE COMPLETED AND ATTACHED TO THE BIDDING DOCUMENT BY THE BIDDER WITH TECHNICAL CATALOG)

	Description	Make Offered	Model Offered	Country of Origin	Country of Manufacture	Supplier	Delivery Period	Remarks
1	800kVA Power Generator							
2	ATS Panel							
3	Main cables							
4	Sub main cables							
5	Earth conductors							
6	uPVC conduits							
7	Cable trays/ ladders							
8	Cable trunking							
9	Under floor GI ducts							
10	Air-Circuit breakers (ACB)							
11	Moulded Case Circuit Breakers (MCCB)							
12	Miniature Circuit Breakers (MCB)							
13	Residual current devices (RCD)							
14	Low voltage circuit boards							
15	Main switch boards(MSB)							
16	Main distribution boards (MDB)							
17	Sub distribution boards (SDB)							
18	Final distribution boards(FDB)							
19	Panel keys							
20	Motor control centres (MCC)							
21	Power analyzer							
22	Bus duct							
23	Power factor correction, power quality & harmonics filter							
24	Emergency 4 kVA UPS system							
25	Exis sign boards							
26	Switched Socket outlets							
27	Lighting switches							
28	LED aviation obstruction light							
29	Aerodrome identification beacon							
30	Hand dryers							
31	Ceiling fans							
32	Exhaust fans							

33	Lightning protection system							
34	Grounding conductors							
35	Surge protective devices							
36	Solar panels							
37	Solar power inverters							
38	LED lights							
39	Exit sign boards							
40	Aviation obstruction lights							
41	Aerodrome beacon							
42	EFR							
43	PFR							
44	Remote energy meters							
45	Laptop computer							
46	Split type Air-conditioners							

Detail of the Selected Electrical Contractor

Name:……..

EM Category of :……

Date:…….. ……..……..

Company Seal: Signature of Bidder

AASL

IT RELATED SERVICES

General Conditions and Scope of IT Work

The contractor shall supply and install all IT related systems mentioned below, in accordance with the industrial standards and practices. The required power outlets will be provided by AASL.

1. All proposed equipment shall be suitable and certified to operate in the environment of the Proposed Navigational Service Complex at CIAR.

2. Equipment rooms where active equipment is installed shall be provided with an environment control system as recommended by the equipment supplier with Air Conditioning and humidity control etc.

3. All cables, components, equipment, racks etc. shall be systematically labelled in a durable manner for ease of identification and future maintenance.

4. Low-Smoke, Zero-Halogen (LSZH) cable shall be used for all installations.

5. All equipment, devices, and components shall be provided with 01-year warranty, unless otherwise specified.

Systems

1. Structured Cabling System
2. Local Area Network
3. UPS
4. FID System
5. IP-based Telephone System
6. Wireless Network
7. CCTV System
8. Central Clock System
9. Fire Alarm System
10. Evacuation Siren system

Detailed Minimum Requirements/Specifications:

1) Structured Cabling System

The Structured Cabling System shall be a resilient, highly available and seamless cabling infrastructure throughout the Proposed Navigational Services Complex at CIAR. It shall be a multi-purpose cable network system that is utilized as the medium for voice and data transmission and distribution for the proposed Navigational Services Complex at CIAR.
Proper Cable trays and Floor trunking system shall be installed in proposed areas as per the diagrams.
The Contractor shall proposed for any modifications alterations, changes for the proposed Cable tray and Floor trunking system where necessary for the proper installation if the proposed systems are deemed inadequate for the cable installation.

Separate Structured Cabling Systems shall be provided for all I.T. related services.

1. The Structured Cabling System shall comply with the following industry standards where relevant.
    a. ANSI/TIA/EIA-568 C.0 – Generic Telecommunication Cabling for Customer Premises (2009)
    b. ANSI/TIA/EIA-568 C.1 – Commercial Building Telecommunication Cabling Standard (2009)
    c. ANSI/TIA/EIA-568 C.2 – Balanced Twisted Pair Telecommunication Cabling and Component Standard (August 2009)
    d. ANSI/TIA/EIA-568 C.3 – Optical Fiber Cabling Component Standard (2008)
    e. ANSI/TIA/EIA-569 A – Commercial Building Standard for Telecommunication Pathways and Spaces
    f. ANSI/TIA-942 – Telecommunication Infrastructure Standard for Data Centers
    g. ANSI/TIA/EIA-606 – Administration Standard for Telecommunication Infrastructure of Commercial Buildings
    h. ANSI/TIA/EIA-607 A – Commercial Building Grounding (Earthling) / Bonding Requirements for Telecommunication
    i. Any TIA/EIA Telecommunication System Bulletin (TSB) / Addendums issued related to the above-mentioned standards

2. The following cable types shall be used for the Structured Cabling System.
    a. Single Mode Optical Fiber Cable for Data and Voice – ANSI/TIA/EIA-568 C.3
    b. UTP Category 6 Cable or higher for Data and Voice – ANSI/TIA/EIA-568 C.2
    c. UTP Category 3 Multi-pair Cable for Analog Voice and ELV

3. Grounding and Bonding of each IT Equipment Room and Equipment Rack shall be carried out to protect against power surges and lightning as per ANSI/TIA/EIA-607 A standard.

4. The minimum cable requirement between the existing Terminal and the proposed Navigational Services Complex at CIAR.

	From	To	Cable Type	
			Single Mode Optical Fiber	**UTP Category 3 Multi-pair**
1	Existing Terminal Data Center (Laying and Termination and Testing)	Main Fiber Patch panel at Ground floor IT Equipment Room – Proposed Navigational Services Complex at (Laying and Termination and Testing)	01 Nos. 24 core	-
2	Main Fiber Patch panel at Ground floor IT Equipment Room – Proposed Navigational Services Complex at	To each Fiber Patch panels at IT Equipment Rooms (Laying, Termination and Testing)	01 Nos. 12 core to each location	

	(Laying, Termination and Testing)			
3	MDF Room (in existing Terminal) (Laying, Termination and Testing	Main IT Equipment Room Ground floor,500 Pair Telephone MDF (Laying, Termination and Testing)	-	01 Nos100-pair (UG)
4	Main Telephone 500 pair MDF at Ground floor IT Equipment Room (Laying and Termination and Testing)	100 Pair Telephone JBs at each floor IT Equipment Rooms (Laying Termination and Testing)		01 Nos of 50 pair to each location
5	100 pair JB at 1st floor	20 pair JB at system control monitoring Center		01 no of 10 pair
6	100 pair JB at 5th floor	20 pair JB at Lift machine room		01 no of 10 pair
7	100 pair JB at Each floor	Evacuation siren system- siren and push button locations at each floor		02 No of 2 pair to each point

5. Proposed Navigational Services Complex Main fiber patch panel located in the Ground floor shall be linked to the Existing Terminal Building server room Main fiber patch panel through a 24 core fiber cable. The Proposed Navigational Services Complex ground floor main fiber patch panel shall be linked each floor Fiber patch panels through 12 core fiber cables.

6. Network outlets shall be installed as per single line diagram and the layout drawings

7. Existing Terminal Building MDF in server room shall be linked to Proposed Navigational Services Complex by 500 Pair Telephone/ELV junction box which shall be located on the ground floor through a 100 pair underground telephone cable. 100 Pair Telephone/ELV junction box shall be installed in the Existing Terminal Building MDF to link the Navigational Services Complex 500 Pair Telephone/ELV Junction Box.

8. Telephone/ ELV outlets shall be installed as per single line diagram and the layout drawings

9. UTP Category 6 Cables shall be provided to connect IP equipment. and each cable from the IT equipment racks to the end points shall be restricted to a length below 80 meters.

10. Patch Panels (UTP and Optical Fiber) and horizontal/vertical cable management units shall be provided for each rack.

11. Optical Fiber Cable splicing shall be performed as per industry-accepted standards.

12. Dedicated equipment racks, cable trays, and trunking systems shall be available for the Structured Cabling System. Adequate spacing between the electrical cable trays shall be provided. Easy accessibility for the cable tray network shall be provided with adequate working space for cable laying and maintenance purposes.

13. Performance Guarantee Certification for the Structured Cabling System for a period of not less than 10 years shall be provided for all optical fiber and UTP installations.

14. Patch panels, patch cords, outlets and other connection accessories shall be labeled in a standard method for easy identification.

15. All cable entry points shall be properly sealed.

16. Floor boxes or any other customized outlets shall be provided wherever necessary and sample submitted for prior approval.

17. Floor boxes shall be installed with an offset from the under-floor trunking and on the under-floor trunking itself to avoid congestion and for ease of future maintenance.

18. Network cabling shall be mechanically protected over its entire length, except at the termination.

19. Both ends of cables shall be labeled and covered with durable material for long-term maintenance purposes.

20. Standard 19" equipment mounting racks with the following specifications shall be used.
    a. The height of the rack shall be 42U. The racks shall have adequate room for mounting LAN equipment, patch panels, cable management panels, and power panels.
    b. The depth of the rack shall be decided considering the actual equipment sizes and required maintenance space.
    c. Cable management panels and cable ladders shall be installed on floor-standing racks to facilitate easy maintenance.
    d. Shall have perforated front and back doors with locks
    e. Shall have forced air ventilation (cooling fans) and appropriate louvers to facilitate proper ventilation and air circulation.
    f. Shall have an adequate number of IEC power sockets (with a 16A breaker) with proper orientation for the equipment and shall support dual power sources.
    g. All Network outlets shall terminate at the Data Switches in proposed Arias.

2) Local Area Network

The existing Local Area Network shall be extended and upgraded to cater for the requirements of the proposed Navigational Services Complex at CIAR and this Local Area Network shall be the common infrastructure shared by all relevant IP based Systems in the proposed Navigational Services Complex.

1. Cisco Catalyst C9200L-48P-4X Access Switches (minimum specification) shall be installed in the proposed Navigational Services Complex at CIAR.

2. All active network devices shall be electrically powered by the Uninterrupted Power Supply.

3. PoE shall be utilized by all relevant end devices. If the PoE power is not sufficient, high power PoE injector panels shall be provided to cater the power requirement.

4. All optical fiber cables and SFP Modules shall be Single Mode.

5. Required number of SFP Modules (40G, 10G and any other) shall be provided.
6. Active network devices shall be provided with 01-year warranty.

3) UPS Units

5 KVA UPS units shall be installed at the data racks

4) Flight Information Display System

1. Staff Video Display Computers shall be installed according to the drawings.
2. All the Staff Video Display Computers shall use the proposed structured cabling and network solution.

5) IP based Telephone System

The existing IP-based Telephone System shall be extended and upgraded to cater to the requirements of the proposed Navigational Services Complex.

1. Proposed IP Phones shall be fully compatible with the specifications
2. IP Phones shall be provided to all locations where the telephone facility is operationally required such as counters, desks, security points, office areas, etc.

6) Wireless Network

1. One Access point should be configured as controller
2. The above AP should have provided managing and controlling other APs and users
3. After installing all APs supplier should generate a heat map to show the required area is covered by Wi-Fi signals.
4. The signal level should be less than -67dbm.
5. Installation and configuration should have done by the supplier

6. Wireless Network shall be extended and upgraded to cater for the requirements of the proposed Navigational Services Complex.

6.1. A detailed survey shall be carried out by the contractor using manufacturer-certified simulation tools, a coverage map shall be provided to the Employer for approval.

6.2. Wireless Access Points shall be installed to cater to the whole proposed building with adequate signal strength to cater to the projected user density, capacity, and seamless roaming capability.

7. The Supplier should provide proper training for two technical persons nominated by AASL
8. Training should cover the areas of installation, Configuration and Troubleshooting.
9. Training location should be the vender certified training center.

7. CCTV System

1. The proposed cameras shall support H.265 compression technology & and shall be a stable product.
2. The proposed Navigational Services Complex shall be covered by appropriate CCTV cameras. Camera selection shall be done to maintain the existing concept.

3. All areas shall be covered by fixed cameras shall be available for detailed monitoring.

4. The proposed CCTV design shall be provided for approval prior to implementation.

5. All the cameras shall utilize the proposed structured cabling and network solution.
6. All necessary licenses (VMS, Face Recognition, etc.) shall be provided. The existing e-map shall be modified accordingly.

7. Proposed CCTV system shall be connected to the existing CCTV monitoring station (Dahua DSS PRO) at terminal building. Live & playback views of all proposed cameras shall be available on all the workstations

8. Central Clock System

1. All clocks shall be utilize the common network infrastructure for connectivity.

2. Connectivity from nearest Data outlet shall be provided by the contractor for all intended locations of clocks.

3. Installation of clocks done by the contractor using suitable mounting material

9. Fire Alarm System

1. The fire alarm system shall be designed, and installed according to the NFPA, UL, ICATD and shall be according to AASL Fire & Rescue Division's guidelines.

2. A new addressable fire panel shall be installed at the Ground Floor of the proposed building as per the layout diagram.

3. A repeater panel shall be installed at the existing fire watch tower and connected to the fire alarm panel.

4. All cabling, detecting equipment installation, and all other activities related with Fire alarm system shall be carried out by the contractor according to the standards.

5. Smoke, heat, beam, aspiration type, fire detection sensors shall be considered for the design based on the building construction.

6. Shall provide necessary interfaces with the other systems at the building (ex - AHU, baggage handling conveyers, etc.) as per the design.

7. The Supplier should provide proper training for two technical persons nominated by AASL. Training location should be the vender certified training center.

10. Evacuation Siren System

1. Evacuation Siren System shall be installed according to the drawings.
2. Sirens and the operator push buttons shall be installed by the contractor using proposed cable distribution (ELV) for the Evacuation Siren System according to the drawings and single line diagram.
3. For each floor, two sirens, each equipped with push button switches, shall be installed and connected to the 100 Pair Telephone/ELV JB in same floor, using two pair ELV cables.
4. Installation of Control Panel of the Evacuation Siren System and balance cable work will be done by AASL.

11. Access Control System

1. Embedded 20 mm PVC conduits with 100 x100 ABC Boxes and blank plates shall be installed as per the conceptual drawing for Access Control System for the following locations.

   I. Entrance to the Control Tower, (5th floor)
   II. Entrance to the Area Control Center (2nd floor)
   III. Entrance to the ATC Playback Room, (3rd floor)
   IV. Entrance to the ATC record room, (4th floor)
   V. Entrance to the VHF equipment room,(4th floor)
   VI. Entrance to the System Control Monitoring room, (5th floor)

2. Access control system will be installed by AASL.

Network Connectivity for Data, Telephones and CCTV

1. 48-port PoE Switch

1.1. Application : Enterprise-class access deployment
1.2. Item : 48 Port PoE+ Switch
1.3. Switch Ports : 48 Nos. (RJ-45)
1.4. Supported Protocols
   a. Ethernet : IEEE 802.3ab - 1000BaseT
      : IEEE 802.3u - 100BaseT
   b. PoE : IEEE 802.3af PoE
      IEEE 802.3at PoE+
   c. Neighbor discovery: CDP
1.5. Uplink Ports
   a. Speed : 10Gbps SFP+
   b. Number of Ports : 04 or more
   c. SFP Module : 2 x 10Gbps SFP+ and 2x 1GB SFP per switch
1.6. Power Over Ethernet : At least 740W of PoE power shall be available

1.7. DRAM	:	Not less than 2 GB
1.8. Flash	:	Not less than 4 GB
1.9. Switching capacity	:	176 Gbps
1.10. Forwarding rate	:	Not less than 100 Gbps95 Mpps
1.11. MAC address table size	:	Not less than 16,000 entries
1.12. Maximum VLAN IDs	:	4000 or better
1.13. Jumbo Packet size	:	9000 bytes or better
1.14. Console Ports	:	RJ-45
1.15. Mounting	:	19" Rack Mount Type, mounting accessories shall be provided.
1.16. Power Supply	:	Cables shall be provided
1.17. Operating Voltage	:	230 VAC / 50Hz
1.18. Warranty	:	One (01) year or better comprehensive warranty shall be provided from the date of successful supply.

2. CAT 6 UTP Patch Panel (24 Port Fully Loaded Panel)

2.1 Category	:	6 (CAT6)
2.2 Standard	:	EIA/TIA 568B
2.3 No of ports	:	24
2.4 Size (Height)	:	1U
2.5 Preferred Color	:	Black

2.6 1U cable manager shall provide with the patch panel. Shall meet with E1A/T1A standard.

3. CAT 6 UTP Cable

3.1 Category	:	6 (CAT 6)
3.2 Standard	:	EIA/TIA 56
3.3 Type	:	UTP
3.4 Conductor Gauge	:	23 AWG

4. CAT 6 Network Outlet

4.1 Category	:	6 (CAT 6)
4.2 Standard	:	EIA/TIA 568B
4.3 Colour	:	White
4.4 No of ports	:	One
4.5 Faceplate	:	BS flat type with shutter
4.6 Keystone Jack	:	RJ-45, 8 conductor

5. CAT 6 UTP Patch Cord

5.1 Category	:	6 (CAT 6)
5.2 Standard	:	EIA/TIA 568B
5.3 Type	:	UTP
5.4 Length	:	3m
5.5 Conductor Gauge	:	23 AWG

5.6 Connectors shall be factory terminated.

6. CAT 6 UTP Patch Cord

6.1 Category	:	6 (CAT 6)
6.2 Standard	:	EIA/TIA 568B
6.3 Type	:	UTP
6.4 Length	:	0.5m
6.5 Conductor Gauge	:	23 AWG. Connectors shall be factory terminated.

7. Optical Switch (24 Port)

7.1 Switch Ports	:	24 GE SFP ports
7.2 Supported Protocols		
a. Ethernet	:	IEEE 802.3ab - 1000BaseT IEEE 802.3u - 100BaseT
7.3 Uplink		
a. Ports	:	10GbE SFP+
b. Number of Ports	:	04
c. SFP Modules	:	10 Nos. of 1Gbps /Single Mode/ Duplex /SFP Modules 02nos of 10 Gbps/ Single Mode/ Duplex /SFP Modules Shall be supplied with each switch. Provided SFP should support with the offered switch.
7.4 Switching capacity	:	128 Gbps or better
7.5 MAC address table size	:	Not less than 32,000 entries
7.6 Maximum VLAN IDs	:	4000 or better
7.7 Jumbo Packet size	:	9000 bytes or better
7.8 Management	:	Console port RJ-45 / HTTPS / Telnet
7.9 Surge protection	:	AC power port: +/- 6KV in diff mode and +/- 6KV in common Mode
7.10 Power Supply	:	Dual power supplies should be available
7.11 Operating Voltage	:	230V AC / 50Hz
7.12 Other accessories	:	Power cables, mounting accessories for 19' data rack, etc.
7.13 Warranty	:	One (01) year or better comprehensive warranty shall be provided from the date of successful supply
7.14 Product Brochures	:	Brochures of the product should be provided with the offer and offered model should be highlighted clearly

8. Fiber Patch Panel (Fully Loaded)

8.1Fiber Type	:	Single Mode
8.2Connector Type	:	SC
8.3No of ports	:	12 Duplex (24 core)
8.4Size (Height)	:	1U

8.5 Color : Black

8.6 1U cable manager shall provide with the patch panel.

8.7 Patch panel shall fully-loaded.

9. Fiber Cable – 24 Core – Single Mode

9.1 Type : Armored, Jelly filled, Indoor/Outdoor
9.2 Mode : Single Mode
9.3 Standard : ITU-T G.651 or TIA OS2
9.4 No of Cores : 24 in loose tubes with standard color coded cores
9.5 Max. Data Bandwidth : Not less than 10 Gigabit Ethernet

10. Fiber Cable – 12 Core – Single Mode

10.1 Type : Armored, Jelly filled, Indoor/Outdoor
10.2 Mode : Single Mode
10.3 Standard : ITU-T G.652C and G.652D
10.4 No of Cores : 12 in loose tubes with standard color coded cores
10.5 Max. Data Bandwidth: Not less than 10 Gigabit Ethernet

11. Fiber Patch Cord

11.1 Mode : Single Mode
11.2 Type : Duplex
11.3 Connector Types : SC – LC
11.4 Fiber Cable : 50/125µm (OS2)
11.5 Length : Not less than 1m
11.6 Shall made with high quality UPC Zirconia SC ferrules.
11.7 Connectors shall factory terminated.

12. Wireless Indoor Access Points

12.1 Hardware and General features :

(a) The OEM shall be in the leader's quadrant in the Gartner magic quadrant for LAN and WLAN in last five years.

(b) The below protocols and features shall not be tied with subscriptions but if perpetual licenses required, it needs to be added with the offer.

(c) The access point must have 1x10/100/1000BASE-T autosensing (RJ-45) ports and it shall support 802.3af PoE or 802.3at PoE+

(d) The access point shall support PoE

(e) Standard mounting kits applicable for Ceiling Mount, and Wall Mount shall provide from the same OEM.

12.2 Radio Frequency and specification:

(a) The access point shall support simultaneous 802.11ac and 802.11ax on both the 2.4 GHz and 5 GHz radios.

(b) The access point must support 2x2 multiple-input multiple-output (MIMO) with two spatial streams

(c) Access point must have at least 4.5 dBi Antenna gain @ 2.4GHz & 5.5 dBi Antenna gain @ 5GHz radios

(d) The access point must support approved transmit power by TRCSL on 2.4Ghz & 5GHz Radio respectively
(e) The access point must support a minimum of 1.5 Gbps Throughput
(f)The access point shall support layer two and layer 3 Roaming
(g)Access Point shall support Spectrum analysis, real-time wireless intrusion prevention/detection to mitigate rogue AP attacks and RF optimization.
(h) Access point shall support detecting and classifying non-Wi-Fi wireless transmissions while simultaneously serving network traffic

12.3 Wireless Security, QoS, Monitoring & reporting:

(a) The access point shall provide a bandwidth limiter itself to control bandwidth usage
(b) The access point shall be able to set policies based on Groups and SSID and Device
(c) The access point shall integrate a Layer 7 firewall for the identification of user-based application- based traffic
(d) The access point shall prevent DoS attacks, Man in the middle attacks, and over-the-air security threats by acting as a wireless intrusion prevention system.
(e) The access point shall support secure guest access with device isolation
(f) Access Point shall support tunneling with IPsec VPN
(g) Access Point shall support stronger encryption and authentication which is provided via the latest version of WPA2 and WPA3 protected access method
(h) The access point shall provide detailed historical per-client usage statistics

12.4 Flexibility & Manageability :

(a) The access point shall be able to manage via a centralized management platform to provide inherent HA config to prevent failover
(b) Access points shall be able to avoid the sticky client problem of placing end devices to the best AP based on the bandwidth available, the types of applications used, and the type of traffic even in the users on roaming.
(c) The access point shall support automatic firmware upgrades with scheduling control
(d) The access point shall support telnet and/or SSH login to APs directly for troubleshooting flexibility.

13. WLAN controller specifications

1. Hardware and General features:
   1.1. The controller shall be deployed with N+1 redundancy architecture
   1.2. The Controller shall manage locally and on-premises.
2. Management, Security QoS, Monitoring & Reporting
   2.1. The controller shall have the capability to manage 50 access points and supports to cater 100 access points in the future without changing the hardware components
   2.2. The Wireless Network shall continuously function even if the connectivity to the controller is interrupted.
   2.3. The controller shall be provided layer 3 roaming to user connectivity without disconnecting while on the move
   2.4. The controller shall support traffic segmentation based on a defined set of user types such as guest, contractor, or employee to provide greater levels of security.

2.5. The controller shall support web based and application filtering
2.6. The controller shall support deep packet inspection and application awareness
2.7. The controller shall be supported QoS over encrypted traffic
2.8. The controller shall support application visibility and control
2.9. The controller shall be able to set policies based on User, Groups, SSID, and Device.

3. Warranty and Support
3.1. 1 Year Comprehensive Warranty
3.2. If fail the device, Supplier should provide the backup device within 48h until replace faulty device from warranty and services within 1 years
3.3. all the above mentioned features shall include in the Price mentioned (no recurring subscriptions or licensing fee will be entertained)
3.4. The vendor should have at least 2 certified engineers for the proposed product (attached Proof)
3.5. Manufacture Authorization Letter should be provided as per the format provided

14. 5 KVA UPS Unit

14.1 General Features
14.1.1 Power Range : 5 KVA/4.5 KW
14.1.2 Topology : True Online, Double Conversion
14.1.3 Construction : Rack mountable and Free standing configurations Operation
14.1.4 Noise : Shall be less than 60 dBA

14.2 Input Characteristics
14.2.1 Voltage : 220/230 V
14.2.2 Voltage Range : +/- 15 %
14.2.3 Frequency : 50Hz/60 Hz
14.2.4 Frequency Range: 47 Hz – 63 Hz
14.2.5 Total Harmonic Distortion: less than 5 % on full load
14.2.6 Input protection : breaker

14.3 Output Characteristics
14.3.1 Output Power : 5 kVA/4.5 kW
14.3.2 Voltage : 220/230 V
14.3.3 Voltage Range : +/- 5 %
14.3.4 Efficiency(nominal) : more than 94 %
14.3.5 Frequency : 50/60 Hz +/- 0.1%
14.3.6 Crest Factor : shall be 3:1
14.3.7 THD (Voltage) : less than 4 %
14.3.8 Waveform : Pure Sinusoidal
14.3.9 Bypass : Built-in Maintenance Bypass, Built-in Static Bypass
14.3.10 Power Factor : 0.75 or above

14.4 Battery

14.4.1 Battery Type : VRLA, shall be replaceable, standard 12V/7Ah Battery
14.4.2 Nominal Battery Voltage : 240V
14.4.3 Efficiency : more than 95% in battery operation
14.4.4 Battery Test Type: Manual & Automatic
14.4.5 Runtime at Full Load : more than 10 Minutes
14.4.6 Runtime at Half Load : more than 20 Minutes

14.5 Communication & Management

14.5.1 Audible Alarms : Shall be available
14.5.2 Display Type : LED Display
14.5.3 Control panel : Multi-function LCD status and control console
14.5.4 Emergency Power Off : Shall be available
14.5.5 Communication : SNMP & RS232
14.5.6 Software and Cable : shall be provided

14.6 Operating Conditions

14.6.1 Environment : 0 - 40 °C
14.6.2 Relative Humidity : 0 - 95%
14.6.3 Storage Temperature : -20 - 45 °C

14.7 Standards

14.7.1 EMC : IEC 62040-2
14.7.2 Safety : cUL Listed, UL 1778

14.8 Technical Literature

The supplier shall provide the original technical broachers or technical literature of the offered UPS for evaluation purposes.

14.9 Warranty : 02 years comprehensive warranty

15. Floor Mounting Data Rack - 42U (Fully Loaded)

15.1 Size : Height - 42U
Width - 600mm
Depth - Minimum 800mm (Capable to mount the proposed switches)

15.2 Shall be made of steel and power coated wall mounting type with lockable glass door.

15.3 Exhaust fan module shall be provided.

15.4 Removable plates for Top and Bottom cabling paths.

15.5 One power distribution strip shall be provided
Size - 1U

Number of outlets - Not less than 6 numbers of 13A outlets

15.6 Horizontal (19") cable mangers shall provided

15.7 One Rack Mount Tray (1RU) shall be provided

15.8 All other accessories like UPT Cable management, Fiber management, Cage Nuts, Bolts, Cable wraps, Velcro Ties, etc. shall be provided.

15.9 Preferred color – Black

16. SIP Phone Executive Type (Black)

16.1 Supported Voice Codes	G.711a/ μ, G.722, G.729a/b, iLBC, OPUS
16.2 Brand and model	Well Known Brand and Support with Flatrix IPPBX
16.3 Signaling protocol support	Session Initiation Protocol (SIP)
16.4 Supported Call	Features Call Waiting, Call Transfer, Call Hold, Call Forward, Caller ID, call Pickup, Call conference and any other standard features.
16.5 Sip Accounts	06
16.6 Display	4.3" TFT Colour LCD
16.7 WIFI Features	Optional
16.8 Phone Features	Speaker Phone, Volume Adjustment, Hands Free
16.9 Speed dialing buttons	08 Lines
16.10 Key Features	status indicator, Line keys, 4 soft keys, 5 navigation keys, 1 volume keys, menu, cancel, hold, voicemail, mute, headphone, redial, hands-free
16.11 Network Connectivity	2 No of RJ 45 (Fast /Giga Ethernet). Each connection for network and computer.
16.12 IP Assignment	Static / DHCP / PPPoE
16.13 Management	Web Access
16.14 QoS Support	Shall be available
16.15 Power	PoE and External Power Supply
16.16 Colour	Black or Grey
16.17 Warranty	Not less than 01 Year

17. IP Phones (Black)

17.1. Supported Voice Codes	G.711a, G.711u, G.729a, G729ab, G.722
17.2. Supported Voice Codes	SIP v1, SIPv2 and any Other
17.3. Supported Call Features	Call Waiting, Call Transfer, Call Hold, Call Forward, Caller ID, Call conference and any other standard features.
17.4. Phone Features	Speaker Phone, Volume Adjustment

17.5. Accounts Shall be able to setup at least two accounts
17.6. Network Connectivity 2 No of RJ 45 (Fast /Giga Ethernet). Each connection for network and computer.
17.7. IP Assignment Static / DHCP / PPPoE
17.8. Management HTTP or Telnet
17.9. QoS Support Shall be available
17.10. Power PoE and External Power Supply
17.11. Colour Black
17.12. Warranty Not less than 01 Year.

18. Distribution Box (DB) - 500 Pair

Wall mounting IDC type, Steel construction with mounting plates, cable management and lockable door. Polyester powder coated surface finish, protection – IP 54 or better Equipped with 500 Pairs

18.1 IDC modules – 50 Nos. KRONE P/N 6089 – 06
18.2 Back mount frames – 05 Nos. KRONE P/N 6442 3250– 10

19. Distribution Box (DB) - 100 Pair

Wall mounting IDC type, Steel construction with mounting plates, cable management and lockable door. Polyester powder coated surface finish, protection – IP 54 or better Equipped with 100 Pairs

19.1 IDC modules – 10 Nos. KRONE P/N 6089 – 06
19.2 Back mount frames – 02 Nos. KRONE P/N 6442 3250– 10

20. Distribution Box (DB) - 50 Pair

Wall mounting IDC type, Steel construction with mounting plates, cable management and lockable door. Polyester powder coated surface finish, protection – IP 54 or better Equipped With 50 Pairs

20.1 IDC modules – 10 Nos. KRONE P/N 6089 – 06
20.2 Back mount frames – 02 Nos. KRONE P/N 6442 3250– 10

21. 100 pair telephone UG cable

21.1 10 pair unarmored, Jelly Filled, cable suitable for duct/direct burial.
21.2 Solid Conductor, diameter not less than 0.5 mm
21.3 Aluminum tape-moisture barrier/ electrostatic screen
21.4 Randomly cross stranded pairs to minimize cross talk.
21.5 Standard colour coded pairs
21.6 Polyethylene outer sheath
21.7 Loop resistance not more than 150 ohms/Km
21.8 Suitable for utilize with Krone IDC Modules

22. Telephone Cables - 50 Pair

22.1 Indoor type Solid copper conductor, diameter not less than 0.5 mm
22.2 Standard color coded pairs
22.3 Polyethylene / PVC outer sheath
22.4 Loop Resistance not more than 150 ohms / Km
22.5 Suitable for utilize with "Krone" IDC Modules

23. Telephone Cables - 20 Pair

23.1 Indoor type Solid copper conductor, diameter not less than 0.5 mm
23.2 Standard color coded pairs
23.3 Polyethylene / PVC outer sheath
23.4 Loop Resistance not more than 150 ohms / Km
23.5 Suitable for utilize with "Krone" IDC Modules

24. Telephone Cables - 10 Pair

24.1 Indoor type Solid copper conductor, diameter not less than 0.5 mm
24.2 Standard color coded pairs
24.3 Polyethylene / PVC outer sheath
24.4 Loop Resistance not more than 150 ohms / Km
24.5 Suitable for utilize with "Krone" IDC Modules

25. Telephone Cable - 2 Pair

25.1 Indoor type Solid copper conductor, diameter not less than 0.5 mm
25.2 Standard colour coded pairs
25.3 Polyethylene / PVC outer sheath
25.4 Loop Resistance not more than 150 ohms / km
25.5 Suitable for utilize with "Krone" IDC Modules

26. RJ 11 –Telephone Wall Outlet (Dual)

26.1 RJ 11 Type Telephone Wall outlet (Dual) with lift off cover
26.2 Flush mount type

27. Dome Camera

27.1	Type	:	Motorized Varifocal Dome
27.2	Resolution	:	Not less than 3 mega pixels (2048 x 1536)
27.3	Frame Rate	:	Not less than 25fps @ 180p
27.4	Lens	:	2.7 – 12 mm @ F 1.4 – Auto Iris and remote focus

27.5 Minimum Illumination: 0.005 lux / F1.4 (color)

27.6 IR Cutter Filter : Shall be available and automatic operation in day night mode

27.7 IR Distance : Not less than 10m

27.8 Video Compression : H.265, H.264 & MJPEG

27.9 Multiple Individual Configurable Streams : Not less than 3

27.10 Image Enhancement Features : DNR, AGC, AWB Shall be available

27.11 Network Protocols : TCP IP, UDP, ICMP, HTTP, RTSP, IPv4 Shall be available

27.12 Digital PTZ : Shall be available

27.13 Compliance : Onvif profile S or third-party Onvif compatible protocol shall be comply

27.14 Network Interface : RJ45 10M, 100M Ethernet Interface

27.15 Day and Night Operation : Shall be possible

27.16 Operating Condition : 10 – 70C^0 Humidity 95%

27.17 Power : PoE IEEE 802.3at (Class 4)

27.18 Flicker Correction : Shall be available for 50Hz and 60 Hz line frequency

27.19 Mounting : 3 Axis adjustable mounting shall be provided with the camera

27.20 Housing : Minimum IK8, IP66 shall be available

27.21 Warranty : Not less than 1 years

28. Bullet Camera

28.1 Type : Motorized Varifocal Bullet

28.2 Resolution : Not less than 3 mega pixels (2048 x 1536)

28.3 Frame Rate : Not less than 25fps @ 180p

28.4 Lens : 2.7 – 12 mm @ F 1.4 – Auto Iris and remote focus

28.5 Minimum Illumination: 0.005 lux / F1.4 (color)

28.6 Optical Zoom : 4x

28.7 IR Cut Filter : Shall be available and automatic operation in day night mode

28.8 IR Distance : Not less than 20m

28.9 Video Compression : H.265, H.264 & MJPEG

28.10 Multiple Individual Configurable Streams : Not less than 3

28.11 Image Enhancement Features : DNR, AGC, AWB Shall be available

28.12 Network Protocols : TCP IP, UDP, ICMP, HTTP, RTSP, IPv4 Shall be available

28.13	Digital PTZ	:	Shall be available
28.14	Compliance	:	Onvif profile S or third-party Onvif compatible protocol shall be comply
28.15	Network Interface	:	RJ45 10M, 100M Ethernet Interface
28.16	Day and Night Operation:		Shall be possible
28.17	Operating Condition	:	10 – 70C^0 Humidity 95%
28.18	Power	:	PoE IEEE 802.3at (Class 4)
28.19	Flicker Correction	:	Shall be available for 50Hz and 60 Hz line frequency
28.20	Mounting camera	:	3 Axis adjustable mounting shall be provided with the
28.21	Housing	:	Minimum IK10, IP67 shall be available
28.22	Warranty	:	Not less than 1 years

29. Cable Tray Network

The tray network shall be built up from a matching range of straights, bends, reducers, tees, supports etc. They shall be fabricated from minimum 1.5 mm thickness mild steel sheets perforated to between 25% and 50% of the total area. The trays shall be hot dip galvanized after fabrication. Support brackets for cable trays shall be fabricated and finished as for the tray and provided at intervals not exceeding 1200 mm.

Dimensions : 300 mm (W) x 50mm (H)

30. Under Floor Steel Trunking

30.1 225mm x 50mm three Compartment under floor trunking System.

30.2 Pre-galvanized Steel or GI Sheet.

30.3 Body and Cover shall be not less than 1.5 mm sheets.

30.4 All relevant accessories such as end caps, saddle clamps, etc. shall be available.

31. Under Floor Service Box

31.1 Pre-galvanized Steel Sheet Service Box.

31.2 Provision for not less than 6 outlets.

31.3 Provision shall be available at sides to connect to the Trunking System.

31.4 Service box cover with provision to take the cables out.

32. Under Floor Junction Box

32.1 Pre galvanized steel sheet junction box

32.2 Body and divider shall be not less than 1.5mm steel sheet

32.3 Provision shall be available at sides for connect to the under floor Trunking System

32.4 Trunking width shall not less than 280mm

32.5 The cover shall be not less than 2.5mm pre galvanized sheet.

33. CABLE DUCT SYSTEM

2 Way Duct System consist of 2 x 100 mm Φ (T1000) PVC pipes encased in concrete. Refer diagrams.

SPECIFICATIONS OF FIRE ALARM SYSTEM

1.1.0 Applicable Standards

1.1.1 Design of the System and all equipment, components and cables involved in the Project shall
Comply with the latest NFPA or BS Standards (Detectors, Manual Call Points, Wiring & Cabling etc.)

1.1.2 All equipment to be supplied shall conform to ISO Quality Standards.

1.2.0 Schedule of Equipment / Items

The Contractor shall submit a complete list of material and equipment to be incorporated in the project.

1.3.0 Turnkey

1.3.1 The Tendered shall quote for all cabling, terminations to the existing interfacing units or any other Hardware, Software Equipment/Components, necessary which are not specified and not indicated in the BOQ or drawings for a completer fully functional/operational Fire Detection and Alarm System.

1.3.2 The Contractor will be responsible for the complete design, configuration and integration of the System and shall ensure that the offered equipment and components fully complies with the NFPA or BS Standards and requirements.

1.4.0 Spares/Software

The Tendered shall quote (Optional Quotation) for recommended spares, Software and accessories necessary for the maintenance of the system for a period of 5 years.

1.5.0 Wiring and Cabling

The Contractor shall supply and install Fire Resistant Type cables in PVC conduits for all Detectors, Manual Call Points and other signaling circuits in the building

1.6.0 Drawings and Manuals

1.6.1 Comprehensive manuals (operation, programming and service) shall be forwarded in triplicate prior to the Provisional Acceptance. The service manuals shall provide fault findings guides etc., of all the equipment supplied.

1.6.2 Two Sets of Soft Copies (CD Form) of the Services Manuals shall also be supplied.

1.6.3 As built drawings indicating details of the cabling and locations of all components of the Fire Alarm System shall be submitted in triplicate.

1.6.4 The Contractor shall submit the Shop Drawings, Indicating the locations of the Detectors, Manual Call Points etc., for the approval of AASL.

1.7.0 Testing & Commissioning

1.7.1 The contractor shall test and commission the system in the presence of the AASL Engineer and shall prove the performance and all functionalities.

1.7.2 This shall be carried out as per recommended commissioning/testing procedures of the equipment manufacturer(s).

1.8.0 Control Panel

1.8.1 The Control Panel shall be analogue addressable type.

1.8.2 The Control Panel shall provide audible and visual indications in the event of Fire and Fault Conditions. Indicated below are a few fault conditions:

1.8.2.1 Open/Short Circuit and Ground fault of the Loop
1.8.2.2 Failure/Malfunctioning of a Detector/Manual Call Point
1.8.2.3 Failure/Malfunctioning of the Power System
(Eg. Charger Failure, Battery Open Circuit and Mains Failure)
1.8.2.4 Failure/Malfunctioning of the Control Panel
1.8.2.5 Open/Short Circuit of a Sounder or any other signaling circuit

1.8.3 The Panel shall have the capability to retain records of not less than 250 events in its memory.

1.8.4 The Control Panel shall be able to test the Detectors and the System automatically and to initiate pre maintenance warnings.

1.8.5 The Main Control Panel shall be of Modular Construction incorporating plugging type Printed Circuit Boards for easy Maintenance.

1.8.6 Facilities shall be available to adjust the sensitivity/threshold of the individual detectors from the Control Panel.

1.8.7 The panel shall have the capability to upgrade/expand to meet the future requirements.

1.8.8 The Contractor shall supply and install all necessary transient protectors for the Control Panel, Detector/Manual Call Point Loop, Signaling Circuits and the Main supply.

1.8.9 To prevent tampering by unauthorized person, all operations of the Control Panel shall be kept electrically inactive by a key operated switch or pass code.

1.8.10 The Control Panel shall have Voltage Free Contacts for common Fire and Fault for
Remote Monitoring purposes.

1.9.0 Detectors

1.9.1 Addressable Type Photo Electric, smoke, multi sensor and heat.

1.9.2 The Detectors shall be of low profile Design (Recess mounting type)and shall incorporate/provide:

1.9.2.1 Remote function testing capability (Auto Testing Functions)
1.9.2.2 A Fine Mesh as an insect Screen.
1.9.2.3 Visual Indications (LED) to indicate healthy and fire conditions
1.9.2.4 Electronic Assembly of the Detector shall be encapsulated in High Resistant Epoxy Resin against contamination and corrosion.
1.9.2.5 Protection against Voltage Transients.
1.9.2.6 Provision to connect outdoor indicators.

1.9.3 The Contractor shall adjust the sensitivity of the Detectors according to the environmental conditions of the locations.

1.10.0 Manual Call Points

1.10.1 Addressable type Manual Call Points shall be installed as indicated in the drawings.

1.10.2 Manual Call Points shall incorporate/provide the following.

1.10.2.1 Recess Mounting, non-break glass type.
1.10.2.2 Facilities shall be available to reset the Manual Call Points by a special key.

1.10.2.3 Visual indications (LED) to indicate healthy and fire conditions

1.11.0 Power Supply

Power Supply shall consist of a battery/rectifier unit. The batteries shall be of the sealed lead acid type. The capacity of the Battery Bank shall be such that during a power interruption if should support the un-interruptible service of the system under Fire Alarm condition with all sounders on, for not less than 01 hour, and not less than 24 hours under normal standby monitoring condition. The power supply to the main equipment shall be 230 Volts at 50 Hz.

The capacity of the charging unit shall be such that upon the recovery of the main supply, it should handle the inrush currents without any failures.

1.12.0 Networking

The control panel shall be connected to the existing peer to peer network using NOTI.FIRE.NET fiber optic medium

1.13.0 Fire Alarm Repeater Panel

1. Type : Active
2. Display : 2 x 40 LCD Display
3. System Controls : Acknowledge Silence Resent
4. Indicators (LED) : Alarm, Fault, Silence, Power and Disabled
5. Mains Supply : 230V. AC / 50 Hz
6. Internal Power Supply : 27 V DC nominal
7. Battery size : 2 x 12V / 7Ah VRLA
8. The address and time of activation of all programmed points shall be displayed on the LCD screen upon fire or fault indication.
9. An internal sounder shall activate as soon as alarm information is displayed.
10. The silence button shall cancel the operation of the internal sounder.
11. The communication between the main fire alarm panel and repeater shall be fiber/ copper (fire resistance)

Evacuation Siren System

1. Manual Call Point (For push buttons switches)

1.1 Type : Conventional
1.2 Element : No break/Resettable

1.3 Mounting : surface
1.4 Certifications : BS, EN, NFPA
1.5 Operating Voltage : 24VDC
1.6 Contacts : NO /NC
1.7 Finish : Red ABS
1.8 Accessories : Lift off cover, Reset key
(Colour and appearance will be changed by AASL to suit evacuation siren system)

2.Sounder

2.1 Sound level : 100dB(A) at 1m
2.2 Tone : Selectable
2.3 Volume Levels : Not less than2
2.4 Certifications : BS, EN, NFPA
2.5 Operating Voltage : 24VDC
2.6 Mounting : Wall
2.7 Finish : Red colour

Specifications for IP Digital clocks

Double/Single sided clocks

1. Display Type : Green colour 6 digits, HH:MM:SS
2. Power : Power-over-Ethernet PoE
3. Numeral Height : 4 inch or Higher
4. Viewing Distance : Equal or not less than 50m
5. Casing colour : Black/Brown
6. Accuracy : 200 milliseconds typical
7. Operating Temperature: 0C ~ +85C
8. Relative Humidity : 95% non-condensing
9. IP Addressing : DHCP or Static IP addressing.
10. Ethernet Connection: 10/100 BaseT, RJ45
11. Network Protocol: NTP, SNTP, Telnet
12. Time-zones : Configurable for time-zone and daylight saving
13. Mounting : Celling mount (Single side)
14. Celling mount (Double side)
15. Warranty : One year

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FLIGHT INFORMATION DISPLAY SYSTEM

Thin Client Personal Computer

1. Application : Shall be suitable to use in 24*7 operation.
2. CPU : 2.0 GHz or higher
3. Cache : 2 M or higher
4. OS : Genuine Microsoft Windows 10 or higher OS shall be installed in the device.
5. Memory : DDR3, 4 GB, Expandable up to 8 GB
6. Storage : 64 GB SSD or higher.
7. Network : 10/100/1000 Base T
8. Graphics : HD graphics shall be available.
9. Resolution : Minimum 1024*768
10. I/O Ports : 1-HDMI, 4 USB, RJ 45, Power Input, 1 mic in, 1 speaker out.
11. Keyboard : USB or wireless numeric keyboard
12. HDMI Cable : HDMI Cable shall be provided.
13. Mouse : USB or wireless mouse
14. Operation Temperature : 20-70 C
15. Humidity : 10%-80%
16. Size : Less than 18*12*3.7 cm
17. Input Power : Suitable power adapter shall be provided
18. Weight : Not more than 2 Kg
19. Warranty : One-year comprehensive warranty

2. Monitor

1. Panel Size : 24 Inch or better
2. Resolution : 2560 x 1440 or better
3. Backlight Type: LED
4. Panel Type : IPS

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5. Display Surface: Anti -Glare
6. Brightness : 300cd/m^2
7. Contrast Ratio : 1000:1
8. Display Colors : 16.7M or better
9. Flicker Free : Yes
10. Color Temperature Selection: At least 4 modes shall available
11. Display Port : Shall available
12. HDMI Port : Shall available
13. Earth Phone Jack : Shall available
14. Power Consumption: <35W or better
15. Input Voltage : 100-240V, 50/60 Hz
16. Accessories : 1 HDMI cable shall be provided
    1 Display port cable shall be provided
    1 HDMI port cable shall be provided
    1 Factory fitted power cord shall be provided
17. Certificates : ISO 9001, Energy star
18. Warranty : One year comprehensive warranty shall be provided
19. Display shall have Flicker-free technology.
20. Language of on-screen display (OSD) shall be English
21. Power supply unit, power cable, display cables, user manual and software CDs shall be provided.
22. Brochures shall be provided with the offer clearly indicating the model proposed.
23. The proposed monitor model shall be listed on the manufacturer's website to gather more information if required.
24. Bidder shall provide the above mentioned information and failure to do so will make the particular offer liable to be rejected.

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PILE SPECIFICATIONS

BORED PILING

4.1 SCOPE OF WORK

4.1 This Division provides specification for the requirements and procedures for execution and completion of all in situ concrete bored piling and includes the general requirements for provision of materials, workmanship and testing.

4.2 In situ concrete bored piling shall include boring, reinforced in situ concrete piles, and testing to meet the requirements of strength, location, dimension and line, designated on the Drawings and as specified herein.

4.3 Prior to commencement of the in situ concrete bored piling, the Contractor shall prepare a detailed method statement describing the labour, materials and contractor's equipment to be used and the method of work execution and obtain the Engineer's written approval. The statement shall also describe the safety precautions to be adopted and all measures for compliance with environmental requirements.

4.4 Particular care shall be taken in the execution of piling to ensure that no vibration or damage is caused to other structures, buildings or areas within or adjacent to the Site. The Contractor shall inspect all areas with the Engineer prior to the commencement of piling. If in the Contractor's or the Engineer's opinion there is a risk of vibration or damage being so caused, the Contractor shall modify the methods for piling at his own expense and obtain the Engineer's approval therefore.

4.5 The Contractor shall construct the piles to suit his construction programme and seek the Engineer's approval before commencing construction. Where preliminary piles are constructed by the Contractor, the approval of the piles for the main work will not necessarily be given until the results of the loading tests have been received and evaluated.

4.6 All the Pile construction is according to Construction Industry Development, Sri Lanka (CIDA) , Latest Publication of Specifications for Bored and Cast In-Situ Reinforced Concrete Piles.

4.2 MATERIALS

4.2.1 Drilling Fluid

a) Drilling fluid shall be a bentonite or polymer suspension in accordance with this Specification, and as approved by the Engineer.

b) Drilling fluid, immediately prior to mixing, shall be in accordance with The American Petroleum Institute Standard 13A, or equivalent.

c) The Contractor shall obtain manufacturers' certificates of the bentonite powder consigned to the Site giving properties of each consignment and shall submit them to the Engineer when requested.

d) Any other material for the drilling fluid shall be approved by the Engineer.

e) Bentonite or any other approved material shall be mixed thoroughly with clean water to make a suspension which will maintain the stability of the pile excavation for the period necessary to place concrete and complete construction.

f) Where saline or chemically contaminated groundwater occurs special precautions shall be taken to modify the bentonite suspension or pre-hydrate the bentonite in fresh water so as to render it suitable in all respects for the construction of piles

g) The frequency of testing and the method and procedure of sampling drilling fluid shall be proposed by the Contractor and approved by the Engineer prior to the commencement of the work. The frequency may subsequently be varied as required, depending on the consistency of the results obtained.

h) Control tests shall be carried out on the bentonite suspension, using suitable apparatus. The density of freshly mixed bentonite suspension shall be measured daily as a check on the quality of the suspension being formed. The measuring device shall be calibrated to read to within 0.01 g/ml. The control tests of the bentonite supplied to the pile boring, and of the bentonite pumped out of the pile boring, shall cover the determination of density, viscosity, shear strength (10-minute gel strength) and pH values. For average soil conditions the results shall generally be within the ranges stated in the Table given below.

Table 4.1 Range of Drilling Fluid Property

Property to be measured	Range of results at 20°C	Test method
Density	Less than 1.10 g/ml	Mud density balance
Sand content	Less than 3 %	Sand content determination
Viscosity	30-50s or less than 20 cP	Marsh cone method *Fann Viscometer
Shear strength (10minute gel strength) for bentonite only	1.4-10 N/m2 or 4-40 N/m2	Shearometer *Fann Viscometer
pH	9.5-12	pH indicator strips or electrical pH meter

i) The tests shall not be carried out until a consistent working pattern has been established, account being taken of the mixing process, any blending of freshly mixed bentonite suspension and previously used bentonite suspension and any process which may be used to remove impurities from previously used bentonite suspension. When the results show consistent behaviour, the test for shear strength and pH value may be discontinued, and tests to determine density and viscosity shall be carried out as approved by the Engineer. In the event of a change in the established working pattern tests for shear strength and pH value shall be reintroduced for a period if required.

j) Where the viscometer is specified, the fluid sample should be screened by sieve (300 µm) prior to testing.

4.2.2 Concrete

a) The concrete for bored cast-in-place piles shall be a rich coherent mix of high workability in accordance with Division 6 of these Specifications.

b) Cement complying with Division 6 shall be used and the characteristic strength shall not be less than 30 N/mm^2 (Grade 30) unless otherwise specified on the Drawings.

c) The minimum cement content in any mix placed under water or drilling mud by tremie shall not less than 350 kg/m^3.

d) The density and consistency of the concrete shall conform to the tremie casting method and the maintenance of sufficient workability (slump) of all the concrete during the casting and casing handling period, including reasonably calculated delays, shall be secured by a design mix (including the necessary retards and plasticizers) which is tested by trial mixes prior to the pile construction.

e) All relevant concrete properties such as slump, time of setting, temperature and strength shall be measured on the trial mixes.

2. Other workability tests (SCC)
.Flow, L-box , V-funnel,J-ring

4.2.3 Reinforcement

a) The reinforcement shall conform to Division 5 of these Specifications.

4.3 EXECUTION

4.3.1 General

a) The final construction procedures shall be approved by the Engineer.

b) For bored piles on land:

i) Bore and excavate down to final pile tip level without or with temporary castings. The level of water or drilling fluid inside the boreholes or casings shall at all times be at least at ground level. Where boring is carried out without casing, drilling fluid, and not water, shall be used to ensure a stable borehole. Drilling fluid shall not be let out into the environment.

ii) Control and measure the inclination dimensions and depth of the borehole by Sonic Calliper.

iii) Clean up carefully all mud or sedimentation at the bottom of borehole.

iv) Place reinforcement, concreting equipment, etc., and carry out final cleaning of pile base if required by the Engineer.

v) Concrete continuously under water or drilling fluid by use of the tremie method.

vi) Withdraw the temporary boring casing, concurrently with concreting to the specified level.

vii) Carry out integrity testing of the pile.

viii) After hardening, the top surface of the concrete pile shall be chipped off to reach sound concrete.

c) Approval of construction method

i) The Contractor shall submit to the Engineer for approval the construction method he proposes, including information on boring equipment, Sonic Calliper equipment, materials, methods of work, control of quality and bearing capacity and name of subcontractor, if any. The Contractor shall submit references from similar jobs carried out by him or his subcontractor.

ii) The Contractor shall carry out a detailed program and establish a procedure for the pile construction in accordance with the above information.

iii) The detailed program shall contain all information as requested on material, equipment, methods of work etc., and be approved in writing by the Engineer.

iv) Such approval shall not relieve the Contractor of his responsibility for the pile construction.

4.3.2 Setting out piles

a) For piles on land, the Contractor shall check and agree with the Engineer the location of each pile immediately prior to the commencement of boring. The location of temporary casing, or the drill string, shall be checked after the commencement of boring, but not later than when boring has reached the top of the first stiff layer. This second location check will be carried out on all piles or on a selected number of piles, at the discretion of the Engineer. The Total Station instrument is used to survey each pile point.

4.3.3 Diameter of piles

a) Diameters of the piles shall not be less than the diameters specified in the Drawings and approved by the Engineer.

4.3.4 Tolerance

a) Piles shall be bored accurately vertical or to the specified rake. The centre of the completed pile at the cut off level shall not deviate more than 75 mm from the theoretically correct position shown on the Drawings.

b) The maximum permitted deviation of the finished pile shall be 1:100 from the vertical for vertical piles.

4.3.5 Boring

a) General

i) Method of excavation shall be proposed by the Contractor and approved by the Engineer. Water or air jetting for boring of the piles shall not be allowed.

b) Boring near recently cast piles

i) Piles shall not be bored so close to other piles, which have recently been cast and contain workable or unset concrete, that a flow of concrete could be induced from or damage caused to any of the piles. Boring and excavation for a pile shall not be commenced until 24 hours after completion of any pile within a radius of 6.0 m centre to centre but not before the concrete in these piles have reached a strength of 15 N/mm^2.

ii) For each foundation to be constructed, the Contractor shall submit, for the approval of the Engineer, a pile construction sequence.

c) Temporary casings

i) Temporary casing of approved quality or an approved alternative method shall be used to maintain the stability of the pile excavation which might otherwise collapse.

ii) Temporary casings shall be free from significant distortion. They shall be of uniform cross-section throughout each continuous length. During concreting they shall be free from internal projections and encrusted concrete which might prevent the proper formation of piles.

d) Stability of pile excavation using drilling fluid

i) Where the use of drilling fluid is approved for maintaining the stability of borehole, the level of the fluid in the excavation shall be maintained so that the fluid pressure always exceeds the pressures exerted by the soils and external groundwater.

ii) Adequate temporary casing shall be used in conjunction with the drilling fluid to ensure stability of the strata near ground level until concrete has been placed. The fluid level shall be maintained at a level not less than ground level for piles on land.

iii) In the event of a rapid loss of bentonite suspension from the pile excavation, the excavation shall be backfilled without delay and the Contractor shall submit a report regarding the cause and sequences of the problem and a proposal for resolution.

iv) Instructions from the Engineer shall be obtained before excavation at that location is resumed.

e) Disposal of excavated material

i) No excavated material shall be dumped into any waterway. Excavated material, if not required by the Employer, shall be the property of the Contractor and shall be removed from the Site and dumped at permissible dumping areas or taken to the

Contractor's dumping areas on land. The Contractor shall be fully responsible for costs involved in removing the excavated material to spoil including claims arising from the use of private land.

f) Spillage and disposal of bentonite

i) All reasonable steps shall be taken to prevent the spillage of bentonite suspension on the Site in areas outside the immediate vicinity of bore. Discarded bentonite shall be removed from the Site. Any disposal of bentonite shall comply with the regulations of the local controlling authority.

g) Pumping from boreholes

i) Pumping from boreholes shall not be permitted.

h) Cleanliness of pile bases

i) On completion of boring, loose, disturbed or remoulded soil shall be removed from the base of the pile. Any clay material at the base of the pile shall be removed, and the materials brought up during cleaning shall be continuously sampled.

ii) Following insertion of reinforcement, sonic and all equipment required for concreting of the pile, additional cleaning shall be carried out to remove debris, clay and loose or remoulded soil which may have accumulated at the base of the pile. Such cleaning shall continue until the level of the pile base is the same as that measured immediately after completion of the first cleaning, this final cleaning shall not be commenced until all preparations for concreting are complete.

iii) At the discretion of the Engineer and where he is satisfied that the method proposed by the Contractor avoids accumulation of additional debris at the base of the pile, this final cleaning may be omitted.

iv) Any empty borehole which may remain shall be protected and carefully backfilled as soon as possible in accordance with this Specification.

i) Inspection

i) Immediately on completion of boring, the elevation of the base of the borehole shall be measured at several points around the perimeter and at the centre of the pile.

ii) The procedure and equipment for measuring shall be approved by the Engineer. The base of the borehole shall be measured in the same way after each cleaning of the pile base, and after insertion of the reinforcement and sonic into the borehole.

iii) If boring without casing, the diameter of borehole for each pile shall be measured by sonic calliper, or equivalent apparatus, prior to the placing of concrete. The measurement shall be done by the Contractor using calibrated and approved equipment.

iv) As a minimum, sonic calliper measurements shall be taken on two axes at right- angles to each other on the centre of the top of the pile. Depending on the inclination

of the borehole, additional measurements shall be taken at suitable offsets along one or both axes, measured at the top of the pile, in order to confirm the maximum and minimum diameters of the borehole at all elevations. The number of additional offsets shall be approved by the Engineer, and shall as a minimum include measurements corresponding to the centre of the base of the borehole.

v) The results of sonic calliper measurements and measurements of the elevation of the pile base shall be presented by the Contractor on diagrams showing clearly the scale of the measurements and the borehole diameters with corresponding elevations, the corresponding theoretical pile dimensions and the obtained tolerances.

j) Final pile toe level

i) The final pile toe level shall be as indicated on the Drawings or as instructed by the Engineer after his inspection of the earth layers penetrated by the pile, as indicated below.

ii) During the boring of the pile, the Contractor shall record a ″boring log" indicating depths and types of the various soil layers encountered. Disturbed samples shall be submitted to the Engineer as requested.

iii) The Contractor shall allow for carrying out sampling and tests to check bottom soils and excavation geometry and shall not be reimbursed for possible delays.

k) Obstructions

i) Where boulders or other obstructions render it impossible to bore the pile, excavation operations inside the pile casing shall be carried out to remove obstructions. Removal of all obstructions shall be carried out at no extra cost.

4.3.6 Placing reinforcement

a) The reinforcement shall be carried out as indicated on the Drawings.

b) Reinforcement in the form of a cage shall be assembled with additional support, such as spreader forks and lacings, necessary to form a rigid cage. Hoops, links or helical reinforcement shall fit closely around the main longitudinal bars and be bound to them by approved wire, the ends of which shall be turned into the interior of the pile.

Reinforcement shall be placed and maintained in position.

c) The cover to all reinforcement shall be not less than 75 mm.

d) Joints in longitudinal steel bars shall be permitted. Joints in reinforcement shall be such that the full strength of the bar is effective across the joint and shall be made so that there is no relative displacement of the reinforcement during the construction of the pile.

e) Reference is made to Sub-Clause 12 Integrity test of this Specification regarding pipes to be installed for integrity test and Section 4.4 Pile Load Testing regarding the special requirements of test piles.

f) Provide Stiffner Reinforcement of 16mm Diameter of Grade 460 Tor steel at intervals of 2m throughout the pile

4.3.7 Placing concrete

a) General

i) The method of placing and the workability of the concrete shall be such that a continuous monolithic concrete shaft of the full cross-section is formed.

ii) As soon as practicable after the boring has been completed, the concrete shall be placed continuously, and without such interruption as would allow the previously placed batch to have hardened. In this respect the Contractor shall submit details of his contingency plans, standby plant etc. to be utilized in the event of an equipment failure. Concrete shall be placed by tremie method.

iii) Before placing concrete, measures shall be taken to ensure that there is no accumulation of silt or other material at the base of the bore.

iv) The Contractor shall take all precautions in the design of the mix and placing of the concrete to avoid arching of the concrete in a casing. No spoil, liquid or other foreign matter shall be allowed to contaminate the concrete.

b) Workability of concrete

i) Slump measured at the time of discharge into the pile boring shall not be less than 180 mm.

c) Testing of tremie method

i) At least 30 days prior to the proposed date for commencement of supply of the concrete for tremie operations, the Contractor shall submit to the Engineer for approval full details of its proposed methods.

ii) These details shall include:

a. Details of the Contractor's site supervisor who shall have a demonstrated previous experience with tremie concrete applications.

b. The proportions of the concrete mix as designed by the Contractor.

c. Details of any admixtures proposed to be used.

d. Details of tremie equipment proposed to be used and methods of placement to be adopted.

iii) Tremie concrete placement trials and testing of the tremie concrete prior to commencement shall be carried out. If the concrete in the tremie concrete trials fails to meet the specification requirements, the Contractor shall modify at his own cost the equipment or methods and resubmit the details as described above, to the Engineer for approval.

iv) Tremie pipe sare with drawn with the rises of concrete,

v) But,should be maintained the embedded length of Tremie pipe in concrete minimum 2.5m through out the concreting process.

vi) Withdrawal of Tremie pipe is done by dismantling them from top, section by section.

vii) Concrete should be poured up to minimum1m above from the cut off level of the pile.

viii) O rings may have to be inserted to the joints of the Tremie pipes to ensure the adequate water tightness

d) Placing concrete under water or drilling fluid

i) Placement of tremie concrete shall not commence until full evidence of successful trials of tremie concrete placement methods and the testing of the concrete is provided to the Engineer.

ii) The mixing, transport, and placement methods for the permanent works shall be the same as for the trials and no change shall be made to the mix and placement procedures without approval from the Engineer.

iii) Concrete to be placed under water or drilling fluid shall be placed by tremie. It shall not be discharged freely into the water or drilling fluid.

iv) Before placing concrete, measures shall be taken to ensure that there is no accumulation of silt or other material at the base of the borehole and the Contractor shall ensure that heavily contaminated bentonite suspension, which could impair the free flow of concrete from the pipe of the tremie, has not accumulated in the bottom of the hole.

v) A sample of the bentonite suspension shall be taken from the base of the borehole using an approved sampling device. If the density of the suspension exceeds 1.25 g/ml, the placing of concrete shall not proceed. In this event the Contractor shall modify or replace the bentonite to meet the Specification requirements.

vi) Following the final cleaning of the base of the borehole, concreting shall commence within 15 minutes. If the delay is longer, then further cleaning must be carried out before concreting starts.

vii) The concrete shall be placed in such a manner that segregation does not occur.

viii) During and after concreting care shall be taken to avoid damage to the concrete from pumping and dewatering operations.

ix) The hopper and pipe of the tremie shall be clean and watertight throughout. The pipe shall extend to the base of the borehole and a sliding plug or barrier shall be placed on the pipe to prevent direct contact between the first charge of concrete in the tremie pipe and the water or drilling fluid. The pipe shall at all times penetrate the concrete which has previously been placed and shall not be withdrawn from the concrete until completion of concreting.

x) The bottom of the tremie pipe shall be kept a minimum of 2.0 m under the surface of concrete. The level of the concrete in the pile and in the tremie pipe must be checked

at regular intervals. At all times a sufficient quantity of concrete shall be maintained within the pipe to ensure that the pressure from it exceeds that from the water or drilling fluid. The internal diameter of the pipe of the tremie shall be not less than 200 mm for concrete made with 20 mm aggregate. It shall be so designed that external projections are minimized, allowing the tremie to pass through reinforcing cages without causing damage. The internal face of the pipe of the tremie shall be free from projections.

g) Concrete quantities and levels

i) On the basis of the sonic calliper results, estimated concrete levels after each concrete batch are to be calculated. During concreting, concrete levels shall be measured in the pile and in the tremie pipe, at regular intervals, and not less than for every 10 m^3 of concrete discharged into the pile. The Contractor shall, in advance, produce diagrams in a format approved by the Engineer, on which the measured and estimated levels, diameter and volumes may be plotted during concreting. The average diameter of the borehole during concreting shall be calculated from the volume of concrete and rise in level between each measurement.

e) Supervision

i) The execution of the pile concreting shall be supervised by a qualified person of the Contractor's staff, who will keep records on the relation between quantity of concrete used, level of concrete and withdrawal of casing.

4.3.8 Extraction of temporary casing

a) Workability of concrete

i) The plant and methods of extraction shall be subject to the approval of the Engineer. Temporary casings for bored cast in place piles shall be extracted carefully to the satisfaction of the Engineer, whilst the concrete within them remains sufficiently workable to ensure that the concrete is not lifted.

b) Concrete level

i) During extraction, a sufficient quantity of concrete shall be maintained inside the casing to overcome the pressure from external water, soil or drilling fluid and to ensure that no reduction in section or contamination of the pile takes place.

ii) The toe of the temporary casing shall be kept a minimum 2.0 m under the outlet of the tremie.

iii) No concrete shall be placed in the borehole once the bottom of the casing has been lifted above the top of the concrete; it shall be placed continuously as the casing is extracted until the desired head of concrete is obtained.

iv) Adequate precautions to the satisfaction of the Engineer shall be taken in all cases to avoid excess heads of water or drilling fluid could be caused as the casing is withdrawn because of the displacement of water or drilling fluid by the concrete as it flows into its final position against the wall of the shaft.

c) Vibrating Extractors

i) The use of vibrating casing extractors shall not be permitted.

d) Reinforcement Cage

i) During concreting and pulling the casing the reinforcement cage shall be secured against uplift and the top shall be kept under close inspection.

4.3.9 Completion of Concreting

a) The pile shall be concreted with certain over height to allow for chiselling back to the required cut-off level and to ensure sound, uncontaminated concrete in the head of the pile. At least 500 mm top concrete shall be removed unless otherwise noted in the Drawing.

b) After each pile has been cast, any hole remaining shall be protected and shall be carefully backfilled as soon as possible with approved material.

4.3.10 Control methods

a) Normal control of construction materials shall be carried out in accordance with Division 6and Division 5 of these Specifications.

4.3.11 Integrity test

All piles should be covered by Sonic Impulse Testing or Low Strain Impact Integrity Testing. Basically from total number of each piles 10 % should be covered by Sonic Impulse Testing and balance all should be covered by Low Strain Impact Integrity Testing.

Sonic Impulse Testing

Ten percent (10 %) of all bored piles shall be tested to determine integrity by Sonic Impulse Testing. The tests shall be carried out by an approved method and approved specialist firm.

a) General

i) The integrity of each pile shall be examined prior to acceptance of the pile into the Permanent Works.

ii) At least 30 days prior to the commencement of the integrity test, the Contractor shall submit the testing method, equipment, and testing company to the Engineer for his approval.

iii) The Contractor shall demonstrate how the results obtained from the tests are to be interpreted in order that irregularities can be identified.

iv) The equipment of tests shall be certified with recent calibration/set up of the instruments and with curriculum vitae of those using the instruments and interpreting the results.

b) Criteria for acceptance

i) Criteria for acceptance or non-acceptance of the piles shall be established before starting the test in agreement between the Engineer and the Contractor, based on specifications and experience records from the equipment supplier and the specialized company performing the testing, and other available information.

ii) In cases where there is doubt if the pile can be accepted based on the test results an impartial expert appointed by the Engineer shall decide.

c) Installation of pipes installation for integrity test

i) 4 nos. of vertical 50 mm exactly parallel steel pipes shall be inserted and fastened to the inside of the reinforcement cage of up to 1.20 m diameter piles before concreting, in the whole length of the pile and spaced at 90°. For 1.50 m and 2.00 m diameter piles, 6 nos. of 50 mm pipes, spaced at 60°, shall be used. The diameter of pipe may be altered to suit instrument size.

ii) The elevation of the bottom ends of the pipes must be such that they are embedded in concrete, and do not protrude below the base of the pile.

iii) The parallel steel pipes shall be supported and braced securely so that they maintain their position during the subsequent operations.

iv) The 50 mm pipes, installed for sonic logging test, shall be arranged so that they can be used for testing of the soil below the pile toe level and for compaction grouting. The bottom of the pipes shall be closed with a neoprene plastic plug or similar, which can be removed with boring equipment prior to soil testing.

d) Testing

i) The Contractor shall carry out the test by a specialized experienced company approved by the Engineer for ten percent (10%) of all bored piles or as directed by the Engineer.

ii) Unless otherwise directed or approved by the Engineer, integrity tests shall not be carried out until 7 days or more have elapsed since pile casting. And testing shall be undertaken on pile heads before steel reinforcement for pile caps is placed.

iii) The pile head shall be clean and free from water at the time of testing. All laitance and contaminated concrete or concrete overspill shall be trimmed from each pile prior to the commencement of testing.

iv) The testing shall be carried out in the presence of the Engineer.

e) Reporting

i) The Contractor shall submit to the Engineer the test results, associated interpretive report and certificate for each tested pile within 10 days of the completion of each test.

ii) The interpretation of test results shall be carried out by competent specialist engineers.

f) Anomalies

i) If any anomalies, which indicate unacceptable weaknesses in the concrete, are reported as a result of integrity testing, the Contractor shall perform core drilling for

sampling and laboratory testing to prove if the quality and bearing capacity of the concrete are adequate. The program for necessary core drilling and testing shall be approved by the Engineer.

ii) If such anomalies are shown to be detrimental to the performance of the pile, remedial measures shall be approved by the Engineer and undertaken by the Contractor to rectify this.

iii) No covering over of the piles shall occur until the Engineer is satisfied with the results of the testing and any remedial works.

Low Strain Impact Integrity Testing

Piles are not covering by the Sonic Impulse Testing should be covered by the Low Strain Impact Integrity Testing. Generally, above mentioned strategies should follow for the general, reporting and anomalies, other than that contractor should follow the guidelines provided by the CIDA by the Specification for the board and cast in-situ reinforcement concrete piles in the latest version.

Contractor should get approval for the method statement which should clearly defined the procedures going to follow in testing, pile head preparation method, etc. prior to at least 30 days, before start the testing.

4.3.12 Temporary Support

a) The Contractor shall ensure that piles are temporarily braced or stayed to prevent loosening of the piles in the ground and to ensure that no damage resulting from oscillation, vibration or movement of any free-standing pile length can occur.

4.3.13 Records

a) The Contractor shall keep records as indicated below of the installation of each pile and shall submit two signed copies of these records to the Engineer not later than noon of the next working day after the pile was installed. The signed records shall form a record of the work. The following data are required:

1. Contract
2. Pile reference number (location)
3. Pile type
4. Nominal cross-sectional dimensions or diameter
5. Standing ground water level
6. Date and time of boring
7. Date and time of concreting
8. Ground level at commencement of installation of pile
9. Working level
10. Depth from working level to pile toe

11. Intended toe level
12. Depth from working level to pile head level
13. Length of temporary casing
14. Length of permanent casing
15. Supplementary field boring results below pile toe
16. Soil samples taken and in situ tests carried out
17. Standing water level
18. Length and details of reinforcement
19. Concrete mix
20. Volume of concrete supplied to pile where this can be measured in practice
21. Records of compaction grouting
22. Sonic calliper records and measurements of pile tip elevation
23. Records of concrete levels and pile diameter
24. All information regarding obstructions, delays and other interruptions to the sequence of work

b) The Contractor shall, for each pile, produce a diagram in a format approved by the Engineer, with a time scale on one axis and elevations below ground level on the other axis. The diagram shall show the progress of pile boring, concreting, interruptions and delays and as much as possible of all other operations connected with pile installation and the information listed above as may appropriately be shown on such a diagram.

c) Records of sonic logging and core drilling if required shall be supplied without delay after these tests are done.

4.3.14 Measures in Case of Rejected Piles

a) If any pile is found unsatisfactory in the opinion of the Engineer for utilization in the structure, it shall be cut off below the pile caps unless otherwise directed by the Engineer.

b) The pile shall be replaced as directed by the Engineer. All extra expenses shall be borne by the Contractor.

c) When the safe bearing value of any pile is found by test to be less than the design load, longer piles or additional piles shall be installed.

4.4 PILE LOAD TESTING

MAINTAINED LOAD TEST

4.4.1 General

a) Load tests are required on the designated test piles indicated on the Drawings.

b) Test piles shall be incorporated into the Permanent Works, unless in the Engineer's opinion these piles have been damaged by testing, in which case the test piles shall be withdrawn and replaced at the expense of the Contractor.

c) The pile bearing capacity shall be investigated by the application of an axial load or force.

d) The Contractor shall submit the testing company with the type of test proposed to the Engineer for approval at least 30 days prior to pile testing.

e) Definitions

Definitions shall be as given below

i) Allowable load

The load which may be safely applied to a pile after taking into account its ultimate bearing capacity, negative skin friction, pile spacing, overall bearing capacity of the ground below and allowable settlement.

ii) Compression pile

A pile which is designed to resist an axial force such as would cause it to penetrate further into the ground.

iii) Kentledge

The dead weight used in a loading test.

iv) Maintained load test

A loading test in which the increment of load is held constant either for a defined period of time or until the rate of movement (settlement or uplift) falls to a specified value.

v) Pilot pile

A pile installed before the commencement of the main piling works or specific part of the Works for the purpose of establishing the suitability of the chosen type of pile and for confirming its design, dimensions and bearing capacity by "Ultimate Test".

vi) Proof load

A load applied to a selected working pile to confirm that it is suitable for the load at the settlement specified. A proof load should not normally exceed 150% of the working load on a pile.

vii) Reaction system

The arrangement of kentledge, piles, anchors or rafts that provides a resistance against

which the pile is tested.

viii) Raking pile

A pile installed at an inclination to the vertical.

ix) Tension pile

A pile which is designed to resist an axial force such as would cause it to be extracted from the ground.

x) Test pile

Any pile to which a test is applied.

xi) Ultimate bearing capacity

The load at which the resistance of the soil becomes fully mobilized.

xii) Ultimate Test

Ultimate test shall be carried out on the pilot piles only, and minimum applied load shall be 2.0 times of working load as show on the Drawings.

xiii) Working load

The load which the pile is designed to carry.

xiv) Working pile

One of the piles forming the foundation of a structure.

f) Schedule for Load Testing

ii) Load tests for working piles shall be carried out on the designated piles on the drawings.

iii) The maximum load for proof test shall be not exceed 150% of working load, unless otherwise directed by the Engineer.

g) Safety Precautions

ii) When preparing for, conducting and dismantling a pile test the Contractor shall carry out the requirements of the various regulations and other statutory instructions that are applicable to the work for the provision and maintenance of safe working conditions, and shall in addition make such other provision as may be necessary to safeguard against any hazards that are involved in the testing or preparations for testing.

iii) All tests shall be carried out only under the direction of an experienced and competent supervisor who is conversant with the test equipment and test procedure. All personnel operating the test equipment shall have been trained in its use.

iv) Where kentledge is used the Contractor shall construct the foundations for the kentledge and any cribwork, beams or other supporting structure in such a manner that there will not be differential settlement, bending or deflection of an amount that constitutes a hazard to safety or impairs the efficiency of the operation. The kentledge shall be adequately bonded, tied or otherwise held together to prevent it falling apart, or becoming unstable because of deflection of the supports.

v) The weight of kentledge shall be greater than the maximum test load and if the weight is estimated from the density and volume of the constituent materials an adequate factor of safety against error shall be allowed.

vi) In all cases the Contractor shall ensure that when the hydraulic jacks and load measuring devices are mounted on the pile head the whole system shall be stable up to the maximum load to be applied. Means shall be provided to enable dial gauges to be read from a position clear of the kentledge stack or test frame in conditions where failure in any part of the system due to overloading, buckling, loss of hydraulic pressure and so on might constitute a hazard to personnel.

vii) The hydraulic jacks, pumps, hoses, pipes, couplings and other apparatus to be operated under hydraulic pressure shall be capable of withstanding a test pressure of 1.5 times the maximum working pressure without leaking.

viii) The maximum test load or test pressure expressed as a reading on the gauge in use shall be displayed and all operators shall be made aware of this limit.

4.4.2 Execution

e) Preparation of Working Pile to be Tested

ii) If a test is required on a working pile the Contractor shall cut down or otherwise prepare the pile for testing as required by the Engineer.

f) Reaction systems

ii) Compression tests shall be carried out using kentledge, tension piles or specially constructed anchorages. Anchorages may be made by concreting suitable steel joists into anchor piles, or by using driven multiple steel piles as tension piles.

iii) Where kentledge is to be used, it shall be supported on cribwork disposed around the pile head so that its centre of gravity is on the axis of the pile. The bearing pressure under supporting cribs shall be such as to ensure stability of the kentledge stack, if necessary, the Contractor shall provide a pile support system to the kentledge. Kentledge shall not be carried directly on the pile head, except when directed by the Engineer.

iv) Working piles shall not be used as reaction piles without approval from the Engineer.

v) Where working piles or separate anchor piles are used as reaction piles their movement, shall be measured to within an accuracy of 0.5 mm.

vi) Where kentledge is used for loading vertical piles in compression, the distance from the edge of the test pile to the nearest part of the crib supporting the kentledge stack in contact with the ground shall be not less than 1.3 m.

vii) The centre to centre spacing of vertical reaction piles, including working piles used as reaction piles, from a test pile shall be not less than 3 times the diameter of the test pile or the reaction piles or 2 m, whichever is the greatest, unless otherwise directed by the Engineer.

viii) Where a pile to be tested has an enlarged base, the same criteria shall apply with regard to the pile shaft, with the additional requirement that the surface of no reaction pile shall be closer to the base of the test pile than one half of the enlarged base diameter.

ix) Where ground anchors are used to provide a test reaction for loading in compression, no part of the section of the anchor transferring load to the ground shall be closer to the test pile than 3 times the diameter of the test pile.

x) The size, length and number of the piles or anchors, or the area of the rafts, shall be adequate to transmit the maximum test load to the ground in a safe manner without excessive movement or influence on the test pile.

xi) The method employed in the installation of any reaction piles, anchors or rafts shall be such as to prevent damage to any test pile or working pile.

xii) The loading arrangement used shall be designed to transfer safely to the test pile the maximum load required in testing. Full details shall be submitted to the Engineer prior to any work related to the testing process being carried out on the Site.

g) Equipment for Applying Load

ii) The equipment used for applying load shall consist of one or more hydraulic rams or jacks. The total capacity of the jacks shall be at least equal to the required maximum load. The jack or jacks shall be arranged in conjunction with the reaction system to deliver an axial load to the test pile. The complete system shall be capable of transferring the maximum load required for the test.

h) Load Measurement and Instrumentation for Pilot Pile

ii) Suitable approved measuring devices for determining the load on the pile shall be supplied by the Contractor. Certificates of calibration shall be supplied to the Engineer.

i) Adjustability of Loading Equipment

ii) The loading equipment shall be capable of adjustment throughout the test to obtain a smooth increase of load or to maintain each load constant at the required stages of a maintained loading test.

j) Measuring Movement of Pile Heads -

Maintained load test

ii) In a maintained load test, movement of the pile head shall be measured by one of the methods specified in following vii), viii) and ix).

iii) An optical or any other levelling method by reference to an external datum may be used.

iv) Where a level and staff are used, the level and scale of the staff shall be chosen to enable readings to be made to within an accuracy of 0.5 mm. A scale attached to the pile or pile cap may be used instead of a levelling staff.

v) At least two datum points shall be established on permanent objects or other well- founded structures, or deep datum points shall be installed. Each datum point shall be situated so that only one setting up of the level is needed.

vi) No datum point shall be affected by the load testing or other operations on the site.

vii) Where another method of levelling is proposed this shall be approved in writing.

viii) Independent reference frame -

An independent reference frame may be set up to permit measurement of the movement of the pile. The supports for the frame shall be founded in such a manner and at such a distance from the test pile, kentledge support cribs, reaction piles, anchorages and rafts that movements of the ground in the vicinity of the equipment does not cause movement of the reference frame during the test which will affect the required accuracy of the test.

Check observations of any movements of the reference frame shall be made by levelling or other method approved by the Engineer and a check shall be made of the movement of the pile head relative to an external datum during the progress of the test.

In no case shall the supports be less than three test pile diameters or 2 m, whichever is the greater, from the centre of the test pile.

The measurement of pile movement shall be made by two dial gauges rigidly mounted on the reference frame that bear on surfaces normal to the pile axis fixed to the pile cap or head. Alternatively, the gauges may be fixed to the pile and bear on surfaces on the reference frame. The dial gauges shall be placed in diametrically opposed positions and be equidistant from the pile axis. The dial gauges shall enable readings to be made to within an accuracy of 0.1 mm.

The reference frames shall be protected from sun and wind.

ix) Reference wire –

A reference wire shall be held under constant tension between two foundations formed as in the method described in (iii) above. The wire shall be positioned against a scale fixed to the pile and the movement of the scale relative to the wire shall be determined.

Check observations of any movements of the supports of the wire shall be made or a check shall be made of the movement of the pile head as described in the method in (ii) above.

Readings shall be taken to within an accuracy of 0.5 mm. The

reference wire shall be protected from sun and wind.

x) Other Methods –

The Contractor may submit for approval any other method for measuring the movement of pile heads.

k) Protection of Testing Equipment

ii) Throughout the test period all equipment for measuring load and movement shall be protected from the weather.

iii) Construction equipment and persons who are not involved in the testing process shall be kept at a sufficient distance from the test to avoid disturbance to the measurement apparatus.

l) Supervision

m) The Contractor shall give the Engineer at least 24 hours' notice of the commencement of the test.

ii) During the progress of a test, the testing equipment and all records of the test shall be available for inspection by the Engineer.

i) Test Procedure

i) The loading and unloading shall be carried out in stages as shown in Table 4.1 or as required by the Engineer.

ii) Following each application of an increment of load the load shall be held for not less than the period shown in Table 4.1 or until the rate of settlement is less than 0.25 mm/hr and is slowing down. The rate of settlement shall be calculated from the slope of the curve obtained by plotting values of settlement versus time and drawing a smooth curve through the points.

iii) Each stage of unloading shall proceed after the expiry of the period shown in Table 4.1.

iv) For any period when the load is constant, time and settlement shall be recorded immediately on reaching the load and at approximately 15 min intervals for 1 hour, at 30 min intervals between 1 hour and 4 hours, and at 1 hour intervals between 4 hour and 12 hours after the application of the increment of load.

v) The Engineer may require that the full loading or any portion of the loading, be maintained on the pile for periods longer than shown in Table 4.1.

Table 4.1 Loading Pattern

Load, percentage of working load	**Minimum time of holding load**
25 %	1 hr
50 %	1 hr
75 %	1 hr
100 %	1 hr
75 %	10 min
50 %	10 min
25 %	10 min
0 %	1 hr
100 %	6 hr
125 %	1 hr
150 %	6 hr
125 %	10 min
100 %	10 min
75 %	10 min
50 %	10 min
25 %	10 min
0 %	1 hr

n) Presentation of Results

ii) A summary in writing to the Engineer, unless otherwise directed within 24 hours of the completion of the test, which shall give for a proof test by maintained load test for each stage of loading, the period for which the load was held, the load and the maximum settlement or uplift recorded.

iii) The completed schedule of recorded data as specified following within 7 days of completion of the test.

1. General

- Site location
- Contract identification
- Proposed structure
- Contractor
- Engineer
- Client
- Date of test

2. Pile details

- Identification (number and location of the test pile)
- Position relative to adjacent piles
- Brief description of location
- Ground level at pile position
- Head level at which test load is applied
- Type of pile
- Shape and size of cross-section of pile
- Base details
- Head details
- Length in ground
- Level of toe
- Any permanent casing or core
- Concrete mix
- Aggregate type and source
- Cement type
- Slump
- Cube test results for pile
- Reinforcement
- Dates and times of boring, concreting of test pile, cap and adjacent piles
- Type of equipment used and method of boring
- Temporary casing, method of installation and extraction
- Strata encountered during boring
- Water encountered during boring
- Method of placing concrete and conditions pertaining
- Volume of concrete placed
- Concrete level before and after extraction of casing

AASL

3. Test procedure
   - Weight of kentledge
   - Tension pile, ground anchor or compression pile details
   - Plan of test arrangement showing position and distances of kentledge supports, rafts, tension or compression piles and reference frame to test pile
   - Jack capacity
   - Method of load measurement
   - Method(s) of penetration or uplift measurement
   - Proof test by maintained loading
   - Relevant dates and times

4. Test results
   a. In tabular form
   b. In graphical form: load plotted against settlement, load and settlement plotted against times
   c. Ground heave

5. Site investigation
   a. Site investigation report number
   b. Bored hole references

o) Completion of Test

ii) On completion of a test all equipment and measuring devices shall be dismantled, checked and either stored so that they are available for use in further tests or removed from the Site.

iii) Kentledge and its supporting structure shall be removed from the test pile and stored so that they are available for use in further tests or removed from the Site.

iv) On completion of a preliminary test, tension piles and ground anchors shall be cut off below level, removed from the Site and the ground made good with approved material as specified.

v) On completion of a test, the test pile cap, if formed in concrete, shall be broken off and the resulting material disposed of off the Site. If the pile cap is made of steel it shall be cut off and stored so that it is available for use in further tests or removed from the Site.

AASL

HIGH STRAIN DYNAMIC TESTING OF PILES High

i) The Contractor may propose the use of High Strain Dynamic Testing for piles, to estimate the bearing capacity of pile. The Contractor shall provide sufficient evidence for the Engineer to validate the method of testing. High Strain Dynamic Testing shall be carried out by specialist firm.

ii) Contractor should follow guideline provided by the latest version of the CIDA specification for bored and cast in-situ reinforced concrete piles.

iii) The drop weight must be guided by a frame to ensure correct alignment.

iv) The Contractor shall ensure that no damage will cause to the pile. Any damage caused must be repaired by the Contractor to the satisfaction of the Engineer.

SECTION - 7
FORM OF BID

FORM OF BID

Name of Contract: **Navigational Service Complex at Colombo International Airport, Ratmalana (CIAR)**

To: **Chairman, Airport and Aviation Services (Sri Lanka) (Private) Limited**

Gentlemen:

1. Having examined the Standard Bidding Document - Procurement of Works – Major Contracts [ICTAD/SBD/02 - Second Edition, January 2007 and addendum 1 issued in October 2009], Specifications, Conditions of Contract, Drawings and Bills of Quantities and Addenda for the execution of the above-named Works, we the undersigned, offer to execute and complete such Works and remedy any defect therein in conformity with the aforesaid Conditions of Contract, Specifications, Drawings, Bills of Quantities and addenda for the sum of Sri Lankan Rupees ……
……
……(LKR ……) or such other sums as may be ascertained in accordance with the said Conditions.

2. We acknowledge that the Contract Data forms part of our Bid.

3. We undertake, if our Bid is accepted, to commence the Works as soon as is reasonably possible after the receipt of the Engineer's notice to commence, and to complete the whole of the Works comprised in the Contract within the time stated in the Contract Data.

4. We agree to abide by this Bid until the date specified in ITB Clause 16 …… *[insert date]*, and it shall remain binding upon us and may be accepted at any time before that date.

5. Unless and until a formal Agreement is prepared and executed this Bid, together with your written acceptance thereof, shall constitute a binding Contract between us.

6. We understand that you are not bound to accept the lowest or any bid you may receive and that you reserve the right to reject any or all Bids or to cancel the total Bidding Process without assigning reasons in the best interest of the company.

7. We certify/confirm that we comply with the requirements as per ITB Clause 3 and 4 of the bidding documents.

Dated this …….. day of……..2024

Signature ……..in the capacity of ……

duly authorized to sign bids for and on behalf of ……
[in block capitals or typed]

Signature : ……

Name : ……

Designation : ……

Address : ……

……

Witness : ……

SECTION - 8
BILL OF QUANTITIES

Note:-

- ***Bidders are advised to include the VAT Component separately as shown in the Summary and the VAT Component should not carry to the Form of Bid***

- ***Any discount offer will not be considered for Provisional Sum Items.***

BILL OF QUANTITIES

NAVIGATIONAL SERVICE COMPLEX AT CIAR, RATMALANA

Bill No : 01 - PRELIMINARIES

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
1.0	PRELIMINARIES				
1.1	Allow sum for Insurance, stamp duty, Performance Security and Advance Payment Guarantee.	**Provisional**		**sum**	**19,000,000.00**
1.2	Allow sum for construction management services and quality control process *(Details of services to be provided by the contractor should meet the minimum requirement specified in the Bidding Data and Contract Data)*	month	18		
1.3	Allow sum for constructing, furnishing, maintaining and dismantling contractor's site office, Stores with a temporary fence and a gate in accordance with good construction practice and subject to the approval of the Engineer, providing electricity and water supply for the use of construction works, protection and storage of materials and plant and providing sanitary facilities for contractor's staff.	Item	Allow	Sum	
1.4	Allow sum to properly barricade the construction area with Zn/Al subject to the approval of the Engineer.(Rate to include dismantling work)	Item	Allow	Sum	
1.5	Allow sum to obtain security passes for airport access.	**Provisional**		**Sum**	**500,000.00**
	PRELIMINARIES CARRIED TO SUMMARY				

BILL OF QUANTITIES

NAVIGATIONAL SERVICE COMPLEX AT CIAR, RATMALANA

Bill No : 02 - DEMOLITION

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
2.0	DEMOLITION ***Note :*** *Rate for Demolition shall include for the following* *(a) Contractor is requested to acquaint himself regarding the adjoining properties, access, extent of work to be done, possible methods of demolition, existing services, reusable materials etc. prior to the commencement of Demolition works.* *(b) Contractor shall ensure safety measures in all aspects.* *(c) Shifting, relocation and connection to the existing services to be executed to the approval of the Engineer.* *(d) All reusable materials should stack carefully and hand over to the client and all debris to be removed from site.* *(e) All debris shall be cleared away from the building on a regular basis without causing any nuisance, health hazard and the like by the Contractor.* *(f) All materials derived from the demolition works should not be used in the proposed work without prior written approval or written authority from the Engineer .* *(g) The Contractor shall protect all existing structures* and services against any damage. *(h) The Contractor shall prevent smoke, dust, fumes, spillage and other harmful activities that could cause health hazards and nuisance generally.* *(i) Provision of all necessary temporary measures including but not necessarily limited to diversions, signage, indicators within and outside the site for proper control of vehicular traffic.* *(j) Making good to suit existing of all disturbed works as per the Engineer's requirement.* *(k) Provision for rectification of any unexpected damages or interruption of any services and any temporary arrangements.*				
2.1	Demolition of 3.5 m x 6.2 m size *(approximately)* public toilet as directed by the Engineer.	Item	Allow	Sum	
2.2	Demolition of 5.4 m x 7.2 m size *(approximately)* two storied building as directed by the Engineer.	Item	Allow	Sum	
2.3	Removing of 9.2 m x 3.6 m size *(approximately)* GI shed as directed by the Engineer.	Item	Allow	Sum	
2.4	Removing of lamp post with foundation, cables,etc.	nos	3		
2.5	Removing of telephone post with foundation, cables, etc.	nos	3		
2.6	Removing of CCTV camera post with camera, foundation, cables, etc.	nos	2		
2.7	Removing of concrete road kerb with around concrete or any other laid material as directed by the Engineer.	m	54		
2.8	Removing of chain link fence with concrete post, foundation,etc.	m	33		
2.9	Removing or shifting manhole with service line and complete as directed by the Engineer. (Rate to include any earthwork, concrete work,form work, reinforcement work, pipe work, DI cover,etc)	Item	Allow	Sum	
2.10	Allow sum for any other demolition works which not specified in the BOQ but required for proper completion to approval.	**Provisional**		**Sum**	**700,000.00**
	DEMOLITION CARRIED TO SUMMARY				

BILL OF QUANTITIES

NAVIGATIONAL SERVICE COMPLEX AT CIAR, RATMALANA

Bill No : 03 - CIVIL WORKS

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
3.1	SITE PREPARATION , EXCAVATION & EARTHWORK *Rate for Excavation and earthwork shall include for :-* *a. Trimming sides, keeping clean and consolidating bottom of bases and trenches etc., leveling and consolidating where required under floor.* *b. Keeping all excavations free from storm or percolating water as required or directed to keep excavation dry etc.* *c. De-watering of groundwater and storm water is to be included in the item.*				
3.1.1	Removing of trees/bushes including uprooting and disposal of roots cart away from the site.				
a)	Girth 500mm - 1000mm	nos	1		
b)	Girth 1000mm - 2000mm	nos	2		
b)	Girth 2000mm - 3000mm	nos	2		
3.1.2	Excavate top soil average thickness 150mm and disposal cart away the site.	m^2	890		
3.1.3	Excavate for				
a)	Pile cap foundation (depth ; up to 2.0m)	m^3	200		
b)	Pile cap foundation (depth ; exceeding 2.0m and not exceeding 3.0m)	m^3	100		-
c)	Foundation trench (depth; not exceeding 1.0m)	m^3	60		-
d)	Footings (depth; not exceeding 1.5m)	m^3	20		-
e)	Ground sump	m^3	250		-
f)	Lift well	m^3	16		-
g)	Staircase	m^3	4		-
3.1.4	Breaking out hard asphalt layer with Aggregate Base Course or any other material in new construction area paving on excavation surfaces as directed by the Engineer.	m^2	460		-
3.1.5	Demolition of any Reinforced Concrete structure in under ground or above ground as directed by the Engineer *(Optional)*	m^3	5		-
3.1.6	Dry approved earth filling in 150mm thick layers making up levels well compacted (95% proctor compaction) and consolidated using imported earth. *(Measurement for payment - compacted volume).*	m^3	320		-
	DISPOSAL OF GROUND WATER ***(Optional)*** ***Note:-*** *De-watering of ground water where necessary including pumping out water up to the nearest drainage system or as approved by the Engineer.*				
3.1.7	Allow for De-watering.				
(a)	Pumping charges - for2" Pump.	hour	20		
(b)	Pumping charges - for 4" Pump.	hour	20		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
	PLANKING & STRUTTING ***(Optional)***				
	Note:-				
	(a) Payment for planking and strutting will be considered on actual quantities of work executed.				
	(b) Planking & strutting shall be carried out only if approved by the Engineer.				
3.1.8	Planking and strutting to excavated faces. Rate shall include for all required shoring which forms a part of planking and strutting.				
(a)	Total depth not exceeding 1.0m commencing at existing ground level and distance between opposing faces not exceeding 2.0m.	m^2	320		-
(b)	Total depth not exceeding 2.0m commencing at existing ground level and distance between opposing faces not exceeding 2.0m.	m^2	200		-
(c)	Total depth not exceeding 2.0m commencing at existing ground level and distance between opposing faces 2.0-4.0m	m^2	320		-
(d)	Total depth not exceeding 3.0m commencing at existing ground level and distance between opposing faces not exceeding 2.0m.	m^2	115		-
(e)	Total depth not exceeding 3.0m commencing at existing ground level and distance between opposing faces 2.0-4.0m	m^2	80		-
3.1.9	Anti Termite treatment on all exposed surfaces of soil under foundation and floor to approval. Warranty period shall be minimum 10 years. *(Measurement for payment - horizontal surfaces).*	m^2	1,450		-
	EXCAVATION & EARTHWORK CARRIED TO CIVIL WORK SUB SUMMARY 1				
3.2	PILING WORK				
	Note:-				
	(a) Refer Specification for bored cast in-situ concrete piling				
	(b) Payment will be made on linear meter rate for each piles as work done at site.				
	(c) Rate shall include for dewatering, bentonite application throughout the process.				
3.2.1	Allow sum for Mobilization and Demobilization.	Item	allow	sum	
3.2.2	Bored cast in-situ concrete piling from cut off level to Starting of weathered rock(SPT>50), rate shall include for boring, removal of disposal spoil away from site as directed, concreting in grade 30 and necessary tor steel (fy=460N/mm2) reinforcement (measured separately).				
a)	1000mm dia. piles (10 nos.)	m	150		
b)	900mm dia. piles (20 nos.)	m	300		
c)	750mm dia. piles (48 nos.)	m	720		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
3.2.3	Bored cast in-situ concrete piling from cut weathered rock (SPT>50) to Hard Rock. rate shall include for boring, removal of disposal spoil away from site as directed, concreting in grade 30 and necessary tor steel (fy=460N/mm2) reinforcement (measured separately).				
a)	1000mm dia. piles (10 nos.)	m	50		
b)	900mm dia. piles (20 nos.)	m	100		
c)	750mm dia. piles (48 nos.)	m	240		
3.2.4	Allow for preboring for piles from the existing ground level to pile cut off level. Contractor to provide a method for necessary covering and filling the preboring up to ground level.				
a)	1000mm dia. piles (10 nos.)	m	35		
b)	900mm dia. piles (20 nos.)	m	70		
c)	750mm dia. piles (48 nos.)	m	170		
3.2.5	Rock socketing of piles minimum depth 1.0m into rock starting at any depth.				
a)	1000mm dia. piles (10 nos.)	m	10		
b)	900mm dia. piles (20 nos.)	m	20		
c)	750mm dia. piles (48 nos.)	m	48		
3.2.6	Breaking through obstructions irrespective of pile size ***(Optional)***	hour	1		
3.2.7	Cutting off tops of piles and disposal of material up to cut off level including cutting of reinforcement where necessary.				
a)	1000mm dia. piles (10 nos.)	m	10		
b)	900mm dia. piles (20 nos.)	m	20		
c)	750mm dia. piles (48 nos.)	m	48		
3.2.8	Reinforcement (fy=460N/mm2) to piles as specification and drawing.				
(a)	High yield tor steel main bar.	ton	146.4		
(b)	High yield tor steel nominal stirrups bar.	ton	7.5		
(c)	High yield tor steel helical stirrups bar.	ton	16		
	TESTING **Note:** Allow testing for bored cast in-situ concrete piles and the number of piles to be tested as per specification and drawing. The Contractor shall submit the method of test and all technical information along with the Bid for Engineer approval.				
3.2.9	Pile integrity test.	nos.	78		
3.2.10	Pile Dynamic Analyzer (PDA) for				
(a)	1000mm dia.pile	nos.	2		
(b)	900mm dia.pile	nos.	2		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
(c)	750mm dia.pile	nos.	4		
3.2.11	Maintained Load Test (MLT) - 1000mm dia pile	nos.	1		
3.2.11a	Maintained Load Test (MLT) - 750mm dia pile	nos.	1		
3.2.12	Crosshole Sonic logging test (CSL)				
(a)	1000mm dia.pile	nos.	1		
(b)	900mm dia.pile	nos.	2		
(c)	750mm dia.pile	nos.	4		
	PILING WORK CARRIED TO SUB SUMMARY 1				
3.3	CONCRETE, FORMWORK AND REINFORCEMENT				
	CONCRETE				
3.3.1	Grade 15 for lean concrete in blinding for Pile cap,footings, foundation, etc.				
(a)	50 mm thick	m^2	148		
(b)	75 mm thick	m^2	105		
3.3.2	Grade 20 Reinforced concrete in 100mm thick finished floor & pavement slab with forming expansion joints, construction joints & etc., as directed by the Engineer.				
(a)	Floor	m^2	1368		
(b)	Pavement	m^2	288		
3.3.3	Grade 30 reinforced concrete **Sub Structure** in,				
(a)	Pile cap foundation.	m^3	318		
(b)	Tie beam & footings	m^3	74		
3.3.4	Grade **35A** water retain reinforced concrete **Sub Structure** in,				
(a)	Ground Sump	m^3	85		
3.3.5	Grade 30 reinforced concrete **Column** in,				
(a)	Level Up to +350mm	m^3	9		
(b)	Level from +350 mm to +3850 mm	m^3	35		
(c)	Level from +3850 mm to +7350 mm	m^3	29		
(d)	Level from +7350 mm to +10850 mm	m^3	29		
(e)	Level from +10850 mm to +14350 mm	m^3	29		
(f)	Level from +14350 mm to +17850 mm	m^3	29		
(g)	Level from +17850 mm to +21350 mm	m^3	9		
(h)	Level from +21350 mm to Roof slab level	m^3	10		
3.3.6	Grade 30 reinforced concrete **Beam & Slab** in,				
(a)	Level +3850mm	m3	246		
(b)	Level +7350mm	m3	222		
(c)	Level +10850mm	m3	222		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
(d)	Level +14350mm	m3	222		
(e)	Level +17850mm	m3	204		
(f)	Level +21350mm	m3	223		
(g)	Tower Roof slab	m3	61		
3.3.7	Grade 30 reinforced concrete **Staircase** in,				
(a)	Level Up to +350mm	m^3	2		
(b)	Level from +350 mm to +3850 mm	m^3	12		
(c)	Level from +3850 mm to +7350 mm	m^3	12		
(d)	Level from +7350 mm to +10850 mm	m^3	12		
(e)	Level from +10850 mm to +14350 mm	m^3	12		
(f)	Level from +14350 mm to +17850 mm	m^3	18		
(g)	Level from +17850 mm to +21350 mm	m^3	18		
3.3.8	Grade 30 reinforced concrete **Lift** in,				
(a)	Level Up to +350mm	m^3	6		
(b)	Level from +350 mm to +3850 mm	m^3	12		
(c)	Level from +3850 mm to +7350 mm	m^3	12		
(d)	Level from +7350 mm to +10850 mm	m^3	12		
(e)	Level from +10850 mm to +14350 mm	m^3	12		
(f)	Level from +14350 mm to +17850 mm	m^3	15		
(g)	Level from +17850 mm to +21350 mm	m^3	15		
(h)	Machine room floor slab	m^3	5		
(i)	Machine room roof slab	m^3	5		
3.3.9	Grade 30 reinforced concrete **Lintel** in,				
(a)	Level from +350 mm to +3850 mm	m^3	4		
(b)	Level from +3850 mm to +7350 mm	m^3	5		
(c)	Level from +7350 mm to +10850 mm	m^3	4		
(d)	Level from +10850 mm to +14350 mm	m^3	4		
(e)	Level from +14350 mm to +17850 mm	m^3	4		
(f)	Level from +17850 mm to +21350 mm	m^3	4		
(g)	Level from +21350 mm to Tower Roof slab level	m^3	1		
3.3.10	Grade 30 reinforced concrete **Sunshade** in,				
(a)	Level +3850mm	m^3	7		
(b)	Level +7350mm	m^3	7		
(c)	Level +10850mm	m^3	5		
(d)	Level +14350mm	m^3	7		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
(e)	Level +17850mm	m^3	6		
(f)	Level +21350mm	m^3	6		
3.3.11	Grade 30 reinforced concrete **other areas** in,				
(a)	Worktop	m^3	8		
(b)	Concrete wall	m^3	48		
(b)	Miscellaneous works	m^3	50		
	SUB TOTAL FOR CONCRETE WORK - 1				
	FORMWORK				
3.3.12	Formwork for substructure				
(a)	Pile cap foundation.	m^2	840		
(b)	Tie Beam & Footings	m^2	456		
(c)	Column - Level Up to +350mm	m^2	70		
(d)	Staircase - Level Up to +350mm	m^2	7		
(e)	Lift - Level Up to +350mm	m^2	56		
3.3.13	Fare face finish Formwork in Ground sump	m^2	280		
3.3.14	Formwork **Columns** in				
(a)	Level from +350 mm to +3850 mm	m^2	318		
(b)	Level from +3850 mm to +7350 mm	m^2	270		
(c)	Level from +7350 mm to +10850 mm	m^2	270		
(d)	Level from +10850 mm to +14350 mm	m^2	270		
(e)	Level from +14350 mm to +17850 mm	m^2	270		
(f)	Level from +17850 mm to +21350 mm	m^2	240		
(g)	Level from +20850 mm to Roof slab level	m^2	66		
3.3.15	Formwork **Beam & Slab** in,				
(a)	Level +3850mm	m^2	1,450		
(b)	Level +7350mm	m^2	1,300		
(c)	Level +10850mm	m^2	1,300		
(d)	Level +14350mm	m^2	1,300		
(e)	Level +17850mm	m^2	1,300		
(f)	Level +21350mm	m^2	980		
(g)	Tower Roof slab	m^2	120		
3.3.16	Formwork **Staircase** in,				
(a)	Level from +350 mm to +3850 mm	m^2	70		
(b)	Level from +3850 mm to +7350 mm	m^2	70		
(c)	Level from +7350 mm to +10850 mm	m^2	70		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
(d)	Level from +10850 mm to +14350 mm	m^2	70		
(e)	Level from +14350 mm to +17850 mm	m^2	105		
(f)	Level from +17850 mm to +21350 mm	m^2	105		
3.3.17	Formwork **Lift** in,				
(a)	Level from +350 mm to +3850 mm	m^2	90		
(b)	Level from +3850 mm to +7350 mm	m^2	90		
(c)	Level from +7350 mm to +10850 mm	m^2	90		
(d)	Level from +10850 mm to +14350 mm	m^2	90		
(e)	Level from +14350 mm to +17850 mm	m^2	90		
(f)	Level from +17850 mm to +21350 mm	m^2	100		
(g)	Machine room floor slab	m^2	40		
(h)	Machine room roof slab	m^2	40		
3.3.18	Formwork **Lintel** in,				
(a)	Level from +350 mm to +3850 mm	m^2	100		
(b)	Level from +3850 mm to +7350 mm	m^2	85		
(c)	Level from +7350 mm to +10850 mm	m^2	70		
(d)	Level from +10850 mm to +14350 mm	m^2	70		
(e)	Level from +14350 mm to +17850 mm	m^2	70		
(f)	Level from +17850 mm to +21350 mm	m^2	70		
(g)	Level from +21350 mm to Roof slab level	m^2	50		
3.3.19	Fare face finish Formwork **Sunshade** in,				
(a)	Level from +350 mm to +3850 mm	m^2	85		
(b)	Level from +3850 mm to +7350 mm	m^2	85		
(c)	Level from +7350 mm to +10850 mm	m^2	70		
(d)	Level from +10850 mm to +14350 mm	m^2	85		
(e)	Level from +14350 mm to +17850 mm	m^2	80		
(f)	Level from +17850 mm to +21350 mm	m^2	80		
3.3.20	Formwork **other areas** in,				
(a)	Worktop	m^2	40		
(b)	Concrete wall	m^2	670		
(b)	Miscellaneous works	m^2	300		
	SUB TOTAL FOR FORMWORK -2				
	REINFORCEMENT				
3.3.21	Mild Steel reinforcement in **Sub Structure**,				
(a)	Ground Sump	kg	17,000		
(b)	Ground Floor	kg	19,200		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
3.3.22	Mild Steel reinforcement in **Column** ,				
(a)	Level Up to +350mm	kg	810		
(b)	Level from +350 mm to +3850 mm	kg	1080		
(c)	Level from +3850 mm to +7350 mm	kg	900		
(d)	Level from +7350 mm to +10850 mm	kg	900		
(e)	Level from +10850 mm to +14350 mm	kg	900		
(f)	Level from +14350 mm to +17850 mm	kg	900		
(g)	Level from +17850 mm to +21350 mm	kg	420		
(h)	Level from +21350 mm to Roof slab level	kg	570		
3.3.23	Mild Steel reinforcement in **Lintel** ,				
(a)	Level from +350 mm to +3850 mm	kg	132		
(b)	Level from +3850 mm to +7350 mm	kg	150		
(c)	Level from +7350 mm to +10850 mm	kg	132		
(d)	Level from +10850 mm to +14350 mm	kg	132		
(e)	Level from +14350 mm to +17850 mm	kg	132		
(f)	Level from +17850 mm to +21350 mm	kg	144		
(g)	Level from +21350 mm to Roof slab level	kg	36		
3.3.24	Mild Steel reinforcement in **other areas**,				
(a)	Worktop	kg	132		
(b)	Concrete Wall	kg	864		
(c)	Miscellaneous works	kg	1800		
3.3.25	Tor Steel reinforcement in **Sub Structure**,				
(a)	Pile cap foundation.	kg	34,800		
(b)	Tie Beam & Footings	kg	104,400		
(c)	Ground Sump	kg	12,000		
(d)	Ground Floor	kg	199,200		
3.3.26	Tor Steel reinforcement in **Column** ,				
(a)	Level Up to +350mm	kg	6,300		
(b)	Level from +350 mm to +3850 mm	kg	10,320		
(c)	Level from +3850 mm to +7350 mm	kg	8,520		
(d)	Level from +7350 mm to +10850 mm	kg	8,520		
(e)	Level from +10850 mm to +14350 mm	kg	8,520		
(f)	Level from +14350 mm to +17850 mm	kg	8,520		
(g)	Level from +17850 mm to +20850 mm	kg	4,920		
(h)	Level from +20850 mm to Roof slab level	kg	480		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
3.3.27	Tor Steel reinforcement in **Beam & Slab** ,				
(a)	Level +3850mm	kg	48,000		
(b)	Level +7350mm	kg	45,600		
(c)	Level +10850mm	kg	45,600		
(d)	Level +14350mm	kg	45,600		
(e)	Level +17850mm	kg	42,000		
(f)	Level +20850mm	kg	49,200		
(g)	Tower Roof slab	kg	13,800		
3.3.28	Tor Steel reinforcement in **Staircase** ,				
(a)	Level Up to +350mm	kg	672		
(b)	Level from +350 mm to +3850 mm	kg	1680		
(c)	Level from +3850 mm to +7350 mm	kg	1680		
(d)	Level from +7350 mm to +10850 mm	kg	1680		
(e)	Level from +10850 mm to +14350 mm	kg	1680		
(f)	Level from +14350 mm to +17850 mm	kg	2520		
(g)	Level from +17850 mm to +20850 mm	kg	2250		
3.3.29	Tor Steel reinforcement in **Lift** ,				
(a)	Level Up to +350mm	kg	900		
(b)	Level from +350 mm to +3850 mm	kg	1200		
(c)	Level from +3850 mm to +7350 mm	kg	1200		
(d)	Level from +7350 mm to +10850 mm	kg	1200		
(e)	Level from +10850 mm to +14350 mm	kg	1200		
(f)	Level from +14350 mm to +17850 mm	kg	1440		
(g)	Level from +17850 mm to +20850 mm	kg	1440		
(h)	Machine room floor slab	kg	960		
(i)	Machine room roof slab	kg	960		
3.3.30	Tor Steel reinforcement in **Lintel** ,				
(a)	Level from +350 mm to +3850 mm	kg	360		
(b)	Level from +3850 mm to +7350 mm	kg	450		
(c)	Level from +7350 mm to +10850 mm	kg	360		
(d)	Level from +10850 mm to +14350 mm	kg	360		
(e)	Level from +14350 mm to +17850 mm	kg	360		
(f)	Level from +17850 mm to +20850 mm	kg	360		
(g)	Level from +20850 mm to Roof slab level	kg	90		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
3.3.31	Tor Steel reinforcement in **Sunshade** ,				
(a)	Level +3850mm	kg	900		
(b)	Level +7350mm	kg	900		
(c)	Level +10850mm	kg	660		
(d)	Level +14350mm	kg	900		
(e)	Level +17850mm	kg	780		
(f)	Level +21350mm	kg	540		
3.3.32	Tor Steel reinforcement in **other areas**,				
(a)	Worktop	kg	180		
(b)	Concrete wall	kg	7,200		
(c)	Pavement	kg	1,800		
(b)	Miscellaneous works	kg	1,800		
	SUB TOTAL FOR REINFORCEMENT WORK - 3				
	CONCRETE FORMWORK & REINFORCEMENT CARRIED TO CIVIL WORK *SUB SUMMARY 1 (1 + 2 + 3)*				
3.4	BLOCK WORK *Note:-* *a) Rate for Block work shall include for forming necessary openings for Doors, Windows and Exhaust fans.* *b) Preparation of existing surfaces for proper bonding.* *c) Rate to include 3m interval horizontal any reinforced stiffener column and beams to the full wall thickness.* *d) Measured actual quantity deducting all voids*				
3.4.1	Hollow Cement Block work 200mm. thick in superstructure in 1:5 cement sand mix in walls.				
(a)	Level from +350 mm to +3850 mm	m^2	600		
(b)	Level from +3850 mm to +7350 mm	m^2	450		
(c)	Level from +7350 mm to +10850 mm	m^2	450		
(d)	Level from +10850 mm to +14350 mm	m^2	450		
(e)	Level from +14350 mm to +17850 mm	m^2	450		
(f)	Level from +17850 mm to +21350 mm	m^2	480		
(g)	Level from +21350 mm to Roof slab level	m^2	240		
3.4.2	Solid Cement Block work 200mm. thick in superstructure in 1:5 cement sand mix in walls.				
(a)	Level from +350 mm to +3850 mm	m^2	450		
(b)	Level from +3850 mm to +7350 mm	m^2	338		
(c)	Level from +7350 mm to +10850 mm	m^2	338		
(d)	Level from +10850 mm to +14350 mm	m^2	338		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
(e)	Level from +14350 mm to +17850 mm	m^2	338		
(f)	Level from +17850 mm to +21350 mm	m^2	360		
(g)	Level from +21350 mm to Roof slab level	m^2	180		
3.4.3	Solid Cement Block work 150mm. thick in superstructure in 1:5 cement sand mix to create 300mm thick double wall.				
(a)	Level from +350 mm to +3850 mm	m^2	55		
3.4.4	Hollow Cement Block work 150mm. thick in superstructure in 1:5 cement sand mix in walls.				
(a)	Level from +350 mm to +3850 mm	m^2	280		
(b)	Level from +3850 mm to +7350 mm	m^2	320		
(c)	Level from +7350 mm to +10850 mm	m^2	360		
(d)	Level from +10850 mm to +14350 mm	m^2	280		
(e)	Level from +14350 mm to +17850 mm	m^2	400		
(f)	Level from +17850 mm to +21350 mm	m^2	320		
(g)	Level from +21350 mm to Roof slab level	m^2	160		
3.4.5	Solid Cement Block work 150mm. thick in superstructure in 1:5 cement sand mix in walls.				
(a)	Level from +350 mm to +3850 mm	m2	140		
(b)	Level from +3850 mm to +7350 mm	m2	160		
(c)	Level from +7350 mm to +10850 mm	m2	180		
(d)	Level from +10850 mm to +14350 mm	m2	140		
(e)	Level from +14350 mm to +17850 mm	m2	200		
(f)	Level from +17850 mm to +21350 mm	m2	160		
(g)	Level from +21350 mm to Roof slab level	m2	80		
3.4.6	Hollow Cement Block work 100mm. thick in superstructure in 1:5 cement sand mix in walls.				
(a)	Level from +350 mm to +3850 mm	m2	140		
(b)	Level from +3850 mm to +7350 mm	m2	140		
(c)	Level from +7350 mm to +10850 mm	m2	135		
(d)	Level from +10850 mm to +14350 mm	m2	135		
(e)	Level from +14350 mm to +17850 mm	m2	135		
(f)	Level from +17850 mm to +21350 mm	m2	130		
(g)	Level from +21350 mm to Roof slab level	m2	40		
(b)	Above roof level	m2	30		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
3.4.7	Solid Cement Block work 100mm. thick in superstructure in 1:5 cement sand mix in walls.				
(a)	Level from +350 mm to +3850 mm	m2	70		
(b)	Level from +3850 mm to +7350 mm	m2	70		
(c)	Level from +7350 mm to +10850 mm	m2	68		
(d)	Level from +10850 mm to +14350 mm	m2	68		
(e)	Level from +14350 mm to +17850 mm	m2	68		
(f)	Level from +17850 mm to +21350 mm	m2	65		
(g)	Level from +21350 mm to Roof slab level	m2	20		
(b)	Above roof level	m2	15		
	BLOCK WORK CARRIED TO CIVIL WORK SUB SUMMARY 1				
3.5	WATER PROOFING *Note:-* *a) The contractor shall prepare a detailed method statement describing the labour, materials and equipment to be used and the method of work execution and obtain the Engineers approval. The statement shall also describe the safety precautions to be adopt and all measures for compliance with environmental requirement.* *b) Rates shall include for necessary testing and surface protection in layouts to be approved by the Engineer.* *(c) A warranty for a* **period of 10 years** should be provided for all water proofing works.				
3.5.1	Damp proof membrane laid with 700 gauge polythene approved by the Engineer with lapped and folded joints sealed with an approved pressure sensitive tape.	m^2	1,100		
3.5.2	Supply and installation of roof water proofing system consist with layers of 5mm bituminous membrane laid on clean surface of the roof slab and around the parapets, 25 mm rigid polystyrene board, type 700 polythene sheet, Mild steel wire mesh (2251) and protection concrete (topping) and filler with sealant cover at construction gaps complete as per the detail drawings. The application should be carried out in conformity with the manufacturer's specification and approval of the Engineer.				
(a)	Level +3850mm	m^2	300		
(b)	Level +7350mm	m^2	100		
(c)	Level +10850mm	m^2	175		
(d)	Level +14350mm	m^2	120		
(e)	Level +17850mm	m^2	350		
(f)	Level +21350mm	m^2	670		
(g)	Tower Roof slab	m^2	124		
3.5.3	Water proofing for toilet areas. (including toilet floor area and necessary height to toilet walls prior to tiling)				
(a)	Level from +350 mm to +3850 mm	m^2	160		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
(b)	Level from +3850 mm to +7350 mm	m^2	210		
(c)	Level from +7350 mm to +10850 mm	m^2	100		
(d)	Level from +10850 mm to +14350 mm	m^2	120		
(e)	Level from +14350 mm to +17850 mm	m^2	350		
(f)	Level from +17850 mm to +21350 mm	m^2	70		
3.5.4	Water proofing for other areas.				
(a)	Ground Sump	m^2	26		
(b)	Lift well	m^2	270		
(c)	Concrete Wall	m^2	340		
	WATER PROOFING WORKS CARRIED TO CIVIL WORK SUB SUMMARY 1				
3.6	PLASTER WORK AND OTHER FLOOR/WALL FINISHES				
	Note:				
	a)Rate shall include for all temporary works costs for scaffolding and preparatory work for screds,grounds,etc.				
	b)Contractor should be responsible of keep provision for laying of conduits and cover the conduits				
3.6.1	Plaster 16mm. thick cement and sand (1:5) finished semi rough *externally* on block walls, concrete walls, column/beams flush to walls match with existing. Rate to include for making expansion groove filled with rubber sealant(Exterior sealant with UV resistance and paintable) to approval.				
(a)	Level from +350 mm to +3850 mm	m^2	600		
(b)	Level from +3850 mm to +7350 mm	m^2	450		
(c)	Level from +7350 mm to +10850 mm	m^2	450		
(d)	Level from +10850 mm to +14350 mm	m^2	450		
(e)	Level from +14350 mm to +17850 mm	m^2	450		
(f)	Level from +17850 mm to +21350 mm	m^2	480		
(g)	Level from +21350 mm to Roof slab level	m^2	360		
(h)	Above Roof level	m^2	120		
3.6.2	Plaster 16mm. thick cement and sand (1:5) finished semi rough *externally* on sides of slab projection,etc.				
(a)	Level from +350 mm to +3850 mm	m^2	70		
(b)	Level from +3850 mm to +7350 mm	m^2	70		
(c)	Level from +7350 mm to +10850 mm	m^2	70		
(d)	Level from +10850 mm to +14350 mm	m^2	70		
(e)	Level from +14350 mm to +17850 mm	m^2	80		
(f)	Level from +17850 mm to +21350 mm	m^2	70		
(g)	Level from +21350 mm to Roof slab level	m^2	60		
(h)	Above Roof level	m^2	40		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
3.6.3	Plaster 16mm. thick cement and sand (1:5) finished semi rough *externally* on reveals.				
(a)	Level from +350 mm to +3850 mm	m	350		
(b)	Level from +3850 mm to +7350 mm	m	314		
(c)	Level from +7350 mm to +10850 mm	m	300		
(d)	Level from +10850 mm to +14350 mm	m	312		
(e)	Level from +14350 mm to +17850 mm	m	302		
(f)	Level from +17850 mm to +21350 mm	m	206		
(g)	Level from +21350 mm to Roof slab level	m	85		
3.6.4	Plaster 16mm thick cement and sand (1:5) finished smooth with putty *internally* on Block walls, column/beam flushed to walls.				
(a)	Level from +350 mm to +3850 mm	m^2	1,500		
(b)	Level from +3850 mm to +7350 mm	m^2	1,220		
(c)	Level from +7350 mm to +10850 mm	m^2	1,100		
(d)	Level from +10850 mm to +14350 mm	m^2	1,120		
(e)	Level from +14350 mm to +17850 mm	m^2	1,100		
(f)	Level from +17850 mm to +21350 mm	m^2	1,300		
(g)	Level from +21350 mm to Roof slab level	m^2	75		
3.6.5	Plaster 16mm thick cement and sand (1:5) finished smooth with putty *internally* on concrete Column, Wall, Beam,etc.				
(a)	Level from +350 mm to +3850 mm	m^2	750		
(b)	Level from +3850 mm to +7350 mm	m^2	648		
(c)	Level from +7350 mm to +10850 mm	m^2	636		
(d)	Level from +10850 mm to +14350 mm	m^2	606		
(e)	Level from +14350 mm to +17850 mm	m^2	606		
(f)	Level from +17850 mm to +21350 mm	m^2	485		
(g)	Level from +21350 mm to Roof slab level	m^2	126		
3.6.6	Plaster 16mm. thick cement and sand (1:5) finished smooth with putty *internally* on reveals.				
(a)	Level from +350 mm to +3850 mm	m	620		
(b)	Level from +3850 mm to +7350 mm	m	460		
(c)	Level from +7350 mm to +10850 mm	m	340		
(d)	Level from +10850 mm to +14350 mm	m	420		
(e)	Level from +14350 mm to +17850 mm	m	510		
(f)	Level from +17850 mm to +21350 mm	m	270		
(g)	Level from +21350 mm to Roof slab level	m	75		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
3.6.7	Plaster 10mm. thick cement and sand (1:3) finished smooth with putty on soffit.				
(a)	Level +3850mm	m^2	1,450		
(b)	Level +7350mm	m^2	1,300		
(c)	Level +10850mm	m^2	1,300		
(d)	Level +14350mm	m^2	1,300		
(e)	Level +17850mm	m^2	1,300		
(f)	Level +21350mm	m^2	980		
(g)	Tower Roof slab	m^2	120		
3.6.8	Render 16mm. thick cement sand (1:3) finished smooth with colored cement float (colour to approval) on Plinth area				
(a)	Pavement	m^2	160		
(b)	Plinth	m^2	55		
3.6.9	Render 16mm. thick cement sand (1:3) finished smooth with colored cement float (colour to approval) on Floor/Slab				
(a)	Level +3850mm	m^2	300		
(b)	Level +7350mm	m^2	100		
(c)	Level +10850mm	m^2	175		
(d)	Level +14350mm	m^2	120		
(e)	Level +17850mm	m^2	350		
(f)	Level +21350mm	m^2	670		
(g)	Tower Roof slab	m^2	124		
	PLASTER WORK AND OTHER FLOOR/WALL FINISHES CARRIED TO CIVIL WORK SUB SUMMARY 1				
3.7	FLOOR AND WALL TILES WITH BACKING & TIMBER FLOOR				
	Note:				
	a) Rate for tiling should include in 20mm thick cement and sand 1:3 backing including pointing and grout to match. Manufacturer and colours of tiles to approval.				
	b) Prior to commencing tiling wet areas a 48 hour pond test should be carried out to the approval of the Engineer.				
	c) Tile Sample to be submitted for approval prior to the commencement of work.				
	d) All tile work shall be cleaned in regular manner and protected.				
3.7.1	600mm x 600mm size (or approval) Glazed Porcelan Design Tile laid on concrete floor at lobby area				
(a)	Level from +350 mm to +3850 mm	m^2	65		
(b)	Level from +3850 mm to +7350 mm	m^2	20		
(c)	Level from +7350 mm to +10850 mm	m^2	65		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
(d)	Level from +10850 mm to +14350 mm	m^2	20		
(e)	Level from +14350 mm to +17850 mm	m^2	65		
	Basic Price for Glazed Porcelan floor tiles - Rs. 6000.00 approximately per m^2				
3.7.2	-Ditto- in Skirting 75mm. high. fixed to walls/column				
(a)	Level from +350 mm to +3850 mm	m	90		
(b)	Level from +3850 mm to +7350 mm	m	38		
(c)	Level from +7350 mm to +10850 mm	m	15		
(d)	Level from +10850 mm to +14350 mm	m	45		
(e)	Level from +14350 mm to +17850 mm	m	29		
	Basic Price for Glazed Porcelan floor tiles - Rs. 6000.00 approximately per m^2				
3.7.3	600mm x 600mm size Semi Glazed Porcelan Tile laid on concrete floor at				
(a)	Level from +350 mm to +3850 mm	m^2	540		
(b)	Level from +425 mm to +3850 mm	m^2	150		
(c)	Level from +3850 mm to +7350 mm	m^2	620		
(d)	Level from +7350 mm to +10850 mm	m^2	105		
(e)	Level from +10850 mm to +14350 mm	m^2	450		
(f)	Level from +14350 mm to +17850 mm	m^2	590		
(g)	Level from +17850 mm to +21350 mm	m^2	510		
(h)	Level from +21350 mm to Roof slab level	m^2	60		
	Basic Price for Semi Glazed Porcelan floor tiles - Rs. 6500.00 approximately per m^2				
3.7.4	-Ditto- in Skirting 75mm. high. fixed to walls/column				
(a)	Level from +350 mm to +3850 mm	m	440		
(b)	Level from +425 mm to +3850 mm	m	50		
(c)	Level from +3850 mm to +7350 mm	m	375		
(d)	Level from +7350 mm to +10850 mm	m	323		
(e)	Level from +10850 mm to +14350 mm	m	195		
(f)	Level from +14350 mm to +17850 mm	m	390		
(g)	Level from +17850 mm to +21350 mm	m	260		
(h)	Level from +21350 mm to Roof slab level	m	50		
	Basic Price for Semi Glazed Ceramic floor tiles - Rs. 6500.00 approximately per m^2				
3.7.5	600*600 mm Glazed Porcelain Tile laid on concrete floor at				
(a)	Level from +350 mm to +3850 mm	m^2	175		
(b)	Level from +3850 mm to +7350 mm	m^2	50		
(c)	Level from +7350 mm to +10850 mm	m^2	54		
(d)	Level from +10850 mm to +14350 mm	m^2	60		
(e)	Level from +14350 mm to +17850 mm	m^2	60		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
(f)	Level from +17850 mm to +21350 mm	m^2	30		
	Basic Price for Matt Ceramic floor tiles - Rs. 6500.00 approximately per m^2				
3.7.6	-Ditto- in Skirting 75mm. high. fixed to walls/column				
(a)	Level from +350 mm to +3850 mm	m	45		
(b)	Level from +3850 mm to +7350 mm	m	20		
(c)	Level from +7350 mm to +10850 mm	m	25		
(d)	Level from +10850 mm to +14350 mm	m	27		
(e)	Level from +14350 mm to +17850 mm	m	20		
(f)	Level from +17850 mm to +21350 mm	m	22		
	Basic Price for Semi Glazed Ceramic floor tiles - Rs. 6500.00 approximately per m^2				
3.7.7	2mm thick maintenace free Heavy duty Vinyl laid on raised floor in steel work (This includes all necessary supporting steel structures, provisions for suitable openings, and other required installation services, subject to the Engineer's approval.)				
(a)	Level from +350 mm to +3850 mm	m^2	150		
(b)	Level from +3850 mm to +7350 mm	m^2	500		
(c)	Level from +7350 mm to +10850 mm	m^2	600		
(d)	Level from +10850 mm to +14350 mm	m^2	100		
(e)	Tower Floor	m^2	60		
	Basic Price for Heavy duty Vinyl - Rs. 15,000.00 approximately per m^2				
3.7.8	450mm x 900mm size (or approval) Matt Porcelain floor tiles laid on concrete floor in toilet area				
(a)	Level from +350 mm to +3850 mm	m^2	45		
(b)	Level from +3850 mm to +7350 mm	m^2	48		
(c)	Level from +7350 mm to +10850 mm	m^2	32		
(d)	Level from +10850 mm to +14350 mm	m^2	32		
(e)	Level from +14350 mm to +17850 mm	m^2	70		
(f)	Level from +17850 mm to +21350 mm	m^2	28		
	Basic Price for Matt Ceramic floor tiles - Rs. 6500.00 approximately per m^2				
3.7.9	Staircase 450*900 mm Semi Matte Porcelain Tile (nosing shall have a performed non-slip grooved surface and a rounded front edge)				
(a)	Level from +350 mm to +3850 mm	m^2	40		
(b)	Level from +3850 mm to +7350 mm	m^2	40		
(c)	Level from +7350 mm to +10850 mm	m^2	40		
(d)	Level from +10850 mm to +14350 mm	m^2	40		
(e)	Level from +14350 mm to +17850 mm	m^2	40		
(f)	Level from +17850 mm to +21350 mm	m^2	40		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
	Basic Price for Semi Matte Porcelain floor tiles - Rs. 7000.00 approximately per m²				
3.7.10	-Ditto- in Skirting 75mm. high. fixed to walls				
(a)	Level from +350 mm to +3850 mm	m	18		
(b)	Level from +3850 mm to +7350 mm	m	18		
(c)	Level from +7350 mm to +10850 mm	m	18		
(d)	Level from +10850 mm to +14350 mm	m	18		
(e)	Level from +14350 mm to +17850 mm	m	18		
(f)	Level from +17850 mm to +21350 mm	m	18		
	Basic Price for Matte Porcelain floor tiles - Rs. 7000.00 approximately per m²				
3.7.11	450*600 mm matt Porcelain Tiles laid in concrete floor				
(a)	Level from +350 mm to +3850 mm	m²	35		
	Basic Price for Porcelain Tiles tiles - Rs. 6,000.00 approximately per m²				
3.7.12	600mm x 600mm size Glazed Porcelan wall tiles fixed to toilet walls in				
(a)	Level from +350 mm to +3850 mm	m²	128		
(b)	Level from +3850 mm to +7350 mm	m²	162		
(c)	Level from +7350 mm to +10850 mm	m²	86		
(d)	Level from +10850 mm to +14350 mm	m²	95		
(e)	Level from +14350 mm to +17850 mm	m²	265		
(f)	Level from +17850 mm to +21350 mm	m²	68		
	Basic Price for Glazed Porcelan wall tiles - Rs. 6,500.00 approximately per m²				
3.7.13	20mm thick Granite Vanity counter tops in fixed to concrete slab to approval				
(a)	Pantry area	m²	15		
	Basic Price for Polished Granite top - Rs. 30,000.00 approximately per m²				
	FLOOR AND WALL TILES WITH BACKING CARRIED TO CIVIL WORK SUB SUMMARY 1				
3.8	<u>DOORS AND WINDOWS & PARTITIONING WORKS</u> <u>*DOORS & WINDOWS WORK*</u> <u>*Note:*</u> *a) All Extrusions shall be Powder coated Aluminium (colour to approval). Minimum extrusion thickness to be 1.6 mm. and minimum powder coating thickness to be 60 microns (colour to approval), with suitable gaskets around frame with clear float glass of 5 mm. All complete to working order including hinges, locking-closing mechanisms, indicators, handles, etc., as per drawing and to approval.* *b)Exact measurements to be taken at site prior to fabrication of Aluminium/Tempered Glass of Door* *(c)Door sash paint including preparation of surface, apply one coat of approved wood preservative, stain to approval, sanding and applying 2 coats of hardwearing 'Water based' Coatings (colour to approval).*				
3.8.1	Supply, fabricate and installation of Steel framed Double sashed Steel door **Type D1** size 1800mm x 2100mm as per the drawing and to approval of the Engineer. Rate to include for necessary fittings,locking system,etc. in complete to working order.				

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
(a)	Level from +350 mm to +3850 mm	nos	2		
(b)	Level from +3850 mm to +7350 mm	nos	2		
(c)	Level from +7350 mm to +10850 mm	nos	1		
(d)	Level from +10850 mm to +14350 mm	nos	2		
(e)	Level from +14350 mm to +17850 mm	nos	2		
(f)	Level from +17850 mm to +21350 mm	nos	3		
3.8.2	Supply, fabricate and installation of Steel framed Veneer Plywood Double sashed door **Type D1a** size 1500mm x 2100mm as per the drawing and to approval of the Engineer. Rate to include for necessary fittings,locking system,etc. in complete to working order.				
(a)	Level from +7350 mm to +10850 mm	nos	2		
3.8.3	Supply, fabricate and installation of Powder coated Aluminium framed Veneer Plywood Double sashed door **Type D2** size 1500mm x 2100mm as per the drawing and to approval of the Engineer. Rate to include for necessary fittings,locking system,etc. in complete to working order.				
(a)	Level from +350 mm to +3850 mm	nos	2		
(b)	Level from +3850 mm to +7350 mm	nos	5		
(c)	Level from +7350 mm to +10850 mm	nos	3		
(d)	Level from +10850 mm to +14350 mm	nos	2		
(f)	Level from +14350 mm to +17850 mm	nos	3		
3.8.4	Supply, fabricate and installation of Powder coated Aluminium framed Veneer Plywood single sashed door **Type D3** size 900mm x 2100mm as per the drawing and to approval of the Engineer. Rate to include for necessary fittings,locking system,etc. in complete to working order.				
(a)	Level from +350 mm to +3850 mm	nos	22		
(b)	Level from +3850 mm to +7350 mm	nos	8		
(c)	Level from +7350 mm to +10850 mm	nos	1		
(d)	Level from +10850 mm to +14350 mm	nos	16		
(e)	Level from +14350 mm to +17850 mm	nos	35		
(f)	Level from +17850 mm to +21350 mm	nos	19		
3.8.5	Supply, fabricate and installation of Powder coated Aluminium framed **PVC laminated** single sashed **Marine plywood** door with louver, **Type D4** size 900mm x 2100mm as per the drawing and to approval of the Engineer. Rate to include for necessary fittings,locking system,etc. in complete to working order.				
(a)	Level from +350 mm to +3850 mm	nos	3		
(b)	Level from +3850 mm to +7350 mm	nos	4		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
(c)	Level from +7350 mm to +10850 mm	nos	2		
(d)	Level from +10850 mm to +14350 mm	nos	3		
(e)	Level from +14350 mm to +17850 mm	nos	4		
(f)	Level from +17850 mm to +21350 mm	nos	3		
3.8.6	Supply, fabricate and installation of Powder coated Aluminium framed Veneer Plywood Double sashed door **Type D5** size 1200mm x 2100mm as per the drawing and to approval of the Engineer. Rate to include for necessary fittings,locking system,etc. in complete to working order.				
(a)	Level from +350 mm to +3850 mm	nos	1		
(b)	Level from +17850 mm to +21350 mm	nos	1		
3.8.7	Supply, fabricate and installation of Steel framed Steel Double sashed door **Type D6** size 1500mm x 2400mm as per the drawing and to approval of the Engineer. Rate to include for necessary fittings,locking system,etc. in complete to working order.				
(a)	Level from +350 mm to +3850 mm	nos	4		
3.8.8	Supply, fabricate and installation of Powder coated Aluminium framed Veneer Plywood single sashed door **Type D7** size 750mm x 2100mm as per the drawing and to approval of the Engineer. Rate to include for necessary fittings,locking system,etc. in complete to working order.				
(a)	Level from +350 mm to +3850 mm	nos	2		
(b)	Level from +3850 mm to +7350 mm	nos	4		
(c)	Level from +14350 mm to +17850 mm	nos	10		
3.8.9	Supply, fabricate and installation of Steel framed Steel Double sashed Fire resistance door Type FD size 1500mm x 2400mm as per the drawing and to approval of the Engineer. Rate to include for necessary fittings,locking system,Fire rated pyran glass, view panels, etc. in complete to working order.				
(a)	Level from +350 mm to +3850 mm	nos	1		
(b)	Level from +3850 mm to +7350 mm	nos	1		
(c)	Level from +7350 mm to +10850 mm	nos	1		
(d)	Level from +10850 mm to +14350 mm	nos	1		
3.8.10	Supply, Fabricate & fix of Powder coated Aluminium framed Single sashed Aluminium louvered door **Type DD** size 750mmx 2100mm as per the drawing and complete to working order to approval of the Engineer. Rate to include necessary framing supports,fittings,locking system,etc. in complete to working order.				-
(a)	Level from +350 mm to +3850 mm	nos	1		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
(b)	Level from +3850 mm to +7350 mm	nos	3		
(c)	Level from +7350 mm to +10850 mm	nos	5		
(d)	Level from +10850 mm to +14350 mm	nos	3		
(e)	Level from +14350 mm to +17850 mm	nos	2		
(f)	Level from +17850 mm to +21350 mm	nos	3		
3.8.11	Supply, Fabricate & fix of Powder coated Aluminium framed Single sashed Aluminium louvered door **Type DD2** size 525mmx 2100mm as per the drawing and complete to working order to approval of the Engineer. Rate to include necessary framing supports,fittings,locking system,etc. in complete to working order.				
(e)	Level from +14350 mm to +17850 mm	nos	1		
3.8.12	Supply, Fabricate & fix of Powder coated Aluminium framed Glazed Sliding Window **Type W1** size 5600mmx 1500mm Window as per the drawing and complete to working order to approval of the Engineer. Rate to include necessary framing supports, fittings, locking system, etc. in complete to working order.				
(a)	Level from +350 mm to +3850 mm	nos	7		
(b)	Level from +3850 mm to +7350 mm	nos	7		
(c)	Level from +7350 mm to +10850 mm	nos	5		
(d)	Level from +10850 mm to +14350 mm	nos	10		
(e)	Level from +14350 mm to +17850 mm	nos	9		
(f)	Level from +17850 mm to +21350 mm	nos	8		
3.8.13	Supply, Fabricate & fix of Powder coated Powder coated Aluminium framed Glazed Sliding Window **Type W2** size 3750mmx 1500mm Window as per the drawing and complete to working order to approval of the Engineer. Rate to include necessary framing supports, fittings, locking system, etc. in complete to working order.				
(a)	Level from +350 mm to +3850 mm	nos	6		
(b)	Level from +3850 mm to +7350 mm	nos	3		
(c)	Level from +7350 mm to +10850 mm	nos	2		
(d)	Level from +10850 mm to +14350 mm	nos	2		
(e)	Level from +14350 mm to +17850 mm	nos	2		
(f)	Level from +17850 mm to +21350 mm	nos	1		
3.8.14	Supply, Fabricate & fix of Powder coated Aluminium framed Glazed Sliding Window **Type W3** size 3265mmx 1500mm Window as per the drawing and complete to working order to approval of the Engineer. Rate to include necessary framing supports, fittings, locking system, etc. in complete to working order.				

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
(b)	Level from +3850 mm to +7350 mm	nos	1		
(c)	Level from +7350 mm to +10850 mm	nos	2		
(d)	Level from +10850 mm to +14350 mm	nos	2		
(e)	Level from +14350 mm to +17850 mm	nos	1		
(f)	Level from +17850 mm to +21350 mm	nos	1		
3.8.15	Supply, Fabricate & fix of Powder coated Aluminium framed Glazed Sliding Window **Type W4** size 4490mmx 1500mm Window as per the drawing and complete to working order to approval of the Engineer. Rate to include necessary framing supports, fittings, locking system, etc. in complete to working order.				
(a)	Level from +7350 mm to +10850 mm	nos	1		
3.8.16	Supply, Fabricate & fix of Powder coated Aluminium framed Glazed Sliding Window **Type W5** size 4710mmx 1500mm Window as per the drawing and complete to working order to approval of the Engineer. Rate to include necessary framing supports, fittings, locking system, etc. in complete to working order.				
(a)	Level from +14350 mm to +17850 mm	nos	1		
3.8.17	Supply, Fabricate & fix of Powder coated Aluminium framed Glazed Window **Type W6** size 1500mmx 1500mm Window as per the drawing and complete to working order to approval of the Engineer. Rate to include necessary framing supports, fittings, locking system, etc. in complete to working order.				
(a)	Level from +350 mm to +3850 mm	nos	2		
(b)	Level from +3850 mm to +7350 mm	nos	3		
(c)	Level from +7350 mm to +10850 mm	nos	2		
(d)	Level from +10850 mm to +14350 mm	nos	2		
(e)	Level from +14350 mm to +17850 mm	nos	1		
3.8.18	Supply, Fabricate & fix of Powder coated Aluminium framed Glazed Window **Type W7** size 900mmx 2250mm Window as per the drawing and complete to working order to approval of the Engineer. Rate to include necessary framing supports, fittings, locking system, etc. in complete to working order.				
(a)	Level from +17850 mm to +21350 mm	nos	1		
3.8.19	Supply, Fabricate & fix of Powder coated Aluminium framed Hung Glazed Window **Type W8** size 7650mmx 1500mm Window as per the drawing and complete to working order to approval of the Engineer. Rate to include necessary framing supports, fittings, locking system, etc. in complete to working order.				
(a)	Level from +3850 mm to +7350 mm	nos	1		
3.8.20	Supply, Fabricate & fix of Powder coated Aluminium framed Hung Glazed Window **Type W9** size 3550mmx 1500mm Window as per the drawing and complete to working order to approval of the Engineer. Rate to include necessary framing supports, fittings, locking system, etc. in complete to working order.				
(a)	Level from +3850 mm to +7350 mm	nos	1		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
3.8.21	Supply, Fabricate & fix of Powder coated Aluminium framed Top Hung glass with louver **Type F1** size 1450mmx 600mm Fanlight as per the drawing and complete to working order to approval of the Engineer. Rate to include necessary framing supports,fittings,locking system,etc. in complete to working order.				
(a)	Level from +350 mm to +3850 mm	nos	1		
(b)	Level from +3850 mm to +7350 mm	nos	2		
(c)	Level from +10850 mm to +14350 mm	nos	1		
(d)	Level from +14350 mm to +17850 mm	nos	2		
3.8.22	Supply, Fabricate & fix of Powder coated Aluminium framed Top Hung glass with louver **Type F2** size 4710mmx 600mm Fanlight as per the drawing and complete to working order to approval of the Engineer. Rate to include necessary framing supports,fittings,locking system,etc. in complete to working order.				
(a)	Level from +350 mm to +3850 mm	nos	1		
(b)	Level from +3850 mm to +7350 mm	nos	1		
(c)	Level from +10850 mm to +14350 mm	nos	1		
(d)	Level from +17850 mm to +21350 mm	nos	1		
3.8.23	Supply, Fabricate & fix of Powder coated Aluminium framed Top Hung glass with louver **Type F2** size 5600mmx 600mm Fanlight as per the drawing and complete to working order to approval of the Engineer. Rate to include necessary framing supports,fittings,locking system,etc. in complete to working order.				
(a)	Level from +7350 mm to +10850 mm	nos	1		
3.8.24	Supply, Fabricate & fix of Powder coated Aluminium framed Top Hung glass with louver **Type F3** size 3045mmx 600mm Fanlight as per the drawing and complete to working order to approval of the Engineer. Rate to include necessary framing supports,fittings,locking system,etc. in complete to working order.				
(a)	Level from +14350 mm to +17850 mm	nos	2		
3.8.25	Supply, Fabricate & fix of Powder coated Aluminium framed Top Hung glass with louver **Type F4** size 750mmx 600mm Fanlight as per the drawing and complete to working order to approval of the Engineer. Rate to include necessary framing supports,fittings,locking system,etc. in complete to working order.				
(a)	Level from +350 mm to +3850 mm	nos	1		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
3.8.26	Supply, Fabricate & fix of Powder coated Aluminium framed Glazed pannel **Type FG** size 3125mmx 3050mm as per the drawing and complete to working order to approval of the Engineer. Rate to include necessary framing supports,fittings,etc.				
(a)	Level from +350 mm to +3850 mm	nos	1		
(b)	Level from +3850 mm to +7350 mm	nos	1		
(c)	Level from +7350 mm to +10850 mm	nos	1		
(d)	Level from +10850 mm to +14350 mm	nos	1		
(e)	Level from +14350 mm to +17850 mm	nos	1		
(f)	Level from +17850 mm to +21350 mm	nos	1		
3.8.27	Supply, Fabricate & fix of Powder coated Aluminium framed Glazed pannel **Type FG1** size1525mmx 3050mm as per the drawing and complete to working order to approval of the Engineer. Rate to include necessary framing supports,fittings,etc.				
(a)	Level from +350 mm to +3850 mm	nos	2		
(b)	Level from +3850 mm to +7350 mm	nos	2		
(c)	Level from +7350 mm to +10850 mm	nos	2		
(d)	Level from +10850 mm to +14350 mm	nos	2		
(e)	Level from +14350 mm to +17850 mm	nos	2		
(f)	Level from +17850 mm to +21350 mm	nos	2		
3.8.28	Supply, Fabricate & fix of Powder coated Aluminium framed Glazed pannel **Type FG2** size 5600mmx 3050mm including size1500mm x 2400mm Double sash Glazed door as per the drawing and complete to working order to approval of the Engineer. Rate to include necessary framing supports,fittings,locking system,etc. in complete to working order.				
(a)	Level from +350 mm to +3850 mm	nos	1		
3.8.29	Supply, Fabricate & fix of Powder coated Aluminium framed Glazed pannel **Type FG3** size 5600mmx 3050mm as per the drawing and complete to working order to approval of the Engineer. Rate to include necessary framing supports,fittings,etc.				
(a)	Level from +3850 mm to +7350 mm	nos	1		
(b)	Level from +7350 mm to +10850 mm	nos	1		
(c)	Level from +10850 mm to +14350 mm	nos	1		
(d)	Level from +14350 mm to +17850 mm	nos	1		
(e)	Level from +17850 mm to +21350 mm	nos	1		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
3.8.30	Supply, Fabricate & fix of Powder coated Aluminium framed Glazed pannel **Type FG4** size 25900mmx 1500mm as per the drawing and complete to working order to approval of the Engineer. Rate to include necessary framing supports,fittings,etc.				
(a)	Level from +7350 mm to +10850 mm	nos	1		
3.8.31	Supply, Fabricate & fix of Powder coated Aluminium framed Glazed pannel **Type FG5** size 7895mmx 1500mm as per the drawing and complete to working order to approval of the Engineer. Rate to include necessary framing supports,fittings,etc.				
(a)	Level from +7350 mm to +10850 mm	nos	1		
3.8.32	Supply, Fabricate & fix of Powder coated Aluminium framed Glazed pannel **Type FG6** size 1500mmx 1500mm as per the drawing and complete to working order to approval of the Engineer. Rate to include necessary framing supports,fittings,etc.				
(a)	Level from +7350 mm to +10850 mm	nos	2		
3.8.33	Supply, fabricate, and install powder-coated aluminum-framed glazed panel **Type FG7** as per the drawing, and complete to working order to approval of the Engineer. Shop drawings are to be submitted for the Engineer's prior approval. The rate shall include all necessary framing supports, fittings, and other accessories etc. **Note:** a) This work contains with all supporting steel structure and special glass details, strictly advised to refer to the details in drawings (Drawing No. - AASL/CIAR/3920244, AASL/CIAR/3920242, AASL/CIAR/3920243, AASL/CIAR/3920245) b) Structural steel work should done accoriding to the structural steel specifications. c) Surface preparation to Sa. 2.5 standard Sand blasting. Dry films thickness of the paint should be suited with C5 environmental corrosivity category 340 microns minimum DFT. This DFT should be completed before the erection. d) Rate to include for; all fabrication work, welding, marking, drilling, for bolts including securing steel plates, bolts, nuts and any type of washers, reverted work, counter sinking and tapping for bolts or machine screws. e) Rate to include for fabrication, erection and temporary supports and fixing in to position. f) Minimum grade of structural steel with grade S275.				
(a)	Tower area	nos	8		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
3.8.34	Fabricate Supply & Install powder coated Zinc Alum Roller Shutter Door **Type RD** size 3600 x 3000 mm should be Dual mode - Remote control (Approximately 100ft) and operate manually on power failure, including 03 remote controls, completed to the approval of the Engineer. Guarantee should be 5years for the panels & 2 years for the motor or better. (Exact measurements to be taken at site prior to fabrication)				
(a)	Level from +350 mm to +3850 mm	nos	4		
	SUB TOTAL FOR DOORS AND WINDOWS WORKS - (1)				
	<u>PARTITIONING WORK</u> ***Note:*** *a) All Extrusions shall be Powder coated Aluminium (colour to approval). Minimum extrusion thickness to be 1.6 mm. and minimum powder coating thickness to be 60 microns (colour to approval), with suitable gaskets around frame with clear float glass of 5 mm. All complete to working order including hinges, locking-closing mechanisms, indicators, handles, etc, as per drawing and to approval.* *b)Exact measurements to be taken at site prior to fabrication of Aluminium/Tempered Glass of Partition* *c) Vertical, horizontal members of frame fixed with suitable expansion type Anchor bolts to existing column to column & floor to slab.*				
3.8.35	Supply, Fabricate and Installation of Glazed Aluminium partitioning in cubicles including vertical, horizontal members fixed with suitable expansion type Anchor bolts to existing column, floor etc. consisting of 10mm. thick plywood board on both sides laminated with coloured high pressured melamine coated board (perstorp or equivalent to approval) (colour to approval) on external faces fixed to aluminium frame work bottom panel and top glass panel completed with suitable gaskets around frames including supply and installation of anti shatter film to inner surface of all glass. Rate shall include for aluminium skirting 75mm. high on both sides and completed as per drawing, specification and to approval. (Door Measured Separately)				
(a)	Level from +350 mm to +3850 mm	m^2	210		
(b)	Level from +3850 mm to +7350 mm	m^2	360		
(c)	Level from +7350 mm to +10850 mm	m^2	150		
(d)	Level from +10850 mm to +14350 mm	m^2	760		
(e)	Level from +14350 mm to +17850 mm	m^2	200		
(f)	Level from +17850 mm to +21350 mm	m^2	600		
3.8.36	Supply, fabricate and installation of 100mm thick Gypsum board partitioning 12mm thick board on both sides including surface preparation (with fillers and primers) two coats of approved emulsion paint to on exposed surface of the cubical, fixed to Galvanized iron frame work (as per the drawing) to approval and fixed to concrete floor with suitable expansion type anchor bolt, etc.				
(a)	Level from +350 mm to +3850 mm	m^2	600		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
(b)	Level from +3850 mm to +7350 mm	m^2	100		
(c)	Level from +7350 mm to +10850 mm	m^2	75		
(d)	Level from +10850 mm to +14350 mm	m^2	75		
(e)	Level from +14350 mm to +17850 mm	m^2	1,050		
(f)	Level from +17850 mm to +21350 mm	m^2	60		
3.8.37	Supply,fabricate and install 2100mm high 12mm thick high pressure laminates compact board toilet partition with door and pilasters to be rest on 150mm high density plastic adjustable foot and anchored to the walls by density plastic U-channel and density plastic top rail consisting of door lock with indicator, hinges, coat hooks, thumb turn, etc. All completed to working order as per specification and drawing to approval. (Measurement for payment - one side of the vertical surfaces including doors)				
(a)	Level from +350 mm to +3850 mm	m^2	55		
(b)	Level from +3850 mm to +7350 mm	m^2	50		
(c)	Level from +7350 mm to +10850 mm	m^2	40		
(d)	Level from +10850 mm to +14350 mm	m^2	40		
(e)	Level from +14350 mm to +17850 mm	m^2	35		
(f)	Level from +17850 mm to +21350 mm	m^2	30		
	SUB TOTAL FOR PARTITIONING WORKS - (2)				-
	DOORS AND WINDOWS & PARTITIONING WORKS CARRIED TO CIVIL WORK SUB SUMMARY 1 (1) + (2)				-
3.9	RAIN WATER DISPOSAL SYSTEM				
	Note:-				
	a) The Contractor shall identify the existing underground services including any pipe lines, fittings, accessories, etc,. and should taken safety measures to protect, prior to the commencement of works.				
	b) Provision for rectification of any unexpected damages to any underground services during earth work.				
	c) Rate to include for de-watering where necessary including pumping out water up to the nearest drainage system.				
	d) Rate to include for necessary planking and strutting if required.				
	e) Pipe pressure testing according to ICTAD Publication SCA/3/2 and to the approval of the Engineer.				
3.9.1	Supply and installation of 100mm dia. cast iron dome strainer type roof drain on roof top, including top protection cover and other all fitting accessories, and complete all as per detail drawing and to approval. Rate to include for fixing with properly connect with roof waterproofing system and sealed to ensure water tightness along the joints.	nos.	60		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
3.9.2	Supply and installation of 100mm dia. type 1000 PVC down pipes and fittings like elbows, sockets, etc, including supports for embedded to concrete columns and connect to the nearest catch pit. Complete all as per drawing and to approval.				
a.	110mm Dia.	m	440		
b.	160mm dia.	m	275		
3.9.3	Design Supply & installation Polyvinyl chloride (PVC) Type 1000 pipes & specials(Rate to include trench excavation,leveling,termination both ends and re-instatement of the area) Size of trench: width not exceeding 750mm, depth should be more than 1000mm.				
a.	110mm Dia.	m	60		-
b.	160mm dia.	m	30		-
3.9.4	Catch Pit size (350mm x 350mm internally x depth to suit) consisting of concrete Gr.20 , 75 mm thick base, 115 mm thick brick work wall, cover slab including 6mm diameter mild steel reinforcement at 150mm c/c necessary formwork, lifting hook and render 20mm thick in cement and sand 1:3 to exposed surfaces internally and externally, including necessary excavation, backfilling and dump away spoil as directed.	nos.	24		
3.9.5	Manhole size (600 x 600mm internally x depth to suit) consisting of concrete Gr. 25, 150mm thick base, wall reinforced with Tor steel bars 10mm dia. at 125mm c/c both ways, 75mm thick pre cast cover slab reinforced with Tor steel bars 10mm dia. at 100mm c/c both ways necessary form work, lifting hooks and finish with smooth neat cement externally to exposed surfaces, complete all as per drawing and specification. Rate to include for necessary excavation, backfilling and dump away spoil as directed.	nos.	5		
3.9.6	Manhole size (900 x 900mm internally x depth to suit) consisting of concrete Gr. 25, 250mm thick base, wall reinforced with Tor steel bars 10mm dia. at 125mm c/c both ways, 75mm thick pre cast cover slab reinforced with Tor steel bars 10mm dia. at 100mm c/c both ways necessary form work, lifting hooks and finish with smooth neat cement externally to exposed surfaces, complete all as per drawing and specification. Rate to include for necessary excavation, backfilling and dump away spoil as directed.	nos.	3		
3.9.7	Supply and installation of uPVC type 1000 pipes for storm water disposal and connect to the existing nearest drain with fittings and accessories. Rate to include for making trench, pipe laying, backfilling, 150mm thick sand bedding, compaction and necessary connections as per the drawing & specifications. (Approx. size of trench: width not exceeding 750mm, minimum depth shall be 1.0m)	**Provisional**		**Sum**	**1,000,000.00**
	RAIN WATER DISPOSAL SYSTEM CARRIED TO CIVIL WORK SUB SUMMARY 1				

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
3.10	PAINTING ***Note:-*** *(a) Painting shall include for preparation of surfaces prior to the application of primer/paint, cleaning down, smoothing knotting, stopping etc., protecting floor finish, fittings, ironmongery and cleaning upon completion and the like.* *(b) Painting to existing surfaces shall also include for cleaning, scraping nails, repairing cracks and filling holes/cracks to the satisfaction of the Engineer.*				
	(c) Rates for painting shall include for reveals, narrow widths, bands, recesses, moldings and the like . *(d) Colour to be submitted for approval prior to the commencement of work*				
3.10.1	Prepare surface and apply one coat of primer , two coats of an elastic surface conditioner & two coats of weathersheild *external* paint (5 coat paint system) to semi rough plastered external walls, columns/beams,etc.				
(a)	Level from +350 mm to +3850 mm	m^2	670		
(b)	Level from +3850 mm to +7350 mm	m^2	520		
(c)	Level from +7350 mm to +10850 mm	m^2	520		
(d)	Level from +10850 mm to +14350 mm	m^2	520		
(e)	Level from +14350 mm to +17850 mm	m^2	530		
(f)	Level from +17850 mm to +21350 mm	m^2	550		
(g)	Level from +21350 mm to Roof slab level	m^2	420		
(h)	Above Roof level	m^2	160		
3.10.1a	Prepare surface and apply one coat of primer , two coats of an elastic surface conditioner & two coats of weathersheild *external* paint (5 coat paint system) to semi rough plastered external soffits, sides of the slab, projections,etc.				
(a)	Level from +350 mm to +3850 mm	m^2	168		
(b)	Level from +3850 mm to +7350 mm	m^2	130		
(c)	Level from +7350 mm to +10850 mm	m^2	130		
(d)	Level from +10850 mm to +14350 mm	m^2	130		
(e)	Level from +14350 mm to +17850 mm	m^2	133		
(f)	Level from +17850 mm to +21350 mm	m^2	138		
(g)	Level from +21350 mm to Roof slab level	m^2	105		
(h)	Above Roof level	m^2	40		
3.10.2	Prepare surface and apply one coat of primer and two coats of Emulsion paint to smooth plastered *internal* walls and columns/beams,etc.				
(a)	Level from +350 mm to +3850 mm	m^2	2,250		
(b)	Level from +3850 mm to +7350 mm	m^2	1,900		
(c)	Level from +7350 mm to +10850 mm	m^2	1,800		
(d)	Level from +10850 mm to +14350 mm	m^2	1,800		
(e)	Level from +14350 mm to +17850 mm	m^2	1,750		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
(f)	Level from +17850 mm to +21350 mm	m^2	1,800		
(g)	Level from +21350 mm to Roof slab level	m^2	300		
(h)	Above Roof level	m^2	50		
3.10.3	Prepare surface and apply one coat of primer and two coats of Emulsion paint to smooth plastered *internal* soffit and sides of slabs and beams at roof.				
(a)	Level from +350 mm to +3850 mm	m^2	1,450		
(b)	Level from +3850 mm to +7350 mm	m^2	1,300		
(c)	Level from +7350 mm to +10850 mm	m^2	1,300		
(d)	Level from +10850 mm to +14350 mm	m^2	1,300		
(e)	Level from +14350 mm to +17850 mm	m^2	1,300		
(f)	Level from +17850 mm to +21350 mm	m^2	980		
(g)	Level from +21350 mm to Roof slab level	m^2	120		
	PAINTING WORK CARRIED TO CIVIL WORK SUB SUMMARY 1				
3.11	MISCELLANIOUS WORK				
	HANDRAIL/GUARD RAIL				
3.11.1	Supply, fabricate & fix Hand rail including 70mmx25mm class 1 timber on top, 40mm wide 8mm thick S/S flat bars, 40mm x 10mm S/S flat bar, 8mm thick 100mm x 100mm S/S plate fixed to the steps with necessary accessories as per the drawing to approval.				
(a)	Level +3850mm	m	18		
(b)	Level +7350mm	m	18		
(c)	Level +10850mm	m	18		
(d)	Level +14350mm	m	18		
(e)	Level +17850mm	m	27		
(f)	Level +21350mm	m	27		
3.11.2	***Note:*** *Stainless steel grade should be minimum of 304and thickness should be more than 4 mm* Guard rail consist of stainless steel pipe with height of 900mm with upright of outside diameter of minimum 73mm dia (3.05mm thick) at spacing of 2m intervals with horizontal 3 pipes of 60mm dia (2.75mm thick) with necessary all fixing materials including cuoplings, joints, etc.(As per the drawing number AASL/CIAR/3920243)	m	50		
	Note: Item number 3.11.2, 3.11.3, 3.11.4, 3.11.5 should follow the specidications for structural steel work. Rate Shall include for; (a) Surface preparation to Sa. 2.5 standard Sand blasting. Dry films thickness of the paint should be suited with C5 environmental corrosivity category 340 microns minimum DFT. This DFT should be completed before the erection.				

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
	(b) All fabrication work, welding, marking, drilling, for bolts including securing steel plates, bolts, nuts and any type of washers, reverted work, counter sinking and tapping for bolts or machine screws. Bolts should be grade 8.8 and anchor bolts should be grade 4.6. (c) Fabrication, erection and temporary supports and fixing in to position. (d) G.I. Pipe works should include applying of one coat of "Etch" primer and two coats of matt enamel spray paint to approval. (e) Minimum grade of structural steel with grade S275.				
3.11.3	(f) Rate for G.I. Pipe works should include Surface preparation & apply one coat of GI metal primer & and two coats of matt enamel spray paint to approval. (g) Rate to include for; all fabrication work, welding, marking, drilling, for bolts including securing steel plates, bolts, nuts and any type of washers, reverted work, counter sinking and tapping for bolts or machine screws. (h) Rate to include for fabrication, erection and temporary supports and fixing in to position. Supply, fabricate & fix Zn/Al roofing at entrance porch with Steel frame work, necessary accessories with painting work as per the drawings No .AASL/CIAR/3920241, AASL/CIAR/3920242	Item	Allow	Sum	
3.11.4	Supply, fabricate & Fix ladder for access to the Tower roof terrace with necessary accessories, painting work as per the drawing, AASL/CIAR/3920250	Item	Allow	Sum	
3.11.5	Supply, fabricate & Fix Steel I section at Tower roof terrace with necessary accessories, painting work as per the drawing no AASL/CIAR/3920245	Item	Allow	Sum	
3.11.6	CEILING WORK ***Note :-*** *Payment for ceiling is per sq.m. of completed ceiling deducting for voids & including all frame work and edge angles required to complete to work. Provision should be made for installation of Light Fittings, Fire and Smoke Detectors, Air Conditioning Diffusers etc. All sample should be approved by the Engineer prior to the commencement of work.* Supply and installation of suspended interior acoustic tile ceiling 600mm X 600mm size (colour and texture to approval) including framework suspended from roof slab and metal clip-in ceiling panel system as per specification in Tower soffit.	m^2	80		
	ANTI-STATIC FLOORING IN TOWER ***Note :-*** *Payment for flooring is per sq.m. of completed flooring deducting for voids & including all frame work and edge angles required to complete to work. Provision should be made for installation of all services and cables etc. All sample should be approved by the Engineer prior to the commencement of work. Refer Drawing Number AASL/CIAR/3920242*				

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
3.11.7	Supply and installation of Anti-static flooring with necessary all supporting structures , steps and edge detailings, etc. in tower floor	m^2	80		
	CLADDING WORK				
3.11.8	Supply, fabrication and installation of 4mm thick Aluminum composite "Extec" cladding to exterior wall surface comprising metal frame work with mounting system, necessary fixing arrangement, beading, sealant, etc,. complete all as per detail drawing and to the approval of the Engineer. (Measurement for payment- Surface area of the cladding sheet installed)				
(a)	Level from +3850 mm to +7350 mm	m2	126		
(b)	Level from +7350 mm to +10850 mm	m2	96		
(c)	Level from +10850 mm to +14350 mm	m2	84		
(d)	Level from +14350 mm to +17850 mm	m2	108		
(e)	Level from +17850 mm to +21350 mm	m2	102		
	MISCELLANIOUS WORK CARRIED TO CIVIL WORK SUB SUMMARY 1				
3.12	EXTERNAL WORK *ROAD WORK*				
3.12.1	Excavate top soil average thickness 150mm and disposal cart away the site	m^2	1,500		
3.12.2	Earth excavation in site leveling or to remove bad soil *(as per Engineer's instruction)* haul and dump where necessary for use as filling material or cart away from site	m^3	450		
3.12.3	Milling / scarifing of existing Road surface at checking area (approximate milling depth 20mm to approval) as per specification. Rate to include for disposal of surplus material away from site.	m^2	200		
3.12.4	Trimming, leveling of original ground to required levels and grades and compaction of sub grade to 95% STD density using a 10 ton vibrating roller as directly. Rate to include the disposal of unsuitable earth & debris within the site.Rate to include for necessary testing.	m^2	1,500		
3.12.5	Supply,transport & spreading Type 1 sub base material for sub base and compacting (100% STD) to required levels..Rates shall include for watering as required to retain optimum moisture content. Sub base shall be measured as finished work in position.(Note: It is advised that the bidder should inspect & identify suitable burrow pits to satisfy the specifications given for type 1 sub base material) Rate to include for necessary testing.	m^3	450		
3.12.6	Dense Graded Aggregate Base Course Supply, transport and uniformly spreading, watering and compacting graded 37.5 mm aggregate in strips,average width not exceeding 1.2m to form a Dense Aggregate Base 200 mm thickness using Machinery including Motergrader & Roller Hire charges.(Measurement for payment - Compacted volume)	m^3	525		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
3.12.7	Prime coat with emulsion/cold bitumen(CSS-1) using 1 ltr/sq.m without blinding, but inclusive of brushing, cleaning and moistening road surface	m^2	1,500		
3.12.8	Tack coat emulsion surfacing (CRS 1) @ 1 ltr. /sq.m including preparing surface, without blinding	m^2	3,000		
3.12.9	Supply, lay & compact asphalt concrete (binder(60/70) 4.5% mix, Plant made) in Binder course Rate to include for necessary testing.	M.Ton	432		
3.12.10	Supply, lay & compact 40mm thick asphalt concrete (binder(60/70) 4.5% mix, Plant made) in wearing course compacted thickness. Rate to include for necessary testing.	M.Ton	288		
3.12.11	Suppling & laying standard type road kerbs(125mmX900mm) set on19mm thick 1:3 cement sand mortar layer on 150mm X 275mm 1:2:4(19) concrete foundation with av. 157mm X 150mm wide backing with same concrete including excavation and shuttering & painting with two coats of enamel paint, etc.	m	600		
3.12.12	Road marking using thermoplastic paint with glass beads inclusive barricading	m^2	500		
3.12.13	Supplying and laying 100mm x 100 mm Heavyduty interlock paving block in Vehical Parking Area (compressive strength 30N/mm2) laid on 30mm quarry dust layer to the approval of the Engineer .Rate to include for fixings, cutting, grouting and all other related ancillary works.	m^2	370		
	SUB TOTAL FOR ROAD WORK - 1				
	CONCRETE DRAIN WORK				
3.12.14	Excavation Drain not exceeding 1.5m deep including levelling and ramming bottom, excavated material materials cart away from the or as directed	m^3	480		
3.12.15	Excavation of Asphalt Road as directed by the Engineer.	m^3	22		
3.12.16	Supply, lay & compacted Quarry dust in Hume pipe around area & top as directed by the Engineer	m^3	12		
3.12.17	Dense Graded Aggregate Base Course Supply, transport and uniformly spreading, watering and compacting graded 37.5 mm aggregate in strips,average width not exceeding 1.2m to form a Dense Aggregate Base 300 mm thickness using vibrator Rammer.(Measurement for payment - Compacted volume)	m^3	10		
3.12.18	Planking and strutting to excavated faces. Rate shall include for all required shoring which forms a part of planking and strutting. (light weight shoring)	m^2	220		
3.12.19	Planking and strutting to excavated faces. Rate shall include for all required shoring which forms a part of planking and strutting. (Sheet piling)	m^2	120		
3.12.20	Laying G15, 50mm thick concrete bellow the drain.	m^2	230		
3.12.21	Form work for the drains as specified in drawings	m^2	851		
3.12.22	supply and laying of G25 concrete for drain work	m^3	253		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
3.12.23	Supply and intallation of required reinforcement for drains				
a)	Tor Steel	M.ton	30		
b)	Mild Steel	M.ton	5		
3.12.24	Supply and intallation of drain covers as per the details (Drawing number - AASL/CIAR/3920252)	Nos	460		
3.12.25	Supply and laying 600mm internal diameter Concrete Hume pipe including cement grout joint filling,etc. as per directed.	m	40		
3.12.26	Strom water interceptor manhole type 1000mm x 1000mm internally with invert depth not exceeding 1200mm including excavation and back filling,concrete work, formwork, reinforcement work,cover slab as per drawing, specification & directed by the Engineer.	Nos	6		
3.12.27	Repairing & connecting to the exsisting drainage system including cleaning & necessary items as per drawing & as directed .	Sum	1		
3.12.28	Supply & lay Steel Grating as per directed.	**Provisional**		**Sum**	**3,000,000.00**
	SUB TOTAL FOR DRAIN WORK - 2				
3.12.4.1	*LANDSCAPING WORK* Preparation of land, Turfing,watering & maintaining (Including Royality, transport, watering & transport of water, etc.) as per directed	m^2	330		
3.12.4.2	Allow sum for tree planting or any other work which not specified in the BOQ but required for proper completion to approval	**Provisional**		**Sum**	**2,000,000.00**
	SUB TOTAL FOR LANDSCAPING WORK - 3				
	EXTERNAL WORK CARRIED TO CIVIL WORK SUB SUMMARY 1 (1 + 2 + 3)				

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
	Bill No : 03 - CIVIL WORKS SUB SUMMARY 1				
3.1	SITE PREPARATION , EXCAVATION & EARTHWORK			Rs.	
3.2	PILING WORK			Rs.	
3.3	CONCRETE, FORMWORK AND REINFORCEMENT			Rs.	
3.4	BLOCK WORK			Rs.	
3.5	WATER PROOFING			Rs.	
3.6	PLASTER WORK AND OTHER FLOOR/WALL FINISHES			Rs.	
3.7	FLOOR AND WALL TILES WITH BACKING & TIMBER FLOOR			Rs.	
3.8	DOORS AND WINDOWS & PARTITIONING WORKS			Rs.	
3.9	RAIN WATER DISPOSAL SYSTEM			Rs.	
3.1	PAINTING			Rs.	
3.11	MISCELLANIOUS WORK			Rs.	
3.12	EXTERNAL WORK			Rs.	
	TOTAL FOR CIVIL WORKS CARRIED TO SUMMARY			Rs.	

BILL OF QUANTITIES

NAVIGATIONAL SERVICE COMPLEX AT CIAR, RATMALANA

Bill No : 04 - INTERNAL WATER SUPPLY, WASTE WATER DISPOSAL & SEWAGE DISPOSAL WORK

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
4.1	**GROUND FLOOR** **SUPPLY & INSTALLATION OF PLUMBING & SANITARY FITTINGS** **Notes:** The Bidders are requested to refer Bills of Quantities, General Notes, Pricing Preambles, Drawings, Specifications, Conditions of Contract, Contract Data and other relevant documents prior to pricing of this section of work. All fittings and specials used in the plumbing installation shall be suitable in all respects to the pipeline to which fittings and specials are fixed. All material approval shall be taken from the Engineer prior to the purchase of materials. All Civil works including casing to walls, drilling, core cuts, provision of all holes, sleeves, openings, chases, ducts, forming holes etc. and making good all works disturbed shall be included under builder works. Contractor shall propose shop drawings and shall obtain approval from the Engineer before commencing installation.				
4.1.1	**Main water Connection & Drain connection** Supply, Installation, Laying and Testing of uPVC Type 1000 pipes & fittings for Water supply & Drainage system on the concrete slab, embedded in walls, under the slab, hanging in the wall/floor/slab, along walls and inside the duct and where necessary. Shall stability for high-pressure water supply (6 bar). Pipes supporting shall be in 1.0m spacing. Work shall be completed as per the design drawings, specifications & direction of the Engineer in charge.				
	Rates for plumbing work shall include, (a). Cutting and waste of pipes etc., and joining pipes. (b). All specials such as elbows, bends, tees, junctions, cleaning eye, socket, reducers, brass & threaded fittings and similar all necessary pipe fittings & accessories, (c) Connecting pipes to sanitary fixtures and appliances. (d). Necessary screws, nail sockets, the connection back nuts standard pipe fixing or supporting clips, saddles, brackets, holder bats, straps etc. (e). Pipe penetrations through floor slabs, walls, columns or beams where necessary. (f) Connecting different types of pipes & Connecting to Existing system including necessary Valves & accessories. (g) Sundry items related to the work where necessary as required by the Engineer. (h). Supply, installation, testing and disinfection after completion.				

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
a	20 mm Dia.	m	50		
b	25 mm Dia.	m	25		
c	32mm Dia.	m	40		
d	40mm dia.	m	20		
e	50mm dia	m	10		
f	63mm dia.	m	15		
G	110mm dia.	m	40		
	Sanitary Fittings **Notes:** All Sanitary fitting & Accessories shall be European made Sanitary fittings and accessories shall be White Glazed Vitreous China All Sanitary fittings and accessories shall be as per specification, drawings and Engineer approval. Rates for sanitary fittings shall include for:- Assembling, jointing together fixing components parts, and jointing to pipes including necessary coupling and for leaving perfectly clean and in perfect working order as on completion.				
4.1.2	Supply & installation of Angle Valve 12mm Dia. with all necessary accessories complete to working order.	Nos.	22		
4.1.3	Supply & installation of Stop Valve (Ball Type) 32mm with all necessary fittings and accessories complete to working order.	Nos.	3		
4.1.4	Supply & installation of C/P Bidet Spray with flexible connection & hand holder with all necessary fittings and accessories complete to working order.	Nos.	8		
4.1.5	Supply & installation of Toilet Paper Holder with all necessary accessories complete to working order.	Nos.	8		
4.1.6	Supply & installation of Flexible Hose C/P 1 ½" x ½" with all necessary accessories complete to working order.	Nos.	15		
4.1.7	Supply & installation of 6" x 6" Stainless steel gully cover with water & air Trap Floor Gully Box with all necessary accessories complete to working order.	Nos.	14		
4.1.8	Supply & installation of C/P Bib Tap with Lever Handel with all necessary accessories complete to working order.	Nos.	2		
4.1.9	Supply & installation of Soap Holder with all necessary accessories complete to working order.	Nos.	3		
4.1.10	Supply & installation of Robe hook with all necessary accessories complete to working order.	Nos.	8		
4.1.11	Supply & installation of Towel rail with all necessary accessories complete to working order.	Nos.	2		
4.1.12	Supply & fixing, testing and commissioning of Vitreous china half pedestal wash Basin complete with C/P Pillar tap, rubber plug, C/P Chain waste & C/P Bottle trap and with all necessary accessories complete to working order. Supply & fixing of Hot dipped galvanized brackets & screws, plugs, nut & bolts and complete as per specifications, drawings and direction of the engineer-in-charge. ***Basic price around 40,000.00***	Nos.	6		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
4.1.13	Supply & fixing, testing and commissioning of Vitreous china closed coupled Water Closet consisting of glazed Vitreous china pedestal, seat cover, duel flushing cistern with siphon mechanism including flexible pipes, bracket, Spring, Bolt Set, nut & bolts, PVC pipes/bend, "P" or "S" Trap and with all other necessary accessories complete to working order. All work shall be completed as per specifications, drawings and direction of the engineer-in-charge. ***Basic price around 88,000.00***	Nos.	8		
4.1.14	Supply & Fixing, testing and commissioning of Vitreous China Wall hung Urinal Tower type fixed with plugs & screws and connected necessary stainless steel pipe with concealed mechanical flush unit with all necessary accessories complete to working order, including supply & fixing of brackets & screws, plugs, nut & bolts and necessary modification to wall. All work shall be completed as per specifications, drawings and direction of the engineer-in-charge. ***Prime cost around 52,000.00***	Nos.	1		
4.1.15	Concealed Shower Mixer, shower head with connection arm C/P with all necessary accessories complete to working order.	Nos	2		
4.1.16	Supply & fixing of 5 mm. Thick Good quality plain mirrors with 04 Nos stainless steel clips/screws fixed to wall with water proof backing a sealant around mirror. Size shall be 450mm x 600mm. Complete as per specifications, detail drawings and direction of the engineer-in-charge.	Nos.	6		
4.1.16	**Main Vertical Stacks Water Supply, Vent Waste Water and Sewerage Disposal** Main Vertical Stacks water supply				
	40mm dia.	m	120		
4.1.17	Main Vertical Stacks including floor connection, Connection intercept manhole/ Sewerage manhole on Ground Floor 110mm dia.	m	250		
4.1.18	Main Vertical Vent Stacks including floor connection, Connection internal 63mm dia.	m	150		
4.1.19	Supply and Install PVC Vent Cover	nos	6		
4.1.20	**Water Supply, Waste Water and Sewerage Disposal** Design Supply & installation of booster pump set for water supply system(3 duty & 1 standby) according to given specification including VSD, Sensor, Panel, valves,heder required pressure reducing valve for the system(5.5 l/s flow rate 55m head)	Set	1		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
4.1.21	Design Supply & installation Polyvinyl chloride (PVC) Type 1000 pipes (Rate to include haging, bracketing,leveling, termination both ends and re-instatement of the area) from pump room to vertical ducts 63mm Dia.	m	120		
4.1.22	Supply & installation uPVC Type 1000 pipes & fittings. Rate shall be included for trench excavation, leveling, termination both ends and re-instatement of the area. Size of trench: width not exceeding 750mm, depth should be more than 1000mm.				
a	63mm Dia.	m	15		
b	110mm dia.	m	30		
c	160mm dia.	m	10		
	Connecting Existing System Waste water and sewerage disposal line connection existing line if necessary construct new manhole & connect to existing line				
4.1.23	Waste interseptor manhole type 650mm x 450mm internally with invert depth not exceeding 900mm including excavation and back filling, 150mm thick RCC grade 30 foundation including necessary reinforcement forming channels and benching, 100mm thick grade 25 concrete walls, DI (D400) frame with cover, lifting hook and render 20mm thick in cement and sand 1:3 to exposed surfaces intrnally and externally, including necessary excavation, backfilling and dump away spoil as directed. Inlet and outlet connections to complete the manhole.	Nos.	8		
4.1.24	Waste manhole type 450mmx450mm internally invert depth not exceeding 900mm including excavation and back filling, 150mm thick RCC grade 30 foundation including necessary reinforcement forming channels and benching, 100mm thick grade 25 concrete walls, DI (D400) frame with cover, lifting hook and render 20mm thick in cement and sand 1 :3 to exposed surfaces intrnally and externally, including necessary excavation,backfilling and dump away spoil as directed. Inlet and outlet connections to complete the manhole.	Nos.	1		
4.1.25	Sewer manhole type 450mmx450mm internally invert depth not exceeding 900mm including excavation and back filling, 150mm thick RCC grade 30 foundation including necessary reinforcement forming channels and benching, 100mm thick grade 25 concrete walls, DI (D400) frame with cover, lifting hook and render 20mm thick in cement and sand 1 :3 to exposed surfaces intrnally and externally, including necessary excavation,backfilling and dump away spoil as directed. Inlet and outlet connections to complete the manhole.	Nos.	8		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
4.1.26	Sewer manhole type 600mmx600mm internally invert depth not exceeding 1000mm including excavation and back filling, 150mm thick RCC grade 30 foundation including necessary reinforcement forming channels and 100mm thick grade 25 concrete walls ,DI (D400) frame with cover ,lifting hook and render 20mm thick in cement and sand 1 :3 to exposed surfaces intrnally and externally, including necessary excavation,backfilling and dump away spoil as directed .Inlet and outlet connections to complete the manhole	Nos.	8		
4.1.27	Sewer manhole type 900mmx900mm internally invert depth not exceeding 1500mm including excavation and back filling, 150mm thick RCC grade 30 foundation including necessary reinforcement forming channels and 100mm thick grade 25 concrete walls ,DI (D400) frame with cover ,lifting hook and render 20mm thick in cement and sand 1 :3 to exposed surfaces intrnally and externally, including necessary excavation,backfilling and dump away spoil as directed. Inlet and outlet connections to complete the manhole	Nos.	5		
4.1.28	To conect the existing line, construction of new manhole (900mmx900mm) internally including excavation and back filling, 150mm thick RCC grade 30 foundation including necessary reinforcement forming channels and 100mm thick grade 25 concrete walls ,DI (D400) frame with cover ,lifting hook and render 20mm thick in cement and sand 1 :3 to exposed surfaces intrnally and externally, including necessary excavation,backfilling and dump away spoil as directed. Inlet and outlet connections to complete the manholepipes with accessories laid under ground with concrete protection including excavation and backfilling.	Nos.	1		
4.1.29	Builders works	Item	Allow	Sum	
4.1.30	Testing & commissioning	Item	Allow	Sum	
4.1.31	Allow for any other items specially not mentioned but which the tender considers necessary	Item	Allow	Sum	
	GROUND FLOOR WORK CARRIED TO INTERNAL WATER SUPPLY, WASTE WATER DISPOSAL & SEWAGE DISPOSAL SUB SUMMARY 2				
4.2	**FIRST FLOOR** *SUPPLY & INSTALLATION OF PLUMBING & SANITARY FITTINGS* **Notes:** The Bidders are requested to refer Bills of Quantities, General Notes, Pricing Preambles, Drawings, Specifications, Conditions of Contract, Contract Data and other relevant documents prior to pricing of this section of work. All fittings and specials used in the plumbing installation shall be suitable in all respects to the pipeline to which fittings and specials are fixed. All material approval shall be taken from the Engineer prior to the purchase of materials.				

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
	All Civil works including casing to walls, drilling, core cuts, provision of all holes, sleeves, openings, chases, ducts, forming holes etc. and making good all works disturbed shall be included under builder works. Contractor shall propose shop drawings and shall obtain approval from the Engineer before commencing installation.				
4.2.1	**Main water Connection & Drain connection** Supply, Installation, Laying and Testing of uPVC Type 1000 pipes & fittings for Water supply & Drainage system on the concrete slab, embedded in walls, under the slab, hanging in the wall/floor/slab, along walls and inside the duct and where necessary. Shall stability for high-pressure water supply (6 bar). Pipes supporting shall be in 1.0m spacing. Work shall be completed as per the design drawings, specifications & direction of the Engineer in charge.				
	Rates for plumbing work shall include, (a). Cutting and waste of pipes etc., and joining pipes. (b). All specials such as elbows, bends, tees, junctions, cleaning eye, socket, reducers, brass & threaded fittings and similar all necessary pipe fittings & accessories, (c) Connecting pipes to sanitary fixtures and appliances. (d). Necessary screws, nail sockets, the connection back nuts standard pipe fixing or supporting clips, saddles, brackets, holder bats, straps etc. (e). Pipe penetrations through floor slabs, walls, columns or beams where necessary. (f) Connecting different types of pipes & Connecting to Existing system including necessary Valves & accessories. (g) Sundry items related to the work where necessary as required by the Engineer. (h). Supply, installation, testing and disinfection after completion.				
a	20 mm Dia.	m	50		
b	25 mm Dia.	m	25		
c	32mm Dia.	m	40		
d	40mm dia.	m	20		
e	50mm dia	m	10		
f	63mm dia.	m	15		
G	110mm dia.	m	40		
	Sanitary Fittings **Notes:** All Sanitary fitting & Accessories shall be European made Sanitary fittings and accessories shall be White Glazed Vitreous China All Sanitary fittings and accessories shall be as per specification, drawings and Engineer approval. Rates for sanitary fittings shall include for:- Assembling, jointing together fixing components parts, and jointing to pipes including necessary coupling and for leaving perfectly clean and in perfect working order as on completion.				

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
4.2.2	Supply & installation of Angle Valve 12mm Dia. with all necessary accessories complete to working order.	Nos.	28		
4.2.3	Supply & installation of Stop Valve (Ball Type) 32mm with all necessary fittings and accessories complete to working order.	Nos.	4		
4.2.4	Supply & installation of C/P Bidet Spray with flexible connection & hand holder with all necessary fittings and accessories complete to working order.	Nos.	10		
4.2.5	Supply & installation of Toilet Paper Holder with all necessary accessories complete to working order.	Nos.	10		
4.2.6	Supply & installation of Flexible Hose C/P 1 ½" x ½" with all necessary accessories complete to working order.	Nos.	18		
4.2.7	Supply & installation of 6" x 6" Stainless steel gully cover with water & air Trap Floor Gully Box with all necessary accessories complete to working order.	Nos.	18		
4.2.8	Supply & installation of C/P Bib Tap with Lever Handel with all necessary accessories complete to working order.	Nos.	4		
4.2.9	Supply & installation of Soap Holder with all necessary accessories complete to working order.	Nos.	4		
4.2.10	Supply & installation of Robe hook with all necessary accessories complete to working order.	Nos.	10		
4.2.11	Supply & installation of Towel rail with all necessary accessories complete to working order.	Nos.	4		
4.2.12	Supply & fixing, testing and commissioning of Vitreous china half pedestal wash Basin complete with C/P Pillar tap, rubber plug, C/P Chain waste & C/P Bottle trap and with all necessary accessories complete to working order. Supply & fixing of Hot dipped galvanized brackets & screws, plugs, nut & bolts and complete as per specifications, drawings and direction of the engineer-in-charge. ***Basic price around 40,000.00***	Nos.	8		
4.2.13	Supply & fixing, testing and commissioning of Vitreous china closed coupled Water Closet consisting of glazed Vitreous china pedestal, seat cover, duel flushing cistern with siphon mechanism including flexible pipes, bracket, Spring, Bolt Set, nut & bolts, PVC pipes/bend, "P" or "S" Trap and with all other necessary accessories complete to working order. All work shall be completed as per specifications, drawings and direction of the engineer-in-charge. ***Basic price around 88,000.00***	Nos.	10		
4.2.14	Concealed Shower Mixer, shower head with connection arm C/P with all necessary accessories complete to working order.	Nos	4		
4.2.15	Supply & fixing of 5 mm. Thick Good quality plain mirrors with 04 Nos stainless steel clips/screws fixed to wall with water proof backing a sealant around mirror. Size shall be 450mm x 600mm. Complete as per specifications, detail drawings and direction of the engineer-in-charge.	Nos.	8		
4.2.16	Builders works	Item	Allow	Sum	
4.2.17	Testing & commissioning	Item	Allow	Sum	

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
4.2.18	Allow for any other items specially not mentioned but which the tender considers necessary	Item	Allow	Sum	
	FIRST FLOOR WORK CARRIED TO INTERNAL WATER SUPPLY, WASTE WATER DISPOSAL & SEWAGE DISPOSAL SUB SUMMARY 2				
4.3	**SECOND FLOOR** *SUPPLY & INSTALLATION OF PLUMBING & SANITARY FITTINGS* **Notes:** The Bidders are requested to refer Bills of Quantities, General Notes, Pricing Preambles, Drawings, Specifications, Conditions of Contract, Contract Data and other relevant documents prior to pricing of this section of work. All fittings and specials used in the plumbing installation shall be suitable in all respects to the pipeline to which fittings and specials are fixed. All material approval shall be taken from the Engineer prior to the purchase of materials. All Civil works including casing to walls, drilling, core cuts, provision of all holes, sleeves, openings, chases, ducts, forming holes etc. and making good all works disturbed shall be included under builder works. Contractor shall propose shop drawings and shall obtain approval from the Engineer before commencing installation.				
4.3.1	**Main water Connection & Drain connection** Supply, Installation, Laying and Testing of uPVC Type 1000 pipes & fittings for Water supply & Drainage system on the concrete slab, embedded in walls, under the slab, hanging in the wall/floor/slab, along walls and inside the duct and where necessary. Shall stability for high-pressure water supply (6 bar). Pipes supporting shall be in 1.0m spacing. Work shall be completed as per the design drawings, specifications & direction of the Engineer in charge. Rates for plumbing work shall include, (a). Cutting and waste of pipes etc., and joining pipes. (b). All specials such as elbows, bends, tees, junctions, cleaning eye, socket, reducers, brass & threaded fittings and similar all necessary pipe fittings & accessories, (c) Connecting pipes to sanitary fixtures and appliances. (d). Necessary screws, nail sockets, the connection back nuts standard pipe fixing or supporting clips, saddles, brackets, holder bats, straps etc. (e). Pipe penetrations through floor slabs, walls, columns or beams where necessary. (f) Connecting different types of pipes & Connecting to Existing system including necessary Valves & accessories. (g) Sundry items related to the work where necessary as required by the Engineer. (h). Supply, installation, testing and disinfection after completion.				
a	20 mm Dia.	m	50		
b	25 mm Dia.	m	20		
c	32mm Dia.	m	30		
d	40mm dia.	m	15		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
e	50mm dia	m	10		
f	63mm dia.	m	20		
G	110mm dia.	m	35		
	Sanitary Fittings **Notes:** All Sanitary fitting & Accessories shall be European made Sanitary fittings and accessories shall be White Glazed Vitreous China All Sanitary fittings and accessories shall be as per specification, drawings and Engineer approval. Rates for sanitary fittings shall include for:- Assembling, jointing together fixing components parts, and jointing to pipes including necessary coupling and for leaving perfectly clean and in perfect working order as on completion.				
4.3.2	Supply & installation of Angle Valve 12mm Dia. with all necessary accessories complete to working order.	Nos.	16		
4.3.3	Supply & installation of Stop Valve (Ball Type) 32mm with all necessary fittings and accessories complete to working order.	Nos.	2		
4.3.4	Supply & installation of C/P Bidet Spray with flexible connection & hand holder with all necessary fittings and accessories complete to working order.	Nos.	6		
4.3.5	Supply & installation of Toilet Paper Holder with all necessary accessories complete to working order.	Nos.	6		
4.3.6	Supply & installation of Flexible Hose C/P 1 ½" x ½" with all necessary accessories complete to working order.	Nos.	10		
4.3.7	Supply & installation of 6" x 6" Stainless steel gully cover with water & air Trap Floor Gully Box with all necessary accessories complete to working order.	Nos.	8		
4.3.8	Supply & installation of C/P Bib Tap with Lever Handel with all necessary accessories complete to working order.	Nos.	2		
4.3.9	Supply & installation of Soap Holder with all necessary accessories complete to working order.	Nos.	2		
4.3.10	Supply & installation of Robe hook with all necessary accessories complete to working order.	Nos.	6		
4.3.11	Supply & fixing, testing and commissioning of Vitreous china half pedestal wash Basin complete with C/P Pillar tap, rubber plug, C/P Chain waste & C/P Bottle trap and with all necessary accessories complete to working order. Supply & fixing of Hot dipped galvanized brackets & screws, plugs, nut & bolts and complete as per specifications, drawings and direction of the engineer-in-charge. ***Basic price around 40,000.00***	Nos.	4		
4.3.12	Supply & fixing, testing and commissioning of Vitreous china closed coupled Water Closet consisting of glazed Vitreous china pedestal, seat cover, duel flushing cistern with siphon mechanism including flexible pipes, bracket, Spring, Bolt Set, nut & bolts, PVC pipes/bend, "P" or "S" Trap and with all other necessary accessories complete to working order. All work shall be completed as per specifications, drawings and direction of the engineer-in-charge. ***Basic price around 88,000.00***	Nos.	6		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
4.3.13	Supply & fixing of 5 mm. Thick Good quality plain mirrors with 04 Nos stainless steel clips/screws fixed to wall with water proof backing a sealant around mirror. Size shall be 450mm x 600mm. Complete as per specifications, detail drawings and direction of the engineer-in-charge.	Nos.	4		
4.3.14	Builders works	Item	Allow	Sum	
4.3.15	Testing & commissioning	Item	Allow	Sum	
4.3.16	Allow for any other items specially not mentioned but which the tender considers necessary	Item	Allow	Sum	
	SECOND FLOOR WORK CARRIED TO INTERNAL WATER SUPPLY, WASTE WATER DISPOSAL & SEWAGE DISPOSAL SUB SUMMARY 2				
4.4	**THIRD FLOOR** *SUPPLY & INSTALLATION OF PLUMBING & SANITARY FITTINGS* **Notes:** The Bidders are requested to refer Bills of Quantities, General Notes, Pricing Preambles, Drawings, Specifications, Conditions of Contract, Contract Data and other relevant documents prior to pricing of this section of work. All fittings and specials used in the plumbing installation shall be suitable in all respects to the pipeline to which fittings and specials are fixed. All material approval shall be taken from the Engineer prior to the purchase of materials. All Civil works including casing to walls, drilling, core cuts, provision of all holes, sleeves, openings, chases, ducts, forming holes etc. and making good all works disturbed shall be included under builder works. Contractor shall propose shop drawings and shall obtain approval from the Engineer before commencing installation.				
4.4.1	**Main water Connection & Drain connection** Supply, Installation, Laying and Testing of uPVC Type 1000 pipes & fittings for Water supply & Drainage system on the concrete slab, embedded in walls, under the slab, hanging in the wall/floor/slab, along walls and inside the duct and where necessary. Shall stability for high-pressure water supply (6 bar). Pipes supporting shall be in 1.0m spacing. Work shall be completed as per the design drawings, specifications & direction of the Engineer in charge.				

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
	Rates for plumbing work shall include, (a). Cutting and waste of pipes etc., and joining pipes. (b). All specials such as elbows, bends, tees, junctions, cleaning eye, socket, reducers, brass & threaded fittings and similar all necessary pipe fittings & accessories, (c) Connecting pipes to sanitary fixtures and appliances. (d). Necessary screws, nail sockets, the connection back nuts standard pipe fixing or supporting clips, saddles, brackets, holder bats, straps etc. (e). Pipe penetrations through floor slabs, walls, columns or beams where necessary. (f) Connecting different types of pipes & Connecting to Existing system including necessary Valves & accessories. (g) Sundry items related to the work where necessary as required by the Engineer. (h). Supply, installation, testing and disinfection after completion.				
a	20 mm Dia.	m	50		
b	25 mm Dia.	m	20		
c	32mm Dia.	m	30		
d	40mm dia.	m	20		
e	50mm dia	m	10		
f	63mm dia.	m	25		
G	110mm dia.	m	40		
	Sanitary Fittings **Notes:** All Sanitary fitting & Accessories shall be European made Sanitary fittings and accessories shall be White Glazed Vitreous China All Sanitary fittings and accessories shall be as per specification, drawings and Engineer approval. Rates for sanitary fittings shall include for:- Assembling, jointing together fixing components parts, and jointing to pipes including necessary coupling and for leaving perfectly clean and in perfect working order as on completion.				
4.4.2	Supply & installation of Angle Valve 12mm Dia. with all necessary accessories complete to working order.	Nos.	19		
4.4.3	Supply & installation of Stop Valve (Ball Type) 32mm with all necessary fittings and accessories complete to working order.	Nos.	3		
4.4.4	Supply & installation of C/P Bidet Spray with flexible connection & hand holder with all necessary fittings and accessories complete to working order.	Nos.	7		
4.4.5	Supply & installation of Toilet Paper Holder with all necessary accessories complete to working order.	Nos.	7		
4.4.6	Supply & installation of Flexible Hose C/P 1 ½" x ½" with all necessary accessories complete to working order.	Nos.	12		
4.4.7	Supply & installation of 6" x 6" Stainless steel gully cover with water & air Trap Floor Gully Box with all necessary accessories complete to working order.	Nos.	10		
4.4.8	Supply & installation of C/P Bib Tap with Lever Handel with all necessary accessories complete to working order.	Nos.	1		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
4.4.9	Supply & installation of Soap Holder with all necessary accessories complete to working order.	Nos.	3		
4.4.10	Supply & installation of Robe hook with all necessary accessories complete to working order.	Nos.	7		
4.4.11	Supply & installation of Towel rail with all necessary accessories complete to working order.	Nos.	1		
4.4.12	Supply & fixing, testing and commissioning of Vitreous china half pedestal wash Basin complete with C/P Pillar tap, rubber plug, C/P Chain waste & C/P Bottle trap and with all necessary accessories complete to working order. Supply & fixing of Hot dipped galvanized brackets & screws, plugs, nut & bolts and complete as per specifications, drawings and direction of the engineer-in-charge. ***Basic price around 40,000.00***	Nos.	5		
4.4.13	Supply & fixing, testing and commissioning of Vitreous china closed coupled Water Closet consisting of glazed Vitreous china pedestal, seat cover, duel flushing cistern with siphon mechanism including flexible pipes, bracket, Spring, Bolt Set, nut & bolts, PVC pipes/bend, "P" or "S" Trap and with all other necessary accessories complete to working order. All work shall be completed as per specifications, drawings and direction of the engineer-in-charge. ***Basic price around 88,000.00***	Nos.	7		
4.4.14	Concealed Shower Mixer, shower head with connection arm C/P with all necessary accessories complete to working order.	Nos	1		
4.4.15	Supply & fixing of 5 mm. Thick Good quality plain mirrors with 04 Nos stainless steel clips/screws fixed to wall with water proof backing a sealant around mirror. Size shall be 450mm x 600mm. Complete as per specifications, detail drawings and direction of the engineer-in-charge.	Nos.	5		
4.4.16	Builders works	Item	Allow	Sum	
4.4.17	Testing & commissioning	Item	Allow	Sum	
4.4.18	Allow for any other items specially not mentioned but which the tender considers necessary	Item	Allow	Sum	
	THIRD FLOOR WORK CARRIED TO INTERNAL WATER SUPPLY, WASTE WATER DISPOSAL & SEWAGE DISPOSAL SUB SUMMARY 2				
4.5	**FOURTH FLOOR** *SUPPLY & INSTALLATION OF PLUMBING & SANITARY FITTINGS* **Notes:** The Bidders are requested to refer Bills of Quantities, General Notes, Pricing Preambles, Drawings, Specifications, Conditions of Contract, Contract Data and other relevant documents prior to pricing of this section of work. All fittings and specials used in the plumbing installation shall be suitable in all respects to the pipeline to which fittings and specials are fixed. All material approval shall be taken from the Engineer prior to the purchase of materials.				

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
	All Civil works including casing to walls, drilling, core cuts, provision of all holes, sleeves, openings, chases, ducts, forming holes etc. and making good all works disturbed shall be included under builder works. Contractor shall propose shop drawings and shall obtain approval from the Engineer before commencing installation.				
4.5.1	**Main water Connection & Drain connection** Supply, Installation, Laying and Testing of uPVC Type 1000 pipes & fittings for Water supply & Drainage system on the concrete slab, embedded in walls, under the slab, hanging in the wall/floor/slab, along walls and inside the duct and where necessary. Shall stability for high-pressure water supply (6 bar). Pipes supporting shall be in 1.0m spacing. Work shall be completed as per the design drawings, specifications & direction of the Engineer in charge. Rates for plumbing work shall include, (a). Cutting and waste of pipes etc., and joining pipes. (b). All specials such as elbows, bends, tees, junctions, cleaning eye, socket, reducers, brass & threaded fittings and similar all necessary pipe fittings & accessories, (c) Connecting pipes to sanitary fixtures and appliances. (d). Necessary screws, nail sockets, the connection back nuts standard pipe fixing or supporting clips, saddles, brackets, holder bats, straps etc. (e). Pipe penetrations through floor slabs, walls, columns or beams where necessary. (f) Connecting different types of pipes & Connecting to Existing system including necessary Valves & accessories. (g) Sundry items related to the work where necessary as required by the Engineer. (h). Supply, installation, testing and disinfection after completion.				
a	20 mm Dia.	m	50		
b	25 mm Dia.	m	20		
c	32mm Dia.	m	30		
d	40mm dia.	m	20		
e	50mm dia	m	10		
f	63mm dia.	m	25		
G	110mm dia.	m	40		
	Sanitary Fittings **Notes:** All Sanitary fitting & Accessories shall be European made Sanitary fittings and accessories shall be White Glazed Vitreous China All Sanitary fittings and accessories shall be as per specification, drawings and Engineer approval. Rates for sanitary fittings shall include for:- Assembling, jointing together fixing components parts, and jointing to pipes including necessary coupling and for leaving perfectly clean and in perfect working order as on completion.				
4.5.2	Supply & installation of Angle Valve 12mm Dia. with all necessary accessories complete to working order.	Nos.	28		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
4.5.3	Supply & installation of Stop Valve (Ball Type) 32mm with all necessary fittings and accessories complete to working order.	Nos.	4		
4.5.4	Supply & installation of C/P Bidet Spray with flexible connection & hand holder with all necessary fittings and accessories complete to working order.	Nos.	10		
4.5.5	Supply & installation of Toilet Paper Holder with all necessary accessories complete to working order.	Nos.	10		
4.5.6	Supply & installation of Flexible Hose C/P 1 ½" x ½" with all necessary accessories complete to working order.	Nos.	21		
4.5.7	Supply & installation of 6" x 6" Stainless steel gully cover with water & air Trap Floor Gully Box with all necessary accessories complete to working order.	Nos.	25		
4.5.8	Supply & installation of C/P Bib Tap with Lever Handel with all necessary accessories complete to working order.	Nos.	10		
4.5.9	Supply & installation of Soap Holder with all necessary accessories complete to working order.	Nos.	4		
4.5.10	Supply & installation of Robe hook with all necessary accessories complete to working order.	Nos.	10		
4.5.11	Supply & installation of Towel rail with all necessary accessories complete to working order.	Nos.	10		
4.5.12	Supply & fixing, testing and commissioning of Vitreous china half pedestal wash Basin complete with C/P Pillar tap, rubber plug, C/P Chain waste & C/P Bottle trap and with all necessary accessories complete to working order. Supply & fixing of Hot dipped galvanized brackets & screws, plugs, nut & bolts and complete as per specifications, drawings and direction of the engineer-in-charge. ***Basic price around 40,000.00***	Nos.	8		
4.5.13	Supply & fixing, testing and commissioning of Vitreous china closed coupled Water Closet consisting of glazed Vitreous china pedestal, seat cover, duel flushing cistern with siphon mechanism including flexible pipes, bracket, Spring, Bolt Set, nut & bolts, PVC pipes/bend, "P" or "S" Trap and with all other necessary accessories complete to working order. All work shall be completed as per specifications, drawings and direction of the engineer-in-charge. ***Basic price around 88,000.00***	Nos.	10		
4.5.14	Supply & Fixing, testing and commissioning of Vitreous China Wall hung Urinal Tower type fixed with plugs & screws and connected necessary stainless steel pipe with concealed mechanical flush unit with all necessary accessories complete to working order, including supply & fixing of brackets & screws, plugs, nut & bolts and neccessary modification to wall. All work shall be completed as per specifications, drawings and direction of the engineer-in-charge. ***Basic price around 52,000.00***	Nos.	3		
4.5.15	Supply & Fixing of Vitreous China urinal division fixed to wall with plugs & screws with all necessary accessories complete to working order as per the specifications, drawings and direction of engineer-in-charge. ***Prime cost around 28,000.00***	Nos.	2		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
4.5.16	Concealed Shower Mixer, shower head with connection arm C/P with all necessary accessories complete to working order.	Nos	10		
4.5.17	Supply & fixing of 5 mm. Thick Good quality plain mirrors with 04 Nos stainless steel clips/screws fixed to wall with water proof backing a sealant around mirror. Size shall be 450mm x 600mm. Complete as per specifications, detail drawings and direction of the engineer-in-charge.	Nos.	8		
4.5.18	Builders works	Item	Allow	Sum	
4.5.19	Testing & commissioning	Item	Allow	Sum	
4.5.20	Allow for any other items specially not mentioned but which the tender considers necessary	Item	Allow	Sum	
	FOURTH FLOOR WORK CARRIED TO INTERNAL WATER SUPPLY, WASTE WATER DISPOSAL & SEWAGE DISPOSAL SUB SUMMARY 2				
4.6	**FIFTH FLOOR**				
	SUPPLY & INSTALLATION OF PLUMBING & SANITARY FITTINGS **Notes:** The Bidders are requested to refer Bills of Quantities, General Notes, Pricing Preambles, Drawings, Specifications, Conditions of Contract, Contract Data and other relevant documents prior to pricing of this section of work. All fittings and specials used in the plumbing installation shall be suitable in all respects to the pipeline to which fittings and specials are fixed. All material approval shall be taken from the Engineer prior to the purchase of materials. All Civil works including casing to walls, drilling, core cuts, provision of all holes, sleeves, openings, chases, ducts, forming holes etc. and making good all works disturbed shall be included under builder works. Contractor shall propose shop drawings and shall obtain approval from the Engineer before commencing installation.				
4.6.1	**Main water Connection & Drain connection** Supply, Installation, Laying and Testing of uPVC Type 1000 pipes & fittings for Water supply & Drainage system on the concrete slab, embedded in walls, under the slab, hanging in the wall/floor/slab, along walls and inside the duct and where necessary. Shall stability for high-pressure water supply (6 bar). Pipes supporting shall be in 1.0m spacing. Work shall be completed as per the design drawings, specifications & direction of the Engineer in charge.				

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
	Rates for plumbing work shall include, (a). Cutting and waste of pipes etc., and joining pipes. (b). All specials such as elbows, bends, tees, junctions, cleaning eye, socket, reducers, brass & threaded fittings and similar all necessary pipe fittings & accessories, (c) Connecting pipes to sanitary fixtures and appliances. (d). Necessary screws, nail sockets, the connection back nuts standard pipe fixing or supporting clips, saddles, brackets, holder bats, straps etc. (e). Pipe penetrations through floor slabs, walls, columns or beams where necessary. (f) Connecting different types of pipes & Connecting to Existing system including necessary Valves & accessories. (g) Sundry items related to the work where necessary as required by the Engineer. (h). Supply, installation, testing and disinfection after completion.				
a	20 mm Dia.	m	50		
b	25 mm Dia.	m	20		
c	32mm Dia.	m	30		
d	40mm dia.	m	20		
e	50mm dia	m	10		
f	63mm dia.	m	25		
g	110mm dia.	m	40		
	Sanitary Fittings **Notes:** (a) All Sanitary fitting & Accessories shall be European made (b) Sanitary fittings and accessories shall be White Glazed Vitreous China (c) All Sanitary fittings and accessories shall be as per specification, drawings and Engineer approval. (d) Rates for sanitary fittings shall include for:- (e) Assembling, jointing together fixing components parts, and jointing to pipes including necessary coupling and for leaving perfectly clean and in perfect working order as on completion.				
4.6.2	Supply & installation of Angle Valve 12mm Dia. with all necessary accessories complete to working order.	Nos.	16		
4.6.3	Supply & installation of Stop Valve (Ball Type) 32mm with all necessary fittings and accessories complete to working order.	Nos.	3		
4.6.4	Supply & installation of C/P Bidet Spray with flexible connection & hand holder with all necessary fittings and accessories complete to working order.	Nos.	6		
4.6.5	Supply & installation of Toilet Paper Holder with all necessary accessories complete to working order.	Nos.	6		
4.6.7	Supply & installation of Flexible Hose C/P 1 ½" x ½" with all necessary accessories complete to working order.	Nos.	10		
4.6.8	Supply & installation of 6" x 6" Stainless steel gully cover with water & air Trap Floor Gully Box with all necessary accessories complete to working order.	Nos.	8		
4.6.9	Supply & installation of C/P Bib Tap with Lever Handel with all necessary accessories complete to working order.	Nos.	2		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
4.6.10	Supply & installation of Soap Holder with all necessary accessories complete to working order.	Nos.	3		
4.6.11	Supply & installation of Robe hook with all necessary accessories complete to working order.	Nos.	6		
4.6.12	Supply & fixing, testing and commissioning of Vitreous china half pedestal wash Basin complete with C/P Pillar tap, rubber plug, C/P Chain waste & C/P Bottle trap and with all necessary accessories complete to working order. Supply & fixing of Hot dipped galvanized brackets & screws, plugs, nut & bolts and complete as per specifications, drawings and direction of the engineer-in-charge. ***Basic price around 40,000.00***	Nos.	4		
4.6.13	Supply & fixing, testing and commissioning of Vitreous china closed coupled Water Closet consisting of glazed Vitreous china pedestal, seat cover, duel flushing cistern with siphon mechanism including flexible pipes, bracket, Spring, Bolt Set, nut & bolts, PVC pipes/bend, "P" or "S" Trap and with all other necessary accessories complete to working order. All work shall be completed as per specifications, drawings and direction of the engineer-in-charge. ***Basic price around 88,000.00***	Nos.	6		
4.6.14	Supply & fixing of 5 mm. Thick Good quality plain mirrors with 04 Nos stainless steel clips/screws fixed to wall with water proof backing a sealant around mirror. Size shall be 450mm x 600mm. Complete as per specifications, detail drawings and direction of the engineer-in-charge.	Nos.	4		
4.6.15	Builders works	Item	Allow	Sum	
4.6.16	Testing & commissioning	Item	Allow	Sum	
4.6.17	Allow for any other items specially not mentioned but which the tender considers necessary	Item	Allow	Sum	
	FIFTH FLOOR WORK CARRIED TO INTERNAL WATER SUPPLY, WASTE WATER DISPOSAL & SEWAGE DISPOSAL SUB SUMMARY 2				

Bill No : 04 - INTERNAL WATER SUPPLY, WASTE WATER DISPOSAL & SEWAGE DISPOSAL WORK
SUB SUMMARY 2

4.1	GROUND FLOOR	Rs.	
4.2	FIRTST FLOOR	Rs.	
4.3	SECOND FLOOR	Rs.	
4.4	THIRD FLOOR	Rs.	
4.5	FOURTH FLOOR	Rs.	
4.6	FIFTH FLOOR	Rs.	
	TOTAL OF INTERNAL WATER SUPPLY, WASTE WATER DISPOSAL & SEWAGE DISPOSAL WORK CARRIED TO SUMMARY	Rs.	

BILL OF QUANTITIES

NAVIGATIONAL SERVICE COMPLEX AT CIAR, RATMALANA

Bill No : 05 - ELECTRICAL INSTALLATION

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
	Note: Samples for all under mentioned electrical fixtures shall produce to the approval of the Engineer				
5.1	Supply, install, test and commission of Apprx. 32W, 100 lm/W, 4000K, **600mm x 600mm** surface mount type **LED Panel Light** fitting c/w high performance electronics control gear and mounting accessories as per the specifications (Quality Philips, Osram, VS, RZB or equivalent)	Nos.	215		
5.2	Supply, install, test and commission of Apprx. **32W,** 100 lm/W, 4000K, **600mm x 600mm** surface mount type **dimmable LED Panel Light** fitting c/w high performance electronics control gear and mounting accessories as per the specifications (Quality Philips, Osram, VS, RZB or equivalent)	Nos.	45		
5.3	Supply, install, test and commission of Apprx. **18W**, 100 lm/W, 4000K, surface mount type **LED Panel Light fitting** c/w high performance electronics control gear and mounting accessories as per the specifications (Quality Philips, Osram, VS, RZB or equivalent)	Nos.	675		
5.4	Supply, install, test and commission of Apprx. **18W**, 100 lm/W, 4000K, surface mount **Circular type LED Panel Light** fitting (for ACC) c/w high performance electronics control gear and mounting accessories as per the specifications (Quality Philips, Osram, VS, RZB or equivalent)	Nos.	50		
5.5	Supply, install, test and commission of Apprx. **18W**, 100 lm/W, 4000K, surface mount **Circular type dimmable LED Panel Light** fitting (for ACC) c/w high performance electronics control gear and mounting accessories as per the specifications (Quality Philips, Osram, VS, RZB or equivalent)	Nos.	25		
5.6	Supply, install, test and commission of Apprx. **18W**, 100 lm/W, 4000K, **Pendent mount Circular type LED down Light** fitting c/w high performance electronics control gear, diffuser and mounting accessories as per the specifications (Quality Philips, Osram, VS, RZB or equivalent)	Nos.	25		
5.7	Supply, install, test and commission of Apprx. **50W**, 6500K, wall mount type **LED Flood Light** fitting c/w die-cast Aluminium body, high performance electronics control gear, high efficiency reflector & diffuser and mounting accessories as per the specifications (Quality Philips, Osram, VS, RZB or equivalent)	Nos.	6		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
5.8	Supply, install, test and commission of Apprx. **20W**, 6500K, wall mount type **LED Flood Light** fitting c/w die-cast Aluminium body, high performance electronics control gear, high efficiency reflector & diffuser and mounting accessories as per the specifications (Quality Philips, Osram, VS, RZB or equivalent)	Nos.	15		
5.9	Supply, install, test and commission of Apprx. **10W**, surface mount dimmable type **LED spot Light** fitting c/w powder coated body, high performance electronics control gear, diffuser and mounting accessories as per the specifications (Quality Philips, Osram, VS, RZB or equivalent)	Sets	12		
5.10	Supply, install, test and commission of Apprx. **18W**, 100 lm/W, 4000K, surface mount type **4ft LED Batten Light** fitting c/w high performance electronics control gear, diffuser and mounting accessories as per the specifications (Quality Philips, Osram, VS, RZB or equivalent)	Nos.	50		
5.11	Supply, install, test and commission of Apprx. **18W**, 100 lm/W, 4000K, surface mount type **4ft weather proof (IP65) LED batten Light** fitting c/w high performance electronics control gear and mounting accessories as per the specifications (Quality Philips, Osram, VS, RZB or equivalent)	Nos.	25		
5.12	Supply, install, test and commission of Apprx. **15W**, 4000K, wall mount type weather proof (IP65) **wall washed LED Light** fitting c/w high performance electronics control gear, diffuser and mounting accessories as per the specifications (Quality Philips, Osram, VS, RZB or equivalent)	Nos.	60		
5.13	Supply, install, test and commission of Apprx. **10W**, 100 lm/W, 4000K, surface mount batten type **2ft LED Mirror Light** fitting c/w stainless steel body, high performance electronics control gear, diffuser and mounting accessories as per the specifications (Quality: Philips, Osram, VS, RZB or equivalent)	Nos.	37		
5.14	Supply, install, test and commission of Apprx. **6W, 100 lm/W, 4000K, surface mount type LED Down Light fitting** c/w high performance electronics control gear, diffuser, 13A socket outlet & plug top and mounting accessories as per the specifications for connect to the UPS power supplies for **Emergency Lighting** (Quality Philips, Osram, VS, RZB or equivalent)	Nos.	220		
5.15	Supply, install, test and commission of ceiling suspended type 6W LED illuminated mains/UPS powered type **double sided Exit Sign Board** fitting c/w 2.5hr duration battery backups (Ni-Cd, Ni-MH or equivalent) & 13A Socket outlet & Plug top. (Quality: Thorn, Denco, Samcom or equivalent)	Nos.	10		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
5.16	Supply, install, test and commission of ceiling suspended type 6W LED illuminated mains/UPS powered type **Single sided Exit Sign Board** fitting c/w 2.5hr duration battery backups (Ni-Cd, Ni-MH or equivalent) & 13A Socket outlet & Plug top. (Quality: Thorn, Denco, Samcom or equivalent)	Nos.	15		
5.17	Supply, install, test and commission of ceiling suspended type LED **Ornamental Chandelier** fitting to suit ground floor front lobby (suit to Airport environment and lobby area) c/w mounting accessories.	Nos.	1		
5.18	Supply, install on control tower roof top, test and commission of medium intensity pole mount type **LED Aviation Obstruction Lights** (two OB fittings on single mounting pole) complying with ICAO Annex 14 and FAA L-864 standard (Rate shall include the controllers, mounting pole & accessories and IP65 Enclosure & fitting as per the specifications). Operation shall be dawn to dusk in auto function with local control from control tower.	Item	1		
5.19	Supply, install on control tower roof top, test and commission of omni directional medium intensity **Aerodrome Beacon** suit for commercial land airport, complying with FAA: L-802A A/C150/5345-12 (Current Edition) & ICAO: Annex 14, para 5.3.3 (Rate shall include mounting tower with accessories, IP65 Enclosure & fitting as per the specifications). Operation shall be from ATC control tower. (Proposal to be furnished with the offer for Engineer's approval)	Item	1		
5.20	Supply, install, test and commission of 1400mm **Ceiling Fans** (Quality: KDK, Panasonic or equivalent)	Nos.	15		
5.21	Supply, install, test and commission of ceiling mount **Orbital type Fans** (Quality: KDK, Panasonic or equivalent)	Nos.	30		
5.22	Supply, install, test and commission of **wall mount Fans** c/w in-built speed Regulator with switch (Quality: KDK, Panasonic or equivalent)	Nos.	95		
5.23	Supply, install, test & commission of **18inch** wall mounted **Extractor Fan** for Generator Room c/w shutters (Quality: KDK, Panasonic or equivalent)	Nos.	4		
5.24	Supply, install, test & commission of **8 inch** wall mounted **Extractor Fans** for power house duty room toilet and CES workshop c/w shutters (Quality: KDK, Panasonic or equivalent)	Nos.	4		
5.25	Supply, install, test & commission of sunk type **13A(Single) switched Socket Outlets**, mounting on wall or skirt trunking **(**in 5 **Ring Circuits f**or general power supply)	Nos.	45		
5.26	Supply, install, test & commission of sunk type **13A(Single) switched Socket Outlets**, mounting on wall or skirt trunking **(**in 150 **Radial Circuits** for general power supply)	Nos.	475		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
5.27	Supply, install, test & commission of sunk type **13A(Single) switched Socket Outlets**, mounting on wall or skirt trunking **(**in 55 **Radial Circuits for FCU** power supply)	Nos.	190		
5.28	Supply, install, test & commission of sunk type **13A(Single) switched Socket Outlets**, mounting on wall or skirt trunking **(**in 15 **Radial Circuits for VRV** power supply)	Nos.	40		
5.29	Supply, install, test and commission of 115v/240v **universal shaver socket outlet,** white colour.(Quality: Clipsal or equivalent)	Nos.	14		
5.30	Supply, install, test & commission of automatic electric **Hand driers** as per specifications (Quality: Macdonald,Soloman, Mediclinic, Mitsubishi, Toto or equivalent)	Nos.	20		
	Final Wiring Points				
5.31	**Wiring for Lamp points** using 1.5mm^2 Cu/PVC/PVC wires in embeded conduits and/or cable trays including Conduits and accessories, switches, mounting boxes and accessories as per drawings & specifications. (Cost of cable trays shall not include here) (Quality: ACL, Kelani or equivalent)	Nos.	1050		
5.32	**Wiring for Lamp points with photocel control for outdoor lighting circuits** using 1.5mm^2 Cu/PVC/PVC wires in embeded conduits and/or cable trays including photocell wsitch, Conduits and accessories, switches, mounting boxes and accessories as per drawings & specifications. (Cost of cable trays shall not include here) (Total lamp points: 15Nos. in 03 Ccts.) (Quality: ACL, Kelani or equivalent)	Ccts.	3		
5.33	**Wiring for dimmable Lamp points** using 1.5mm^2 Cu/PVC/PVC wires in embeded conduits and/or cable trays including Conduits and accessories, dimmers, switches, mounting boxes and accessories as per drawings & specifications. (Cost of cable trays shall not include here) (Quality: ACL, Kelani or equivalent)	Nos.	110		
5.34	**Wiring for staircase Lamp points** (two way wiring) using 1.5mm^2 Cu/PVC/PVC wires in embeded conduits including Conduits and accessories switches, mounting boxes and accessories as per drawings & specifications. (Cost of cable trays shall not include here) (Quality: ACL, Kelani or equivalent)	Nos.	11		
5.35	**Wiring for corridor Lamp points (2way wiring)** using 1.5mm^2 Cu/PVC/PVC wires in cable trays including switches, mounting boxes and accessories as per drawings & specifications. (Cost of cable trays shall not include here) (Total lamp points: 95Nos. in 10 Ccts.) (Quality: ACL, Kelani or equivalent)	Ccts.	10		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
5.36	**Wiring for Emergency Lamp & Exit sign points** Powered by Central UPS at each floor switch room, using 1.5mm^2 Cu/PVC/PVC wires in embeded conduits and/or cable trays including 13A Socket & plug top for each point, Conduits and accessories, switches, mounting boxes and accessories as per drawings & specifications. (Cost of cable trays shall not include here) (Total number of Emergency Lamps fittings: 235 Nos.) (Quality: ACL, Kelani or equivalent)	Ccts.	36		
5.37	**Wiring for Aviation Obstruction Light point** (from control tower cabin to Tower top) inclusive of local control and auto operation by a photocell, using 3C-2.5mm^2 Cu/PVC/PVC wire in GI conduits outside to suit weather conditions, including Photo cell & all accessories as per drawings. Steel structure and all metallic parts to be properly grounded and the cost for grounding material to be included here. (Quality: ACL, Kelani or equivalent)	Nos.	1		
5.38	**Wiring for 13A Socket Outlets on walls in radial circuits for General Power** using 2C-2.5mm^2 Cu/PVC/PVC+2.5mm^2 Cu/PVC (Earth) wires on cable trays and/or embeded conduits including conduit and accessories, 100x100x50mm PVC mounting box and accessories, as per drawings and specifications. (Cost of cable trays shall not include here) [Total 475 Nos. socket outlets in 150 radial circuits] (Quality: ACL, Kelani or equivalent)	Ccts.	150		
5.39	**Wiring for 13A Socket Outlets on walls in ring circuits for General Power** using 2C-2.5mm^2 Cu/PVC/PVC+2.5mm^2 Cu/PVC (Earth) wires on cable trays and/or embeded conduits including conduit and accessories, 100x100x50mm PVC mounting box and accessories, as per drawings and specifications. (Cost of cable trays shall not include here) [Total 45 Nos. socket outlets in 5 ring circuits] (Quality: ACL, Kelani or equivalent)	Ccts.	5		
5.40	**Wiring for 13A Socket Outlets on walls in radial circuits for FCUs** using 2C-2.5mm^2 Cu/PVC/PVC+2.5mm^2 Cu/PVC (Earth) wires on cable trays and/or embeded conduits including conduit and accessories, 100x100x50mm PVC mounting box and accessories, as per drawings and specifications. (Cost of cable trays shall not include here) [Total 190 Nos. socket outlets in 55 FCU radial circuits] (Quality: ACL, Kelani or equivalent)	Ccts.	55		
5.41	**Wiring for main supply line to VRV Panel** at AHU Room from Electrical panel room on cable tray, using 4C-10mm^2 Cu/PVC/PVC + 4C-10mm^2 Cu/PVC (PE) wire including Breakers with enclosures, wiring accessories and cable termination etc., as per drawings. (Cost of cable trays shall not include here) (Quality: ACL, Kelani or equivalent) (Measure & Pay)	m	45		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
5.42	**Wiring for 13A Socket Outlets in radial circuits for VRV units** up to VRV panel at relevant AHU room using 2C-2.5mm^2 u/PVC/PVC + 2.5mm^2 Cu/PVC (Earth) wires on cable trays and/or embeded conduits including conduit and accessories, 100x100x50mm PVC mounting box and accessories, as per drawings and specifications. (Cost of cable trays shall not include here) [Total 40 Nos. socket outlets in 15 VRV radial circuits] (Quality: ACL, Kelani or equivalent)	Ccts.	15		
5.43	**Wiring for main supply line to PAHU & FCU Supply Panels at AHU Rooms at floor levels 1 from Electrical panel rooms at relevant floor level,** on cable tray, using 4C-35mm^2 Cu/XLPE/PVC + 1C-16mm^2 Cu/PVC (PE) wires including Breakers with enclosures, wiring accessories and cable termination etc., as per drawings. (Cost of cable trays shall not include here) (Quality: ACL, Kelani or equivalent) (Measure & Pay)	m	20		
5.44	**Wiring for main supply line to PAHU & FCU Supply Panels** at AHU Rooms at floor levels 3 & 5 (2 main supply lines) from Electrical panel rooms at relevant floor le**vel,** on cable tray, using 4C-16mm^2 Cu/XLPE/PVC + 1C-16mm^2 Cu/PVC/PVC (PE)wire including Breakers with enclosures, wiring accessories and cable termination etc., as per drawings. (Cost of cable trays shall not include here) (Quality: ACL, Kelani or equivalent) (Measure & Pay)	m	35		
5.45	**Wiring of Fan points for ceiling & orbital type fans** using 1.5mm^2 Cu/PVC/PVC + Earth (2.5mm^2) wires including conduits and accessories, switch with electronic regulator, mounting boxes, and accessories as per drawings. (Cost of conduits, cable trays and accessories shall not include here) (Quality: ACL, Kelani or equivalent) (Measure & Pay)	Nos.	40		
5.46	**Wiring of Fan points for wall mount type fans** using 1.5mm^2 Cu/PVC/PVC + Earth (2.5mm^2) wires including switch with mounting boxes, 13A socket outlet & plugtop, PVC Conduit/Casing and accessories as per drawings. (Cost of cable trays and accessories shall not include here)	Nos.	90		
5.47	**Wiring of wall mounted Extractor Fan point** for toilets, using 1.5mm^2 Cu/PVC/PVC + Earth (2.5mm^2) wires including switch , mounting boxes 13A socket outlet & plugtop, conduit and accessories as per drawings & specifications. (Cost of cable trays and accessories shall not include here)	Nos.	21		
5.48	**Wiring of Ducted type Extractor Fan point** for toilets, using 1.5mm^2 Cu/PVC/PVC + Earth (2.5mm^2) wires including switches, mounting boxes, 13A socket outlet & plugtop, control system and accessories as per drawings (Cost of conduits, cable trays and accessories shall not include here)	Nos.	16		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
5.49	**Wiring of Hand dryer point** using 2C-2.5mm^2 Cu/PVC/PVC + Earth (2.5mm^2) wires including 13A socket outlet & plug top, mounting boxes, conduits and accessories as per drawings. (Cost of cable trays and accessories shall not include here)	Nos.	20		
5.50	**UPS Systems (Supply, Distribution & Protection)** **Main UPS (E&ANE Navigational Equipment)** Supply, install, test and commission of **160A/4P manual Change Over switch [DB-GF-7(UPS-C/O)]** at Electrical panel room to connect a external Generator as an emergency power supply for the Main UPS supply line, powder coated steel enclosure and accessories as per the specifications & drawings.	Item	1		
5.51	Supply, install, test and commission of Three Phase Distribution Board **[DB-GF-8(UPS-DB)]** for UPS power distribution c/w high quality **3phase 160A online Power Line Filter**, protective devices, powder coated steel enclosure and accessories as per the specifications and drawings. (Proposal with power line filter details to be submitted for Engineers' approval.)	Item	1		
5.52	Wiring for main supply line up to main UPS DB **[DB-GF-8(UPS-DB)]** at UPS Room from **[DB-GF-7(UPS-C/O)]** at AHU room in cable duct or on cable trays, two runs (two parellel cables, 25m each) using 4C-70mm^2 Cu/XLPE/PVC + 1C-35mm^2 PE wires including wiring accessories and cable termination etc., as per drawings (Cost of cable duct and trays shall not include here) (Measure & Pay)	Lm	50		
5.53	Wiring of UPS power distribution line from **[DB-GF-8(UPS-DB)]** at UPS room to **Ground floor MSC/AG room** (2 parallel cables, 35m each) on cable trays and/or conduits using 3C-10mm^2 Cu/PVC/PVC wires including 2 x 40A/2P MCB with enclosure at load end and accessories as per drawings. (Cost for conduits and cable trays shal not include here) (Measure & Pay)	Lm	70		
5.54	Wiring of UPS power distribution line from **[DB-GF-8(UPS-DB)]** at UPS room to **First floor Main Equipment Room** (2 parallel cables, 50m each) on cable trays and/or conduits using 4C-10mm^2 Cu/PVC/PVC wires including 2 x 40A/4P MCB with enclosure at load end and accessories as per drawings. (Cost for conduits and cable trays shal not include here) (Measure & Pay)	Lm	100		
5.55	Wiring of UPS power distribution line from **[DB-GF-8(UPS-DB)]** at UPS room to **Fourth floor VHF Equipment Room** (2 parallel cables, 55m each) on cable trays and/or conduits using 3C-16mm^2 Cu/PVC/PVC wires including 2 x 40A/2P MCB with enclosure at load end and accessories. (Cost for conduits and cable trays shal not include here) as per drawings (Measure & Pay)	Lm	110		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
5.56	Wiring of UPS power distribution line from **[DB-GF-8(UPS-DB)]** at UPS room to **Sifth floor Control Tower** (2 parallel cables, 65m each) on cable trays or conduits using 3C-16mm^2 Cu/PVC/PVC wires including 2 x 40A/2P MCB with enclosure at load end and accessories as per drawings. (Cost for conduits and cable trays shal not include here) (Measure & Pay)	Lm	130		
	UPS (IT Switches)				
5.57	Wiring for main supply line to **IT UPS** (6 supply lines for 6 x 5 kVA UPSs) from Electrical panels in Electrical Panel Rooms at each floor level on cable tray, using 3C-4mm^2 Cu/PVC/PVC wires including Breakers with enclosures, wiring accessories and cable termination etc., as per drawings. (Cost of cable trays shall not include here) (Measure & Pay) (Appx. total length: 1x20 + 5x5m = 45m)	Lm	45		
	UPS (Emergency Lighting)				
5.58	Supply, install, test & commission of **UPS Power Distribution Panels for supply standby power to Emergency Lighting & Exit Sign Circuits** in the Electrical panel rooms at each floor level, c/w 4kVA online UPS (Incl.of Battery pack), Powder coated steel enclosure, 20A/2P MCB (main input breaker), 20A/2P MCB (Output breaker), 40/30mA/2P RCD and 8 distribution circuits incl.10A/SP MCBs to supply standby power to Emergency Lighting/Exit Sign Circuits, as per the specifications and drawings. UPS output shall be connected to emergency lighting circuits while only on failures of the mains power supply. (Proposal to be submitted for the Engineer's approval)	Items	6		
5.59	**Wiring for main supply line to above Emergency lighting UPS power distribution panels** (6 Circuits of 4 kVA UPS panels) from Standby Power panels in Electrical Panel Rooms at each floor level on cable tray, using 3C-4mm^2 Cu/PVC/PVC wires including wiring accessories and cable termination etc., as per drawings. (Cost of cable trays shall not include here) (Appx. total length: 1x20 + 5x5m = 45m) (Measure & Pay)	Lm	45		
5.60	Supply, install, test & commission of 6W Illuminated mains/battery operated type **single sided Exit Sign boards** with 2.5hrs duration battery back up for Power House c/,w 13A socket outlet & Plug top and all mounting accessories. (Quality: Thorn, Denco, Samcom or quivalent to the approval of Engineer)	Nos.	2		
5.61	Supply, install, test & commission of Surface mount type 10W **Emergency Lights** for Power House, with two adjustable type LED Lamp Heads with 3hrs duration battery back up, c/w 13A socket outlet & Plug top and all mounting accessories. (Quality: Thorn, Denco, Samcom or quivalent to the approval of Engineer)	Nos.	5		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
	Main LV Supply Panels **Note:** **Panel Design** The main panels shall construct as three phase floor standing composite modular design with powder coated metal enclosure including MCCBs, original terminal extentions, Bus-bar units and all wiring accessories as per drawings & specifications. The panels shall fabricate to confirm BS EN 61439 and construct to confirm to BS EN 61439-2 Form 4b or better. All panel details including shop drawings shall submit with the Bid. (Quality: Enclosure - KIK or equivalent Switch gears - ABB, Schneider or equivalent to the approval of the Engineer) **Cordination with Building Management System (BMS)** The main Distribution Boards (MSB & MDBs) shall include necessary built-in interfaces to coordinate with BMS. All main DBs shall be designed, built and installed to allow automatic operation, it shall also allow full manual control. It is the duty of the Contractor to ensure full compatibility with the BMS, ensuring automatic Power Control capability and allowing several monitoring functions. **MAIN SWITCH BOARD (MSB at Power House LV Panel Room)** **(MSB-PH)** **MAIN SWITCH BOARD At Power House No. 02**				
5.62	Design, Supply, install, test & commission of **Main LV Panel Board (MSB-PH2)** at Power House No.02, c/w **1. ACB with SHT for CEB feeder** **2. ACB with SHT for Generator feeder** **3. Distribution MCCBs** **4. Busbar unit & Protective devices** with Automatic disconnection of 1600AT (Adjustable)/2000AF 4P/35kA ACB **bus coupler** to isolate of Non Emergency Section from generator supply with manual by-pass switch when mains failure. Following items also incorporate to main LV panel as composite modular design (But cost of these items shall not include here) **5. Auto Transfer System** **6. Power Factor Correction unit** **7. Surge Protection System** (Quality: Enclosure - KIK or equivalent Switch gears - ABB, Schneider or equivalent to the approval of the Engineer)	Item	1		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
5.63	Supply, install, test & commission of **Remote Metering system** for all ACBs and MCCBs more than 200A with all required accessories and all the recommended softwares. The monitoring facility shall be available at NSC duty rooms and EE Office with the approval of the Engineer. Rate shall include all metering hardware and software, two 21" LED displays with necessary interfaces. (Quality: Circuter, Schneider or equivalent to the approval of the Engineer)	Item	1		
	Main Distribution Boards (MDBs at NSC building Ground Floor Switch Room) **Note:** **MDB Panel Construction** MDBs (Standby & Non-standby) shall construct as three phase floor standing composite modular design with powder coated metal enclosure including MCCBs, original terminal extentions, Bus-bar units and all wiring accessories as per drawings. The panels shall fabricate to confirm BS EN 61439 and construct to confirm to BS EN 61439-2 Form 3b or better. All panel details including shop drawings shall submit with the Bid. (Quality: Enclosure - KIK or equivalent Switch gears - ABB, Schneider or equivalent to the approval of the Engineer) **[MDB-NSC-1(CHILLER)]** **MAIN DISTRIBUTION BOARD (AC Chiller) at GFL Chiller Room**				
5.64	Design, Supply, install, test & commission of **Main Feeder Panel Board** to Central A/C Chiller Plant c/w 800AT(Adj.)/800AF/4P/30kA main MCCB with SHT, distribution breakers with SHT [2 x 630A(Adj.)/4P/25kA MCCBs for Chillers, 2 x 250A/4P/25kA MCCBs for Pumps] & Spares with accessories, Power Analizers and Protective devices as per the specifications and drawing.	Item	1		
	[MDB-NSC-2 (SB)] **MAIN DISTRIBUTION BOARD (Standby Power) at GFL Switch Room**				
5.65	Design, Supply, install, test & commission of Standby Power Distribution Board to Ground floor switch room at NSC building c/w 800AT (Adjustable)/800AF/4P/25kA main MCCB with SHT, Distribution MCCBs, Power Analizers and Protective devices as per the specifications and drawing.	Item	1		
	[MDB-NSC-3 (NSB)] **MAIN DISTRIBUTION BOARD (Non Standby Power) at GFL Switch Room**				
5.66	Design, supply, install, test & commission of Non Standby Main Power Distribution Board to Ground floor switch room at NSC Building c/w 125AT(Adj.)/125AF/4P/25kA MCCB with SHT, Distribution MCCBs, terminal extentions and 4P/ Busbar unit Power Analizers and Protective devices as per the specifications and drawing.	Item	1		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
	[MDB-PH2-3 (HANGAR-SB)] **MAIN DISTRIBUTION BOARD (Hangars Standby Power) at Power House**				
5.67	Design, supply, install, test & commission of Standby Main Power Distribution Board to Hangar feeders at power house c/w 400AT(Adj.)/400AF/4P/30kA MCCB with SHT, Distribution MCCBs, terminal extentions and 4P/ Busbar unit Power Analizers and Protective devices as per the specifications and drawing.	Item	1		
	SUB DISTRIBUTION BOARDS (SDBs) **Note:**				
	SDB Panel Construction SDBs (Standby & Non-standby) shall construct as three phase floor standing composite modular design with powder coated metal enclosure including MCCBs, Bus-bar units and all wiring accessories as per drawings. The panels shall fabricate to confirm BS EN 61439 and construct to confirm to BS EN 61439-2 Form 2b or better. All panel details including shop drawings shall submit with the Bid. (Quality: Enclosure - KIK or equivalent Switch gears - ABB, Schneider or equivalent to the approval of the Engineer)				
5.68	Design, Supply, install, test & commission of **Sub Distribution Board [SDB-GF-1 (SB)]** at ground floor AHU room as per the specifications and drawings.	Item	1		
5.69	Design, Supply, install, test & commission of **Sub Distribution Board [SDB-GF-2 (NSB)]** at ground floor AHU room as per the specifications and drawings.	Item	1		
5.70	Design, Supply, install, test & commission of **Sub Distribution Board [SDB-GF-3 (SB-PUMP)]** at ground floor Electrical room, as per the specifications and drawings.	Item	1		
5.71	Design, Supply, install, test & commission of **Sub Distribution Board [SDB-1F-1(SB)]** at first floor Electrical room, as per the specifications and drawings.	Item	1		
5.72	Design, Supply, install, test & commission of **Sub Distribution Board [SDB-1F-2(NSB)]** at first floor Electrical room, as per the specifications and drawings.	Item	1		
5.73	Design, Supply, install, test & commission of **Sub Distribution Board [SDB-2F-1(SB)]** at second floor Electrical room, as per the specifications and drawings.	Item	1		
5.74	Design, Supply, install, test & commission of **Sub Distribution Board [SDB-2F-2(NSB)]** at second floor Electrical room, as per the specifications and drawings.	Item	1		
5.75	Design, Supply, install, test & commission of **Sub Distribution Board [SDB-3F-1(SB)]** at first floor Electrical room, as per the specifications and drawings.	Item	1		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
5.76	Design, Supply, install, test & commission of **Sub Distribution Board [SDB-3F-2(NSB)]** at first floor Electrical room, as per the specifications and drawings.	Item	1		
5.77	Design, Supply, install, test & commission of **Sub Distribution Board [SDB-4F-1(SB)]** at second floor Electrical room, as per the specifications and drawings.	Item	1		
5.78	Design, Supply, install, test & commission of **Sub Distribution Board [SDB-4F-2(NSB)]** at second floor Electrical room, as per the specifications and drawings.	Item	1		
5.79	Design, Supply, install, test & commission of **Sub Distribution Board [SDB-5F-1(SB)]** at second floor Electrical room, as per the specifications and drawings.	Item	1		
5.80	Design, Supply, install, test & commission of **Sub Distribution Board [SDB-5F-2(NSB)]** at second floor Electrical room, as per the specifications and drawings.	Item	1		
	FINAL DISTRIBUTION BOARDS (FDBs)				
5.81	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-GF-1(L)]** at ground floor Corridor-1 c/w 40A/4P/15kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.82	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-GF-1(P)]** at ground floor Corridor 1 c/w 40A/4P/15kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.83	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-GF-2(A/C) Plant Room]** at ground floor chiller room c/w 40A/4P/15kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.84	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-GF-3(SW)]** at ground floor switch room c/w 40A/4P/10kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.85	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-GF-4]** at ground floor Lobby areac/w 40A/4P/15kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.86	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-GF-6(VRV)]** for **VRV control** at ground floor AHU room c/w 40A/4P/10kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.87	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-GF-9(FCU)]** for **FCU control** at ground floor AHU room c/w 40A/4P/10kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
5.88	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-PH-1(SB)]**at Power House LV Panel Room c/w 40A/4P/10kA MCCB with 50A Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.89	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-1F-1(L)]** at first floor Corridor-1 c/w 40A/4P/15kA MCCB with Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.90	Supply, install, test & commission of **Single Phase Final Distribution Board [DB-1F-2(SW)]** at first floor switch room c/w 40A/4P/15kA MCB with Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.91	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-1F-3]** at first floor corridor-2 c/w 40A/4P/15kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.92	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-1F-1(P)]** at first floor corridor-1 c/w 40A/4P/15kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.93	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-1F-5(VRV)]** at first floor AHU room c/w 40A/4P/15kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.94	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-1F-6(FCU+PAHU+Precision AC)]** for **FCU control** at first floor AHU room c/w 100A/4P/15kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.95	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-2F-1]** at second floor Corridor-1 c/w 40A/4P/15kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.96	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-2F-2]** at second floor Corridor-1 c/w 40A/4P/15kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.97	Supply, install, test & commission of **Single Phase Final Distribution Board [DB-2F-3(SW)]** at second floor switch room c/w 40A/4P/15kA MCB with Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.98	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-2F-5(VRV)]** for **VRV control** at second floor AHU room c/w 40A/4P/15kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
5.99	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-2F-6(FCU)]** for **FCU control** at second floor AHU room c/w 40A/4P/15kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.100	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-3F-1(L)]** at third floor Corridor-1 c/w 40A/4P/15kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.101	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-3F-1(P)]** at third floor Corridor-1 c/w 40A/4P/15kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.102	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-3F-2]** at third floor Corridor-2 c/w 40A/4P/15kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.103	Supply, install, test & commission of **Single Phase Final Distribution Board [DB-3F-3(SW)]** at third floor switch room c/w 40A/4P/10kA MCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.104	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-3F-5(VRV)]** for **VRV control** at third floor AHU room c/w 40A/4P/10kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.105	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-3F-6(FCU)]** for **FCU control** at third floor AHU room c/w 40A/4P/10kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.106	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-4F-1(L)]** at fourth floor Corridor-1 c/w 40A/4P/15kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.107	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-4F-1(P)]** at fourth floor Corridor-1 c/w 63A/4P/15kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.108	Supply, install, test & commission of **Single Phase Final Distribution Board [DB-4F-2(SW)]** at fourth floor switch room c/w 40A/4P/15kA MCB with Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.109	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-4F-3]** at fourth floor Lobby area c/w 40A/4P/15kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
5.110	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-4F-5(VRV)]** for **VRV control** at fourth floor AHU room c/w 40A/4P/15kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.111	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-4F-6(FCU)]** for **FCU control** at fourth floor AHU room c/w 40A/4P/15kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.112	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-5F-1(L)]** at fifth floor Corridor-1 c/w 40A/4P/15kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.113	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-5F-1(P)]** at fifth floor Corridor-1 c/w 40A/4P/15kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.114	Supply, install, test & commission of **Single Phase Final Distribution Board [DB-5F-2(SW)]** at fifth floor switch room c/w 40A/4P/15kA MCB with Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.115	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-5F-4(VRV Plant)]** for standby A/C system at fifth floor AHU room c/w 250A/4P/15kA MCCB and 2Nos. 125A/4P MCCBs with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.116	Supply, install, test & commission of **Three Phase Final Distribution Board [DB-5F-6(FCU)+Twr]** for **FCU control** at fifth floor AHU room c/w 63A/4P/15kA MCCB with 4P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
5.117	Supply, install, test & commission of **Single Phase Final Distribution Board [DB-6F-1(TWR)]** for general power supply to 6th floor Tower levels c/w 40A/2P/15kA MCCB with 3P/Bus-bar unit and accessories, as per the specifications and drawings.	Item	1		
	DB-STL/HANGAR (Street Lighting & Hangar Feeder Panel)				
5.118	Supply, install, test & commission of free standing type outdoor (IP65) t**hree Phase Distribution Board [DB-STL]** for street lights & Hangars Feeders. The panel shall be fabricated to confirm BS EN 61439 and constructed to confirm BS EN 61439-2 Form 2b or better, as per the specifications and drawings. (Quality: Enclosure: KIK or equivalent and Switch gears: ABB, Schneider or equivalent to the approval of Engineer)	Item	1		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
	MAINS DISTRIBUTION CABLES				
	Transformer to main LV Panel at Power House				
5.119	Supply, lay, test and commission of **(1C-300mm^2) Cu/XLPE/PVC cable,** fromTransformer to main LV Panel. (Measure & pay) *Rate shall include, cable termination at both ends, wiring accessories and necessary civil works. Laying method: free air or on perforated cable tray. (Cost of cable trays shall not include here)* *Cable length calculation* *Distance from T/F to LV Panel = 50m* *Cable to be drawn = 4[3x(1C-300mm^2)] Cu/XLPE/PVC (3 runs per phase)* *Total (1C-300mm^2) length = 4 x 3 x 50 = 600 m*	Lm	600		
	Generator to main LV Panel at Power House				
5.120	Supply, lay, test and commission of **(1C-240mm^2)] Cu/XLPE/PVC cable**, from Generator to main LV Panel. (Measure & pay) *Rate shall include, cable termination at both ends, wiring accessories and necessary civil works. Laying method: free air or perforated cable tray . (Cost of cable trays shall not include here)* *Cable length calculation* *Distance from Gen to LV Panel = 40m* *Cable to be drawn = 4[3x(1C-240mm^2)] Cu/XLPE/PVC (3 runs per phase)* *Total (1C-240mm^2) length = 4 x 3 x 40 = 480 m*	Lm	480		
	Earth cable 2x(1C-185mm^2) Cu/PVC from Gen to main LV panel. *(Cost of cable trays shall not include here)* (Measure & pay) *Cable length calculation* *Earth Cable to be drawn = 2x(1C-185mm^2) Cu/PVC (2 Runs)* *Distance from Gen to LV Panel = 40m* *Total (1C-185mm^2) Earth cable length = 2 x 40 = 80 m*	Lm	80		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
	Main LV Panel to MDB (Chiller) at NSC Building				
5.121	Supply of main power cable **(4C-240mm^2) Cu/XLPE/SWA/PVC**, from main LV panel at power house to **NSC Chiller Panel** at gound floor Chiller Room. (Measure & pay) *Laying method: Direct in ground or duct in ground , Rate shall include the cost of machinery, excavation, supply & filling river sand, cable laying, supply & laying warning tape and cable tiles, back filling by excavated soil, compacting and finishing up to existing floor level, termination at both ends, cable accessories and all civil & mechanical works relevant to the installation shall include here.* ***Note:*** *Distribution cables from main chiller panel to chillers, pumps, colling towers & AHUs shall not include here.* *Cable length calculation* *Cable to be drawn = 3x(4C-240mm^2) Cu/XLPE/SWA/PVC (3 runs x 35m)* *Total (4C-240mm^2) length = 3 x 35m = 105m*	Lm	105		
	Supply of **Earth cable (1C-185mm^2)** for above main cable, from main LV panel to NSC Chiller panel. (Measure & pay) *Cable length calculation* *Earth Cable to be drawn = 2x(1C-185mm^2)] Cu/PVC (2 Runs x 35m)* *Total (1C-185mm^2) Earth cable length = 2 x 35 = 70 m*	Lm	70		
	Main LV Panel to MDB (Standby Power) at NSC Building				
5.122	Supply of main power cable **(4C-240mm^2) Cu/XLPE/SWA/PVC**, from main LV panel to **MDB-NSC-2(SB)** Panel at gound floor switch room. (Measure & Pay) *Laying method: Direct in ground or duct in ground ,Rate shall include the cost of machinery, excavation, supply & filling river sand, cable laying, supply & laying warning tape and cable tiles, back filling by excavated soil, compacting and finishing up to existing floor level, termination at both ends, cable accessories and all civil & mechanical works relevant to the installation shall include here.* *Cable length calculation* *Cable to be drawn = 3x(4C-240mm^2) Cu/XLPE/SWA/PVC (3 runs x 95m)* *Total (4C-240mm^2) length = 3 x 95m = 285m*	Lm	285		
	Earth cable (1C-185mm^2) for above main cable from main LV panel to NSC standby MDB panel. (Measure & Pay) *(Cost of cable trays shall not include here)* *Cable length calculation* *Earth Cable to be drawn = 2x(1C-185mm^2)] Cu/PVC (2 Runs x 95m)* *Total (1C-185mm^2) Earth cable length = 2 x 95 = 190 m*	Lm	190		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
	Main LV Panel to MDB (Non-Standby Power) at NSC Building				
5.123	Supply of main power cable **4C-95mm² Cu/XLPE/SWA/PVC + 1C-50mm² Cu/PVC Earth**, from main LV panel to **MDB-NSC-3(NSB)** panel at gound floor switch room. (Measure & Pay) *Laying method: Direct in ground or in duct, Rate shall include the cost of machinery, excavation, supply & filling river sand, cable laying, supply & laying warning tape and cable tiles, back filling by excavated soil, compacting and finishing up to existing floor level, termination at both ends, cable accessories and all civil & mechanical works relevant to the installation.*	Lm	95		
5.124	Supply, install, test and commission of main power cable **4 x (1C-240mm²) Cu/XLPE/PVC + 1C-120mm² Cu/PVC Earth**, from main LV panel to **MDB-PH2-3(HANGAR)(SB)** at power house. (Measure & Pay) *Rate shall include, cable laying in Duct, termination at both ends, and all civil & mechanical works related to this.* *Laying method: on Perforated Cable Tray . (Cost of cable trays shall not include here)*	Lm	20		
5.125	Supply, install, test and commission of main power cable (**4C-240mm²) Cu/XLPE/SWA/PVC + 1C-120mm² Cu/PVC Earth**, from **MDB-PH2-HANGAR(SB)** panel at power house to outdoor Hangar/STL Feeder panel. (Measure & Pay) *Laying method: Direct in ground , Rate shall include the cost of machinery, excavation, supply & filling river sand, cable laying, supply & laying warning tape and cable tiles, back filling by excavated soil, compacting and finishing up to existing floor level, termination at both ends, cable accessories and all civil & mechanical works relevant to the installation.*	Lm	60		
5.126	Supply, install, test and commission of main power cable **4C-120mm² Cu/XLPE/SWA/PVC + 1C-70mm² Cu/PVC Earth** from main LV panel to **SDB-GF-3(SB-PUMP)** at NSC building pump room. (Measure & pay) *Rate shall include, cable laying in Duct, termination at both ends, and all civil & mechanical works related to this.* *Laying method: Duct in ground* ***Note:** Supply cables from SDB-GF-3(SB-PUMP) to Pumps shall not inlude here.*	Lm	30		
	SDB SUPPLY CABLES **MDB-NSC to SDBs (GFL)**				
5.127	Supply, install, test and commission of power supply main cable 4C-120mm² Cu/XLPE/PVC + 1C-70mm² Cu/PVC Earth from **MDB-NSC-2(SB)** to **SDB-GF-1(SB)** on cable trays. Rate shall include, cable termination at both ends, and necessary civil works. (Cost of cable trays shall not include here) (Measure & pay)	Lm	25		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
5.128	Supply, install, test and commission of power supply main cable 4C-25mm^2 Cu/XLPE/PVC + 1C-16mm^2 Cu/PVC Earth on cable trays from **MDB-NSC-3(NSB) to SDB-GF-2(NSB)** on cable trays. Rate shall include, cable termination at both ends, and necessary civil works. (Cost of cable trays shall not include here) (Measure & pay)	Lm	25		
	MDB-NSC to SDBs (1FL)				
5.129	Supply, install, test and commission of power supply main cable 4C-25mm^2 Cu/XLPE/PVC + 1C-16mm^2 Cu/PVC Earth on cable ladders from **MDB-NSC-2(SB) to SDB-1F-1(SB)** at first floor switch room. Rate shall include, cable termination at both ends, and necessary civil works. (Cost of cable trays shall not include here) (Measure & pay)	Lm	10		
5.130	Supply, install, test and commission of power supply main cable 4C-35mm^2 Cu/XLPE/PVC + 1C-16mm^2 Cu/PVC Earth on cable ladders from **MDB-NSC-3(NSB) to SDB-1F-2(NSB)** at first floor switch room. Rate shall include, cable termination at both ends, and necessary civil works. (Cost of cable trays shall not include here) (Measure & pay)	Lm	10		
	MDB-NSC to SDBs (2FL)				
5.131	Supply, install, test and commission of power supply main cable 4C-25mm^2 Cu/XLPE/PVC + 1C-16mm^2 Cu/PVC Earth on cable ladders from **MDB-NSC-2(SB) to SDB-2F-1(SB)** at second floor switch room. Rate shall include, cable termination at both ends,and necessary civil works. (Cost of cable trays shall not include here) (Measure & pay)	Lm	15		
5.132	Supply, install, test and commission of power supply main cable 4C-16mm^2 Cu/XLPE/PVC + 1C-16mm^2 Cu/PVC Earth on cable ladders from **MDB-NSC-3(NSB) to SDB-2F-2(NSB)** at second floor switch room. Rate shall include, cable termination at both ends, and necessary civil works. (Cost of cable trays shall not include here) (Measure & pay)	Lm	15		
	MDB-NSC to SDBs (3FL)				
5.133	Supply, install, test and commission of power supply main cable 4C-25mm^2 Cu/XLPE/PVC + 1C-16mm^2 Cu/PVC Earth on cable ladders from **MDB-NSC-2(SB) to SDB-3F-1(SB)** at third floor switch room. Rate to be included, cable termination at both ends, and necessary civil works. (Cost of cable trays shall not include here) (Measure & pay)	Lm	20		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
5.134	Supply, install, test and commission of power supply main cable 4C-25mm^2 Cu/XLPE/PVC + 1C-16mm^2 Cu/PVC Earth on cable ladders from **MDB-NSC-3(NSB) to SDB-3F-2(NSB)** at third floor switch room. Rate shall include, cable termination at both ends, and necessary civil works. (Cost of cable trays shall not include here) (Measure & pay)	Lm	20		
	MDB-NSC to SDBs (4FL)				
5.135	Supply, install, test and commission of power supply main cable 4C-25mm^2 Cu/XLPE/PVC + 1C-16mm^2 Cu/PVC Earth on cable ladders from **MDB-NSC-2(SB) to SDB-4F-1(SB)** at fourth floor switch room. Rate shall include, cable termination at both ends, and necessary civil works. (Cost of cable trays shall not include here) (Measure & Pay)	Lm	25		
5.136	Supply, install, test and commission of power supply main cable 4C-16mm^2 Cu/XLPE/PVC + 1C-16mm^2 earth cable on cable trays from **MDB-NSC-3(NSB) to SDB-4F-2(NSB)** at fourth floor switch room. Rate shall include, cable termination at both ends, and necessary civil works. (Cost of cable trays shall not include here) (Measure & Pay)	Lm	25		
	MDB-NSC to SDBs (5FL)				
5.137	Supply, install, test and commission of power supply main cable 4C-240mm^2 Cu/XLPE/PVC + 1C-120mm^2 Cu/PVC Earth on cable ladders from **MDB-NSC-2(SB) to SDB-5F-1(SB)** at fourth floor switch room. Rate shall include, cable termination at both ends, and necessary civil works. (Cost of cable trays shall not include here) (Measure & Pay)	Lm	30		
5.138	Supply, install, test and commission of power supply main cable 4C-25mm^2 Cu/XLPE/PVC + 1C-16mm^2 earth cable on cable ladders from **MDB-NSC-3(NSB) to SDB-5F-2(NSB)** at fourth floor switch room. Rate shall include, cable termination at both ends, and necessary civil works. (Cost of cable trays shall not include here) (Measure & Pay)	Lm	30		
	FDB Supply Cables **SDBs to FDBs**				
5.139	Supply, install, test and commission of power supply main cable **4C-10mm^2 Cu/PVC/PVC + 1C-10mm^2 Cu/PVC Earth** on cable trays from sub distribution boards to final distribution boards at respective floor levels as per the specifications and drawing. Rate shall include, cable termination at both ends for 33 final DBs and necessary civil works. (Cost of cable trays shall not include here) (Measure & Pay)	Lm	680		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
5.140	Supply, install, test and commission of power supply main cable 4**C-150mm² Cu/PVC/PVC + 1C-95mm² Cu/PVC Earth** on cable trays from **SDB-5F-1(SB)** to **DB-5F-4(VRV-O/D)** as per the specifications and drawings. Rate shall include, cable termination at both ends, and_necessary civil works. (Cost of cable trays shall not include here) (Measure & Pay)	Lm	30		
5.141	Supply, install, test and commission of power supply main cable **4C-35mm² Cu/PVC/PVC + 1C-25mm² Cu/PVC Earth** on cable trays from **SDB-1F-2(NSB)** to **DB-1F-6(FCU+PAHU)** as per the specifications and drawing. Rate shall include, cable termination at both ends and_necessary civil works. (Cost of cable trays shall not include here) (Measure & Pay)	Lm	25		
5.142	Supply, install, test and commission of power supply main cable **4C-70mm² Cu/PVC/PVC + 1C-35mm² Cu/PVC Earth** on cable trays from **SDB-GF-1(SB)** to **DB-GF-7(UPS-C/O)** as per the specifications and drawing. Rate shall include, cable termination at both ends and_necessary civil works. (Cost of cable trays shall not include here) (Measure & Pay)	Lm	25		
5.143	Supply, install, test and commission of power supply main cable **4C-16mm² Cu/PVC/PVC + 1C-16mm² Cu/PVC Earth** on cable trays as per the specifications and drawings. Rate shall include, cable termination (4 Circuits) at both ends and necessary civil works. (Cost of cable trays shall not include here) (Measure & Pay)	Lm	100		
5.144	Supply, install, test and commission of power supply main cable 3**C-6mm² Cu/PVC/PVC** on cable ladder/tray for single phase DB at Tower **DB-6F-1(TWR)** Rate shall include, cable termination at both ends and_necessary civil & mechanical works. (Cost of cable ladder/trays shall not include here) (Measure & Pay)	Lm	10		
5.145	Supply, install, test and commission of power supply main cable 4**C-16mm² Cu/XLPE/SWA/PVC** direct buried from MDB-PH2-3(HANGAR) at power house to **DB-STL** outdoor panel, including cable termination at both ends with cable accessories. Rate shall include, excavation of trench, river sand, cable tiles & warning tape, cable termination at both ends and necessary civil & mechanical works. (Measure & Pay)	Lm	100		
5.146	**Cable Management** **Cable Ducts & Manholes** Supply, install & commission of conctrete encased **4 Way/ 150mm under ground uPVC Cable Ducts** (Type-1) [450mm x 450mm cross sectional dimensions] as per drawings & specifications. Rate shall include T1000 uPVC pipes & accessories/ construction material and civil & mechanical works. (Measure & pay)	Lm	60		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
5.147	Supply & construct of **Concrete (Grade 25) Man Holes** [1000mm(L) x 700mm(W) x 700mm(D) inner area] for the above duct c/w smooth inner surfaces and E600 cat. Covers with tilled floor finish and accessories, as per drawings & Specifications. Rate to be included all accessories/ material and civil & mechanical works.	Nos.	11		
5.148	Supply & construct of **Conctrete Cable Trench** [600mm (W) x 800mm (D) inner dimensions] c/w smooth inner surfaces, GI cover plates (Checkered plate) in Generator Room, A/C Plant & Pump Room, and Electrical Panel Room as per drawings and specifications. Rate to be included all accessories/ material and civil & mechanical works. (Measure & pay)	Lm	25		
5.149	Supply & construct of **Conctrete Cable Trench** [600mm (W) x 600mm (D) inner dimensions] c/w smooth inner surfaces, GI cover plates (Checkered plate) in Generator Room, A/C Plant & Pump Room, and Electrical Panel Room as per drawings and specifications. Rate to be included all accessories/ material and civil & mechanical works. (Measure & pay)	Lm	40		
;5.150	Supply, install & commission of conctrete encased **2 Way/ 150mm under ground uPVC Cable Ducts** (Type-2) [450mm x 250mm cross sectional dimensions] from ground floor Electrical Panel Room to UPS Room, Gen room to pump room and in AHU Room & Electrical Panel Room etc., as per drawings. Rate shall include T1000 uPVC pipes & accessories/ material and civil & mechanical works. (Measure & pay)	Lm	40		
5.151	Supply & construct of **Concrete (Grade 25) Man Holes** [750mm(L) x 500mm(W) x 400mm(D) inner area] for the above duct c/w smooth inner surfaces and E600 cat. Covers with tilled floor finish and accessories, as per drawings & Specifications. Rate to be included all accessories/ material and civil & mechanical works.	Nos.	5		
	Cable Ladders, Trays, Trunkings & Floor Ducts **Note:** Cost of all accessories for connecting or/and inter connecting cables in to Ladders, Trays,Trunkings and Floor ducts & boxes etc., shall be included to the relevant items. (Eg. Connecting methods of final circuits laid in conduits embeded in slab sofit, to the cable trays, trunkings or floor ducts etc.,)				
5.152	Supply, install & commission of steel **Cable Ladders** (300mm x 60mm) in electrical rooms cable shaft, including all accessories & fixings to complete the installation as per drawings. Hot dip galvanized as per BS EN ISO 1461:1991. (Quality: Sample to the approval of Engineer) (Measure & Pay)	Lm	55		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
5.153	Supply, install & commission of 30% perforated steel **Cable Trays (300mm x 60mm)**, including all accessories & fixings to complete the installation as per drawings. Hot dip galvanized as per BS EN ISO 1461:1991. (Quality: Sample to the approval of Engineer) (Measure & Pay)	Lm	575		
5.154	Supply, install & commission of 30% perforated steel **Cable Trays (150mm x 60mm)**, including all accessories & fixings to complete the installation as per drawings. Hot dip galvanized as per BS EN ISO 1461:1991. (Quality: Sample to the approval of Engineer) (Measure & Pay)	Lm	50		
5.155	Supply & install of 3 compartment wall mount **Cable Trunking** (165mm x 50mm, high impact halogen free fire retardent uPVC) for provision of power to socket outlets on the partitioned walls including all accessories and fixings as per the electrical drawings & specifications. Colour shall match with wall finish. Middle compartment shall directly mount socket outlets. (Quality: Sample to the approval of Engineer) (Measure & Pay)	Lm	450		
5.156	Supply, install & commission of **Under Floor GI Ducts** (200mm x 35mm x 1.6mm) for ground floor as per specifications . Rate to be included all accessories and civil & mechanical works. (Measure & Pay)	Lm	150		
5.157	Supply, install & commission of **Junction boxes** for above Under Floor GI Ducts for ground floor as per specifications . Rate to be included all accessories and civil & mechanical works.	Nos.	20		
5.158	Supply, install & commission of 4way **Service outlet boxes** for Under Floor GI Ducts for ground floor as per specifications . Rate to be included all accessories and civil & mechanical works.	Nos.	10		
5.159	Supply, install & commission of 2way **Service outlet boxes** for Under Floor GI Ducts for ground floor as per specifications . Rate to be included all accessories and civil & mechanical works.	Nos.	10		
	RATE OF PANEL ITEMS, REQUIRED FOR MEASURE & PAY (UNDER PROVISIONAL SUM)				
5.160	**Provisional Sum** for measure & Pay Items	Provisional Sum		**1,000,000.00**	**1,000,000.00**
	Note: Wall flush mounted type powder coated steel enclosure c/w din-rails, neutral & earth terminals, cable ducts and cover plate, shall be designed to accomodate the components with ample space for the wiring. (Shop drawings including panel details, shall be submitted with the Bid)				
1	Enclosure Type-1 (400 x 600 x 125mm) 3 row 14 way	Item	1		Rate Only
2	Enclosure Type-2 (500 x 700 x 125mm) 4 row 18 way	Item	1		Rate Only
3	ACB, 2000AT (Adjustable)/2000AF/4P/35kA (with SHT)	No.	1		Rate Only

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
4	MCCB, 1600AT (Adjustable)/2000AF/4P/35kA (with SHT)	No.	1		Rate Only
5	MCCB, 800AT(Adj.)/1000AF/4P/30kA (with SHT)	No.	1		Rate Only
6	MCCB, 630AT(Adj.)/1000AF/4P/30kA (with SHT)	No.	1		Rate Only
7	MCCB, 400AT(Adj.)/1000AF/4P/25kA (with SHT)	No.	1		Rate Only
8	MCCB, 250AT(Adj.)/250AF/4P/25kA (with SHT)	No.	1		Rate Only
9	MCCB, 125AT(Adj.)/200AF/4P/25kA (with SHT)	No.	1		Rate Only
10	MCCB, 100A//4P/20kA (with SHT)	No.	1		Rate Only
11	MCCB, 100A//4P/15kA	No.	1		Rate Only
12	MCCB, 63A//4P/20kA (with SHT)	No.	1		Rate Only
13	MCCB, 63A//4P/15kA	No.	1		Rate Only
14	MCCB, 40A/4P/15kA	No.	1		Rate Only
15	Digital Power analyzer c/w accessories	Item	1		Rate Only
16	Phase Failure Relay c/w accessories	Item	1		Rate Only
17	Earth Fault Relay, 300mA c/w CTs, fuses & accessories	Item	1		Rate Only
18	RCD, 40A/30mA/2P	No.	1		Rate Only
19	RCD, 40A/100mA/4P	No.	1		Rate Only
20	RCD, 63A/100mA/4P	No.	1		Rate Only
21	RCD, 100A/100mA/4P	No.	1		Rate Only
22	MCB, 40A/2P/T3	No.	1		Rate Only
23	MCB, 40A/4P/T3	No.	1		Rate Only
24	MCB, 25A/3P/T3	No.	1		Rate Only
25	MCB, 20A/2P/T3	No.	1		Rate Only
26	MCB, 16A/2P/T4	No.	1		Rate Only
27	MCB, 10A/2P/T3	No.	1		Rate Only
28	MCB, 20A/SP/T3	No.	1		Rate Only
29	MCB, 16A/SP/T3	No.	1		Rate Only
30	MCB, 10A/SP/T3	No.	1		Rate Only
31	MCB, 6A/SP/T3	No.	1		Rate Only
32	3 Phase Indicators c/w fuses (Three colour to indicate 3phases)	Item	1		Rate Only
	Building, Equipment, Powerline & Personnel Protection **LIGHTNING & SURGE PROTECTION INSTALLATION with GROUNDING** **Note:**				
	Applicable Standards: BS EN 62305 and IEC 62305: Protection against lightning & transient overvoltage, 50310 and ISO/IEC 30129: Telecommunications bonding networks for buildings and other structures, Bs EN 50600 and ISO/IEC 22237: Information Technology - Data centre facilities and infrastructures. Bs En 50164: Lightning Protection Components.				

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
5.161	Design, supply, install, test and commission of **Lightning Protection system (LPS) for the NSC building** (as per the specifications), c/w adecuate no. of air terminals, down conductors and earth terminals/electrodes ensuring proper equipotential bonding to protect the whole building, equipment and personnel lives from any lightning srike. 14mm dia Copper multiple Air termination network shall be covered the entire roof of the building consist of a meshed conductor arrangement, adequate number of 25mm x 3mm solid copper tapes (Down conductors), 16mm dia x 1.8m long Copper Earth Electrodes (or Copper plates) to furnish a mesh/ ring formation around the main NSC building and power house, Test clamps, Cu tape clips, inspection boxes for each down conductor, Cast iron earth inspection pits and all accessories to achieve Earth Resistance of less than 2 Ohms. All conductive materials including building structural system and all metalic parts shall be earthed to the common earthing system. Earth Test report (on installation and testing) shall be submitted upon the completion of installation. Detailed design/ proposal inclusive method statement to be submitted with the bid.	Item	1		
5.162	Design, supply, install & commission of **Power Line Surge Protection System.** Design shall be considered, properly coordinated Class I & II SPDs where applicable at each vulnerable points to protect entire electrical installation including power house as per the specifications and drawings, c/w earth electrodes, conductors, wiring & accessories. Provision shall be available at ground floor switch room to display all SPD data of each main & sub distribution boards where necessary. All Earthing systems to be inter connected to ensure equipotential bonding. Detailed design/ proposal inclusive method statement to be submitted with the bid.	Item	1		
5.163	Design, supply, install & commission of **Server Room Shielding** to protect all the sensitive electronics equipment, data and power lines, complying the standards applicable for protection from electro magnetic induction. Rate shall include all protective equipment, material and accessories using for room shielding. All Earthing systems to be inter connected each other to ensure equipotential bonding. Detailed design/ proposal inclusive method statement to be submitted with the bid.	Item	1		
	PROTECTIVE EARTHING SYSTEM FOR LV DISTRIBUTION				
5.164	Design, supply, install & commission of Main Earthing Panel in Power house panel room including MSB earthing (Electrical), Transformer earthing, Generator earthing & ELV panel earthing etc. c/w properly rated earth cables, earth pit, earth conductor copper tapes, copper earth plates, copper rods & all required accessories to achieve an Earth Resistance of less than 2 Ohm. (All earthing systems to be interconnected to maintain equipotentiolity) Earth Test Report shall be submitted.	Item	1		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
	Power Supply Management **CONSTRUCTION OF POWER HOUSE NO.02**				
5.165	**Power House shall** design with Three seperate rooms as per the specifications & drawings having adequate access to handle equipment (Generator & Panels etc.) (1) **Generator room** [dimensions 20 m (L) x 6 m (W) x 4m (H)] for 800 kVA Prime Power Generator set (2) **Panel room** for Main LV Panel (3) **Technician's duty room** inclusive of wash room & Toilet facility Water ptoofed Concrete Roof Slab. Cable ducts, ladders & trays for all the feeder cables with ample space, Concrete plinths for Generator & Panels Cement Rendering for Generator room, tiling for Panel room and Duty room. Suitable & durable Aluminium luvoured doors and windows to ensure proper ventilation to Generator room with Extractor Fans, and suitable ducts for intake & exhaust air. Panel room and technicians' duty room shall be air-conditioned by FCUs and standby split AC units Rate shall include the construction of concrete plinths for generator and floor standing panels, air ducts for intake & exhaust air of generator, as appropriate. (Cost of Cable ducts, Trenches, Trays & Ladders, air-condition units, FCUs, extractor fans, emergency lights & exit signs shall not inlude here).	Item	1		
5.166	Supply, install, test and commission of **24000Btu/hr Split Type Air-conditioners** to Power House LV Panel Room.	Nos.	2		
5.167	Supply, install, test and commission of **18000Btu/hr Split Type Air-conditioners** to Power House Duty Room.	Nos.	1		
5.168	Wiring for S/T A/C units from **DB-GF-PH** in embedded conduits using 2.5 mm2 Cu/PVC/PVC wire + 2.5 mm Cu/PVC earth wires including conduits and accessories, 13A socket outlet, plug top, mounting box & wiring accessries as per drawings.	Nos.	3		
	OBTAIN CEB LV POWER SUPPLY (c/w Outdoor type Transformer)				
5.169	Cost for **Establish 1250kVA, LV Power Supply** (400V/50Hz/TT-4Wire/3Ph) obtaining from the service provider Ceylon Electricity Board (CEB) to Main LV Panel (MSB-PH) at Power House No.02. Rate shall include all CEB costs for approvals, equipment and connections. Contractor shall coordinate and obtain necessary approvals from CEB to obtain 1250kVA LV power supply and carry-out all the works (Civil, Mech & Elect) related to establish CEB power at the site.	Item	1		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
5.170	Construction of metering cubical as per CEB requirement (Drawing for the Metering Cubicle will be issued by CEB), Transformer site preperation, construction of suitable fence (Chain link preferred) around the switch yard and fulfil all the requirement request by CEB.	Item	1		
	STANDBY POWER GENERATOR WITH AUTO TRANSFER SYSTEM **Generator Room at Power House -2**				
5.171	Supply, install, test & commission of factory fitted **800 kVA Prime Power Sound Attenuated Brand New Generator set** (Power rating shall confirm to ISO8528-1) at 1500 rpm comprising of 400V, 3phase, 4 wire, 50Hz brushless permanent magnet exciting self regulating Alternator with automatic voltage regulator to a turbo charged water cooled Diesel Engine and a day service tank for minimum 08hrs running oeriod. (Sound level shall be less than 80dB@1m) c/w Auto Transfer system. as per the specifications and drawings). Air intake, heat generation and engine exhaust shall be properly managed within the generator room with maintaining air quality and sound since the NSC building is prime operational and sensitive area. (Cost of ATS shall not include here)	Item	1		
5.172	Supply, install, test & commission of floor standing factory fitted three phase **ATS Panel** for the above generator c/w all wiring accessories as per drawings & specifications. The panel shall be fabricated to confirm BS EN 61439 and construct to confirm BS EN 61439-2 Form 4b or better. ATS panel shall incorporate to main LV panel, as a composite modular design. (Quality: Enclosure - Factory fitted panel and switch gears - ABB or Schneider or equivalent to the approval of the Engineer.)	Item	1		
	UNDER GROUND BULK STORAGE DIESEL TANK & FUEL MANAGEMENT				
5.173	Supply, install, test & commission of **2000 gallons Under Ground Bulk Storage Diesel Tank, pumping system** c/w **associated fuel transfer lines incorporate with safety equipment, regulating valve and accessories** to supply diesel to the day tank of standby Generator at Power House No.02, inclusive of electric fuel transfer system with standby manual transfer facility as per specifications (Rate shall include the cost of all Civil, Electrical & Mechanical works and safty work should carriedout as per fuel suppliers specification and certification adhere to regulation stapulated by international and Government of Sri Lanka regulations and acts , also this should be adhere to relavent fire regulation s and acts)	Item	1		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
	POWER FACTOR CORRECTION, POWER QUALITY & HARMONICS FILTRATION				
5.174	Design, Supply, install, test & commission of **microprocessor based Automatic LV Power factor correction (Apprx. 800kVar), Power Conditioning and Harmonics Filtration equipment** for Main LV panel Bus-Bar at Power House No.02, as a composite modular design as per the specifications. Conventional type capacitor banks shall not be used for power factor correction. Design Propsal for PFC shall be submitted with the bid, for Engineer's approval.	Item	1		
	ROOFTOP SOLAR PV SYSTEM				
5.175	Design, Supply, install, test & commission of complete (Apprx.200kWp) **Solar PV system on the fifth floor roof top of the proposed NSC building** incorporate to fifth floor SDB as per specifications c/w Solar panels, Inverters/controllers, Breakers with powder coated enclosures, Lightning & surge protection systems, Mounting structures, Cabling with all accessories. Rate shall include, main supply cables from Solar controllers to SDB, cable termination and preperation of cable path inclusive all accessories. Special Note: Design must consider to minimize the installation height and panel angle, to ensure the tower view and avoid the glare to the ATC operators at control tower cabin. Design Propsal for Solar Power Generation system shall be submitted for Engineer's approval.	Item	1		
	TESTING & CERTIFICATION				
5.176	**Inspection & Test Certificates** for the entire Electrical Installation according to IET wiring regulations shall be provided upon the completion of the electrical installation (Certified by a Chartered Electrical Engineer)	Item	1		
	ELECTRICAL WORKS CARRIED TO SUMMARY				

BILL OF QUANTITIES

NAVIGATIONAL SERVICE COMPLEX AT CIAR, RATMALANA

Bill No : 06 - AIR CONDITION WORKS - VRV / VRF SYSTEM

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
6.1	AIR CONDITION WORKS - VRV SYSTEM				
	Note:				
I	The Bidder is requested to refer the Bill of Quantities, General Notes and Pricing Preambles, Design Drawing, Specification, Conditions of Contract, Special Conditions of Contract and other relevant documents prior to pricing of items in this trade.	Note			
II	Proposed design is only for guidance. The Contractor shall include the rates for the detail design, submission of design calculations, supply, installation and maintenance during defect liability period.	Note			
III	Rates for all plants and equipment shall include for:	Note			
	a) Importation, clearing, transportation to site and installation at given position and necessary insurance.				
	b) Electrical connection, piping connection to equipment, sound insulation, hardware fixing and other material require for trouble free operation of the plant.				
	c) All control device, thermostat, controls etc.				
	d) Testing and commissioning of total air conditioning system.				
	e) With suitably designed hot deep galvanized bracket for out door and indoor unit to withstand corrosive environment and to the satisfaction of the Engineers.				
	f) All other items which are not specifically described in the Bill of Quantities but necessary for satisfactory completion to working order.				
IV	The Bidder shall submit the following information on the items/ equipment/ fittings quoted for together with the Bid.	Note			
	1 Make				
	2. Model No.				
	3. Technical data				
	4. Country of manufacture				
	5. Delivery period				
	6. Lead time for manufacturing.				
	7. Schedule of materials.				
V	All equipment shall be guaranteed for a period of 12 months from the date of commissioning.	Note			

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
VI	Rate for pipe work shall include thermally insulated of all pipes and fittings, supports, hangers, flanges and flexible coupling union.	Note			
VII	Rate for all Air grilles and diffusers shall include volume control dampers, supports, final connection to duct, plenum box, etc.	Note			
VIII	Air tight access door complete with gaskets, hinges and handles for easy inspection and access shall be provided to all fire dampers, on/off dampers, volume control dampers and where necessary.	Note			
IX	Rate for all piping and ducting passing through walls and slabs shall include isolated with galvanized steel sleeves and insulation.	Note			
X	ACMV Contractor shall coordinate with the Main Contractor and other trade contractors in all aspects to successfully handover the project.	Note			
XI	Rate for all pipes, ducts and cable penetrations through floor slab & wall shall include approved quality fire stop material.	Note			
XII	All outdoor control panels shall be weatherproof type.	Note			
XIII	All air intake/exhaust louvers shall be equipped with insect screening mesh.	Note			
XIV	Emergency stop buttons shall be provided to all equipment	Note			
XV	Power supply to all AC units will be terminated closer to the units by the Electrical Contractor. All cabling and wiring from this point to the respective indoor and outdoor unit including power isolators, starters and other necessary controls and accessories shall be done by the ACMV Contractor.	Note			
XVI	All wall mounted thermostats shall be mounted at approximate 1.5 meter above finished floor level unless otherwise specified. Exact location of thermostats shall be submitted to and confirmed with the Engineer.	Note			
XVII	All FCU/AHU control switches shall be installed near the room entrances and exact locations shall be agreed by the Engineer. Power supply should be from the same phase and this Contractor shall be responsible to co-ordinate with the Electrical Contractor for such work.	Note			
XVIII	Air filter shall be permanent washable type as per the specification.	Note			

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
XIX	Rate shall include the required sensors remote controllers, schedule timers, etc..	Note			
XX	Rate for refrigerant lines and condensate drain line shall include nitro rubber elastomeric insulation material as per Contract/Manufactures Specification.	Note			
XXI	Volume control dampers shall be provided for all branch air ducts when they Tee-off from main duct, regardless of whether they are indicated on Specification/Drawings.	Note			
XXII	Selections of grilles/diffusers and their performance shall be submitted to the engineer for acceptance before ordering.	Note			
XXIII	Internal part of duct/plenum connected to external louvers or grilles shall be painted in matt black.	Note			
XXIV	All duct work connected to external plenum or louvers shall be installed to slope downward to prevent water entry.	Note			
XXV	Pipes anchors shall be provided for all pipe risers at the intervals as specified and pipe sliding sleeves shall be provided in all pipe risers above and below the anchor points.	Note			
XXVI	Motorized dampers of associated fans shall be hardware interlocked to the fan control.	Note			
XXVII	Non-return damper shall be provided as indicated in the Specification/ Drawings	Note			
XXVIII	All grilles and diffusers etc., specified herein shall be of approved quality powder coated Aluminum finish and shall be to Engineer's approval.	Note			
XXIX	Samples of grills shall be submitted for approval when requested at no extra cost to the Employer.	Note			
XXX	Expansion joints and other necessary items are shown on the drawings or not, shall be include in the pipe rates. Expansion joint shall be proved for those pipe work passing though any movable joint or building or structural joint.	Note			
XXXI	All vertical and horizontal pipes shall be clipped and fixed to the structure with suitable pipe supports and clips and shall be to the approval of the Engineer's.	Note			
XXXII	Rate for all pipes shall include for pipe supports, screws, nails, hooks, saddles, brackets, sockets, connections, lagging short lengths, bowknots nipple joints, folder flange, hardware fixing and joints materials, cutting holes, etc.	Note			

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
XXXIII	Rate for all pipes shall include fire collars for all pipes passing through fire compartments.	Note			
XXXIV	Rates for ducting shall include for all supports, hangers, brackets, guide vanes, flow regulating, devices, sound attenuates, acoustic duct lining air plenum lining etc., (where necessary) dampers, flexible connectors etc., hardware tools and fixing, jointing and insulating materials.	Note			
XXXV	All ducts have been measured in meters inclusive of bends, tees, reducers, connections, hanging system elbows, branches etc. and rates for ducting shall be accordingly.	Note			
XXXVI	Rate for ducts shall include for duct access doors to be provided where fire dampers are fitted for easy maintenance.	Note			
XXXVII	All branch ducts from main ducts to be completed with volume control damper. Curtain type fire dampers shall be provided for all vertical ducts at appropriate positions.	Note			
XXXVIII	Each flexible duct connection shall not exceed 2m in length, flexible connections to linear diffusers shall suit the diffuser standard connection size, but shall not be less than 100mm diameter.	Note			
XXXIX	Duct sizes shown on drawings are clear internal dimensions (excluding internal and external insulation).	Note			
XL	Air-Conditioning and Ventilation ducts to be fabricated with G.I sheets and fabrication and installation should fully confirm to ASHRAE OR SMACNA standards and ducts shall be rectangular/ square in shape. Recommended sheet thickness shall be as given in the schedule.	Note			
XLI	All ducts passing through protected areas shall be internally and externally 2 hours minimum fire rated, regardless of whether they are indicated on Specification/ Drawings.	Note			
XLII	Rate for all ducts passing through fire compartment walls/floors shall include fire dampers of the same rating as for the compartment walls/floors.	Note			
XLIII	Rate for all GI ducts shall include bends, Tees, flexible connection, sound attenuators, Anti-vibration mounts, air sealant, connecting flanges, vans, splitters, supports, access panels, fire barriers, flexible connections wall/floor sleeves etc.	Note			
XLIV	Rate for all pipes and G.I ducts shall include supports brackets and hangers etc. All pipes and G.I ducts supports brackets and hangers shall be of hot dip galvanized finishes with minimum thickness of 120 microns.	Note			

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
XLV	Rate for all pipes and G.I ducts shall include hot dip galvanized finishes for bolts and nuts, screws, nails and supporting clips.	Note			
XLVI	All equipment, accessories, components, measuring devices, signaling devices, motorized valves, motorized dampers, control panels and controlling devices etc. used in the ACMV system shall be BMS compatible products.	Note			
XLVII	All openings, including cable trays, ducts, shafts, and voids, shall be properly sealed with foam or a suitable material.	Note			
6.1.1 6.1.1.1	**Chillers and valves** Supply, delivery and installation of water-cooled steeples variable speed oil free magnetic levitation centrifugal VFD chiller with chilled water inlet temperature 12°C, chilled water outlet temperature 7°C, condenser water inlet temperature 30°C, condenser water outlet temperature 35°C including power supply 400v/50hz/3 phase as per specification (with all the ancillaries for the completion of chiller installation). Minimum chiller capacity 300TR	Nos	2		
6.1.1.2	Design, Supply and installation of valves and fittings connected with the both chillers at PN 16 rating. Flexible joints, strainers, isolation valves, DRVs, air and dirt separators, pressure gauges, thermometers, drain and air vent points etc.	Item	1		
6.1.2 6.1.2.1	**Cooling tower and valves** Supply and installation of induced draft cross flow square shape CTI certified 360TR cooling towers as per the specification and the drawings	Nos	2		
6.1.2.2	Design, Supply and installation of valves and fittings connected with the both cooling towers at PN 16 rating. Flexible joints, strainers, isolation valves, DRVs, pressure gauges, thermometers, drain and air vent points etc.	Item	1		
6.1.3 6.1.3.1	**Pumps and valves** Design, Supply & install of VSD driven chilled water pumps with necessary valves, pressure vessel, fittings, insulations with cladding, controllers, accessories, etc. Capacities to match the chiller & chilled water pipe network as per Specification & Drawing. The price quoted for the chilled water pumps shall deem to be included the cost of vibration isolation spring mounts and inertia bases.	Set.	1		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
6.1.3.2	Design, Supply & install condenser VSD driven water pumps with necessary valves, fittings, controllers, accessories, etc. Capacities to match the chiller & cooling tower system when operating at full capacity as per Specification & Drawing. The price quoted for the condenser water pumps shall deem to be included the cost of vibration isolation spring mounts and inertia bases.	Set.	1		
6.1.4	**AHU & Valves** (PAU shall be with induction motor, Soft-starter and external VSD. VSD shall be compatible to BMS control system. Selector switch shall be provide to select Auto/Manual mode. Auto mode shall be controlled the external VSD via BMS control system. Manual mode shall be controlled direct soft-starter.) Price shall include for all necessary fittings, valves and gauges.				
6.1.4.1	Supply & Installation of PAU1 Fresh Air Handling Unit including valves & accessories, plinth, floor gully as per the specifications and Ground floor location shown in the drawing Total Capacity - 9 RT Sensible Capacity - 3 RT Floor Rate - 800 L/s @ ESP -350 pa	Nos	1		
6.1.4.2	Supply & installation of variable speed drives for PAU1 fan drivers	Item	1		
6.1.4.3	Design, Supply & Installation of Insulated GI ducting for Fresh Ducting System for PAU1 as per specification, inclusive of all kind of Dampers, grills, sound attenuators, insulation, supports , field devices, cabling, conduit etc. according to the Ground & 1st floors drawing.	Item	1		
6.1.4.4	Supply & Installation of PAU2 Fresh Air Handling Unit including valves & accessories, plinth, floor gully as per the specifications and 2rd floor location shown in the drawing Total Capacity - 10 RT Sensible Capacity - 3 RT Floor Rate - 920 L/s @ ESP - 350 pa	Nos	1		
6.1.4.5	Supply & installation of variable speed drives for PAU2 fan drivers	Item	1		
6.1.4.6	Design, Supply & Installation of Insulated GI ducting for Fresh Ducting System for PAU2 as per specification, inclusive of all kind of Dampers, grills, sound attenuators, insulation, supports , field devices, cabling, conduit etc. according to the 2nd & 3rd floors drawing.	Item	1		
6.1.4.7	Supply & Installation of PAU3 Fresh Air Handling Unit including valves & accessories, plinth, floor gully as per the specifications and 4th floor location shown in the drawing Total Capacity - 8 RT Sensible Capacity - 3 RT Floor Rate - 720 L/s @ ESP - 350 pa	Nos	1		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
6.1.4.8	Supply & installation of variable speed drives for PAU3 fan drivers	Item	1		
6.1.4.9	Design, Supply & Installation of Insulated GI ducting for Fresh Ducting System for PAU3 as per specification, inclusive of all kind of Dampers, grills, sound attenuators, insulation, supports , field devices, cabling, conduit etc. according to the 4th, 5th floors & Control tower drawing.	Item	1		
6.1.5	**Precision Air conditioning system**				
6.1.5.1	Design, Supply, delivery, installation, testing & commissioning of Suitable Chilled water Precision Air conditioning system for the Equipment Room (ATM/LINK/AWOS/AMHS/VCCS) as per the specifications. (Approximate cooling capacity shall be 200,000 btu/hr). Indoor conditions need to be maintained at 21+/-1°C and RH 43+/-3. Outdoor condition DB – 33.1°C, WB – 24.8°C.	Item	1		
6.1.6	**FCU & Valves** (Ceiling concealed FCUs with fittings, valves and gauges)				
6.1.6.1	Supply, installation and wiring of 9,000 BTU ceiling Cassette Fan Coil Units (FCU1) including vales & accessories as per the specifications and the drawings	Nos	38		
6.1.6.2	Supply, installation and wiring of 12,000 BTU ceiling Cassette Fan Coil Units (FCU2) including vales & accessories as per the specifications and the drawings	Nos	47		
6.1.6.3	Supply, installation and wiring of 18,000 BTU ceiling Cassette Fan Coil Units (FCU3) including vales & accessories as per the specifications and the drawings	Nos	39		
6.1.6.4	Supply, installation and wiring of 18,000 BTU ceiling Suspended Fan Coil Units (FCU4) including vales & accessories as per the specifications and the drawings	Nos	1		
6.1.6.5	Supply, installation and wiring of 24,000 BTU ceiling Suspended Fan Coil Units (FCU5) including vales & accessories as per the specifications and the drawings	Nos	20		
6.1.6.6	Supply, installation and wiring of 60,000 BTU Floor Standing Tower Type Fan Coil Units (FCU6) including vales & accessories as per the specifications and the drawings	Nos	13		
6.1.6.7	Supply, installation and wiring of 9,000 BTU wall mounted Fan Coil Units (FCU7) including vales & accessories as per the specifications and the drawings	Nos	16		
6.1.7	**Split Air Conditioners**				
6.1.7.1	Supply, installation and wiring of 9,000 BTU wall mounted Split Air Conditioners (FCU8) including all accessories as per the specifications and the drawings	Nos	8		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
6.1.8	Design, Supply, installation, Testing & commissioning of Insulated Chilled water piping system - This should include all equipment connections, headers, distribution complete with fittings, joints, rubber inserts, supports, insulation, cladding, valves, provision for future testing & future connections, expansion tanks and make up water system etc. CHW pipes in Chiller plant room shall be cladded.	Item	1		
6.1.9	Design, Supply, installation, Testing & commissioning of GI condenser water piping system - This should include all equipment connections, headers, distribution complete with fittings, joints, U-traps, rubber inserts, supports and make up water system etc.	Item	1		
6.1.10	Supply, installation, testing and commissioning of Electrical & Control panels for Chillers, Cooling Towers, Pumps, Primary Fresh Air Units and Fan Coil Units with passive harmonic filters (Compatible with BMS and manual mode) including relevant items as per specification – Air conditioning. Chiller Control panel shall be open protocol type to communicate with BMS. The price quoted for the Chiller shall deem to be included the cost of interface module/card etc.	Item	1		
6.1.11	Supply, Installation, testing & commissioning of automatic chemical treatment system including chemical storage tanks, automatic dosing pumps, pipe connections, fittings, valves, sensors, actuators and all other equipment and accessories for the completion for both chilled water and condenser water systems. The unit shall be compatible with BMS in order to implement monitoring the TDS level of the chilled water via BMS.	Item	1		
6.1.12	Supply, Installation, testing & commissioning of an automatic blowdown system with TDS controller for the condenser water system, comprising pipe connections, fittings, valves, sensors, actuators and all other equipment and accessories for the completion of the system. The TDS controller shall be compatible with BMS in order to implement monitoring the TDS level of the condenser water via BMS.	Item	1		
6.1.13	Supply, Installation, testing & commissioning of a make-up water system for the chilled water system including pumps(if necessary), PVC tanks, valves, flexible connections, pipe fittings and accessories for the completion of the installation.	Item	1		
6.1.14	Supply, Installation, testing & commissioning of a make-up water system for the condenser water system including pumps(if necessary), PVC tanks, valves, flexible connections, pipe fittings and accessories for the completion of the installation.	Item	1		
6.1.15	Design, Supply, Installation & commissioning of Automatic monitoring & controlling system for MVAC system (Refer Point schedule attached)	Item	1		
6.1.16	Submission of design calculations (approved by a chartered engineer), shop drawings, as built drawings, test reports, operational and maintenance manuals	Item	1		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
6.1.17 6.1.17.1	**EXHAUST SYSTEM** **For General Spaces** Design, Supply & Installation, testing and commissioning of suitable **centrifugal floor mounted, ducted** exhaust fan for **Ground & First Floors** EX-1(air flow rate shall be **650 L/s @300Pa**) with necessary plinth, dampers, bracketing & all other necessary fittings and accessories complete to working order.	Nos.	1		
6.1.17.2	Design, Supply & Installation, testing and commissioning of suitable **centrifugal floor mounted, ducted** exhaust fan for **Second & Third Floors** EX-2 (air flow rate shall be **730 L/s @300Pa**) with necessary plinth, dampers, bracketing & all other necessary fittings and accessories complete to working order.	Nos.	1		
6.1.17.3	Design, Supply & Installation, testing and commissioning of suitable **centrifugal floor mounted, ducted** exhaust fan for **Fourth Floor, Fifth Floor & Tower** areas EX-3 (air flow rate shall be **570 L/s @300Pa**) with necessary plinth, dampers, bracketing & all other necessary fittings and accessories complete to working order.	Nos.	1		
6.1.17.4	Design, Supply & Installation of Insulated GI ducting for Exhaust Ducting System for **Corridor Area - General Spaces** as per specification, inclusive of all kind of flexible connections, dampers, grills, sound attenuators, insulation, supports etc.	Item	1		
6.1.18 6.1.18.1	**For Lunch Rooms** Design, Supply & Installation, testing and commissioning of suitable **duct mounted** exhaust fan for **Ground Floor** area (air flow rate shall be **150 L/s @150Pa**) with necessary supports, dampers, bracketing, flexible connections, gravity shutters & all other necessary fittings and accessories complete to working order.	Nos.	1		
6.1.18.2	Design, Supply & Installation, testing and commissioning of suitable **wall mounted** exhaust fan for **Ground Floor** area (air flow rate shall be **100 L/s**) with necessary supports, dampers, bracketing, flexible connections, gravity shutters & all other necessary fittings and accessories complete to working order.	Nos.	1		
6.1.18.3	Design, Supply & Installation, testing and commissioning of suitable **wall mounted** exhaust fan for **First Floor** area (air flow rate shall be **300 L/s @150Pa**) with necessary supports, dampers, bracketing, flexible connections, gravity shutters & all other necessary fittings and accessories complete to working order.	Nos.	1		
6.1.18.4	Design, Supply & Installation, testing and commissioning of suitable **duct mounted** exhaust fan for **Second Floor** area (air flow rate shall be **150 L/s @150Pa**) with necessary supports, dampers, bracketing, flexible connections, gravity shutters & all other necessary fittings and accessories complete to working order.	Nos.	1		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
6.1.18.5	Design, Supply & Installation, testing and commissioning of suitable **duct mounted** exhaust fan for **Third Floor** area (air flow rate shall be **150 L/s @150Pa**) with necessary supports, dampers, bracketing, flexible connections, gravity shutters & all other necessary fittings and accessories complete to working order.	Nos.	1		
6.1.18.6	Design, Supply & Installation, testing and commissioning of suitable **wall mounted** exhaust fan for **Third Floor** area (air flow rate shall be **100 L/s**) with necessary supports, dampers, bracketing, flexible connections, gravity shutters & all other necessary fittings and accessories complete to working order.	Nos.	1		
6.1.18.7	Design, Supply & Installation, testing and commissioning of suitable **duct mounted** exhaust fan for **Fourth Floor** area (air flow rate shall be **200 L/s @150Pa**) with necessary supports, dampers, bracketing, flexible connections, gravity shutters & all other necessary fittings and accessories complete to working order.	Nos.	2		
6.1.18.8	Design, Supply & Installation, testing and commissioning of suitable **wall mounted** exhaust fan for **Fifth Floor** area (air flow rate shall be **100 L/s**) with necessary supports, dampers, bracketing, flexible connections, gravity shutters & all other necessary fittings and accessories complete to working order.	Nos.	2		
6.1.18.9	Design, Supply & Installation of Insulated GI ducting for Exhaust Ducting System for **Lunch rooms** as per specification, inclusive of all kind of flexible connections, dampers, grills, sound attenuators, insulation, supports etc.	Item	1		
6.1.19	**For Toilet Blocks**				
6.1.19.1	Design, Supply & Installation, testing and commissioning of suitable **duct mounted** exhaust fan for **T1-Ground Floor** area (air flow rate shall be **300 L/s @150Pa**) with necessary supports, dampers, bracketing, flexible connections, gravity shutters & all other necessary fittings and accessories complete to working order.	Nos.	1		
6.1.19.2	Design, Supply & Installation, testing and commissioning of suitable **wall mounted** exhaust fan for **T2 -Ground Floor** area (air flow rate shall be **150 L/s**) with necessary supports, dampers, bracketing, flexible connections, gravity shutters & all other necessary fittings and accessories complete to working order.	Nos.	1		
6.1.19.3	Design, Supply & Installation, testing and commissioning of suitable **duct mounted** exhaust fan for **T1-First Floor** area (air flow rate shall be **300 L/s @150Pa**) with necessary supports, dampers, bracketing, flexible connections, gravity shutters & all other necessary fittings and accessories complete to working order.	Nos.	1		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
6.1.19.4	Design, Supply & Installation, testing and commissioning of suitable **wall mounted** exhaust fan for **T3-First Floor** area (air flow rate shall be **180 L/s**) with necessary supports, dampers, bracketing, flexible connections, gravity shutters & all other necessary fittings and accessories complete to working order.	Nos.	2		
6.1.19.5	Design, Supply & Installation, testing and commissioning of suitable **duct mounted** exhaust fan for **T4-Second Floor** area (air flow rate shall be **300 L/s @150Pa**) with necessary supports, dampers, bracketing, flexible connections, gravity shutters & all other necessary fittings and accessories complete to working order.	Nos.	1		
6.1.19.6	Design, Supply & Installation, testing and commissioning of suitable **duct mounted** exhaust fan for **T1-Third Floor** area (air flow rate shall be **300 L/s @150Pa**) with necessary supports, dampers, bracketing, flexible connections, gravity shutters & all other necessary fittings and accessories complete to working order.	Nos.	1		
6.1.19.7	Design, Supply & Installation, testing and commissioning of suitable **wall mounted** exhaust fan for **T5-Third Floor** area (air flow rate shall be **100 L/s**) with necessary supports, dampers, bracketing, flexible connections, gravity shutters & all other necessary fittings and accessories complete to working order.	Nos.	1		
6.1.19.8	Design, Supply & Installation, testing and commissioning of suitable **duct mounted** exhaust fan for **T6-Fourth Floor** area (air flow rate shall be **180 L/s @150Pa**) with necessary supports, dampers, bracketing, flexible connections, gravity shutters & all other necessary fittings and accessories complete to working order.	Nos.	1		
6.1.19.9	Design, Supply & Installation, testing and commissioning of suitable **duct mounted** exhaust fan for **T7-Fourth Floor** area (air flow rate shall be **250 L/s @150Pa**) with necessary supports, dampers, bracketing, flexible connections, gravity shutters & all other necessary fittings and accessories complete to working order.	Nos.	1		
6.1.19.10	Design, Supply & Installation, testing and commissioning of suitable **wall mounted** exhaust fan for **T8-Fourth Floor** area (air flow rate shall be **180 L/s**) with necessary supports, dampers, bracketing & all other necessary fittings and accessories complete to working order.	Nos.	2		
6.1.19.11	Design, Supply & Installation, testing and commissioning of suitable **duct mounted** exhaust fan for **T9-Fifth Floor** area (air flow rate shall be **250 L/s @150Pa**) with necessary supports, dampers, bracketing, flexible connections, gravity shutters & all other necessary fittings and accessories complete to working order.	Nos.	1		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
6.1.19.12	Design, Supply & Installation, testing and commissioning of suitable duct **wall mounted** exhaust fan for **T10-Fifth Floor** area (air flow rate shall be **100 L/s @ 75Pa**) with necessary supports, dampers, bracketing, flexible connections, gravity shutters & all other necessary fittings and accessories complete to working order.	Nos.	1		
6.1.19.13	Design, Supply & Installation of Non-Insulated GI ducting for Exhaust Ducting System for **Toilet blocks** as per specification, inclusive of all kind of flexible connections, dampers, grills, sound attenuators, insulation, supports etc.	Item	1		
6.1.20 6.1.20.1	**Air Registers** Supply & Installation of **weather proof fresh air intake louver** for all PAUs, with a suitable face size considering the width and height, including with flexible connections, insect screens, volume control damper, plenum box, hanging supports and other necessary accessories to complete the installation, aluminum construction coated with oven baked enamel paint of colour to the architect's approval	Nos.	3		
6.1.20.2	Supply & Installation of **weather proof exhaust air louver** for all exhaust fans, with a suitable face size considering the width and height, including with flexible connections, insect screens, volume control damper, plenum box, hanging supports and other necessary accessories to complete the installation, aluminum construction coated with oven baked enamel paint of colour to the architect's approval	Item	1		
6.1.20.3	Supply & Installation of **Egg crate** Exhaust removable mesh type grilles (Neck size 150 x 150mm) for corridor areas, lunch room & toilet blocks included with flexible connections, volume control damper, plenum box, hanging supports and other necessary accessories to complete the installation, aluminum construction coated with oven baked enamel paint of colour to the architect's approval	Nos.	100		
6.1.21	Testing & commissioning with client representative and presence of a chartered building service engineer	Lot	1		
6.1.22	Manufacturer recommended Spare Parts as per Specifications	Set.	1		
6.1.23	Maintenance During Defect Liability Period as Specified	Item	1		
6.1.24	FAT & Trainings	Item	1		
6.1.25	Allow for any other items specially not mentioned but which the tender considers necessary	Lot	1		
	AIR CONDITION WORKS - VRV SYSTEM CARRIED TO SUB SUMMARY 3				

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
6.2 6.2.1	AIR CONDITION WORKS - VRF STSTEM Supply & installation 18,000Btu/Hr of Ceiling Suspended indoor units connected with refrigerant lines with necessary controllers, filters, thermostats, wireless remote controllers, drain pumps and drain lines.(drain connect storm water floor gully/nearest drain)	Nos.	8		
6.2.2	Supply & installation 24,000Btu/Hr of Ceiling Suspended indoor units connected with refrigerant lines with necessary controllers, filters, thermostats, wireless remote controllers, drain pumps and drain lines.(drain connect storm water floor gully/nearest drain)	Nos.	17		
6.2.3	Supply & installation 48,000Btu/Hr of Ceiling Suspended indoor units connected with refrigerant lines with necessary controllers, filters, thermostats, wireless remote controllers, drain pumps and drain lines.(drain connect storm water floor gully/nearest drain)	Nos.	9		
6.2.4	Supply & installation of outdoor units to match with the capacity of above indoor units. (Minimum capacity shall be 82 RT x 2 Sets) (1 duty/1 standby).Outdoor unit shall meet the minimum efficiency requirements (EER & IEER) of ASHRAE Standard 90.1 and AHRI Standard 1230.	Sets.	1		
6.2.5	Design, supply & installation of refrigerant piping system (as specified) including proper insulation.	Item	1		
6.2.6	Supply and installation of **Pipe Tray** (With suitable width, thick and height as per the site condition) with fabricated of thick Zinc Aluminum sheets and powder coated with brackets and all the material required for laying the refrigerant pipes. The Tray shall be supported at 1.2 m intervals. All supports and accessories shall be hot dip galvanized and powder coated.	Item	1		
6.2.7	Supply and Installation of GI Cladding for Insulating refrigerant piping	Item	1		
6.2.8	Power supply to all units, including panels, Power & control wiring with GI conduit or PVC wall exposed plastic casing for concealed the electrical wiring with necessary accessories.	Item	1		
6.2.9	Control and Monitoring System (Computer Controlled network system to control outdoor units and indoor units with inbuilt LCD display)	Item	1		
6.2.10	Any other work required for the completion of the A/C system (to be Specified) including builder's works and for proper functioning of the AC System	Item	1		
6.2.11	Testing & commissioning	Item	1		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
6.2.12	Supply of recommended spare parts for 2 years trouble free operation of the proposed A/C system.	Item	1		
6.2.13	Maintenance during defect liability period as mention in the specification	Item	1		
	AIR CONDITION WORKS - VRF SYSTEM CARRED TO SUB SUMMARY 3				

Bill No : 06 - AIR CONDITION WORKS - VRV / VRF SYSTEM SUB SUMMARY 3

6.1	AIR CONDITION WORKS - VRV SYSTEM	Rs:	
6.2	AIR CONDITION WORKS - VRF STSTEM	Rs:	
	AIR CONDITION WORKS - VRV / VRF SYSTEM WORK CARRIED TO SUMMARY	Rs:	

BILL OF QUANTITIES

NAVIGATIONAL SERVICE COMPLEX AT CIAR, RATMALANA

Bill No : 07 - FIRE WATER & PROTECTION SYSTEM

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
7.0	FIRE PROTECTION SYSTEM **NOTE 1** Allow for all cost of supply including CIF, CID, PAL, clearing charges, transport charges, erection, factory testing, site testing, commissioning as per specification and drawings and profits etc. Allow for cost of providing security bonds, guaranties, insurance of personnel, property, material against accidents, damage, trespass or theft. Allow for the cost of all temporary works such as scaffolding etc. associated civil and electrical works related to the installation work such as drilling of suitable holes in walls, breaking of any parts of walls and finishing works of the same such as plastering, painting, etc. electrical power / control wiring, services connections, etc. **NOTE 2** The work includes the supply of all materials and the provision of site testings, pre-site visits, plants, tools, machines, scaffoldings, labor, documents, drawings, stores, method statements, test reports, handing over documents, technical data sheets, manufacturer's specifications & recommendations, method statements, services in connection with the work as set out in these documents and required for handing over the Fire Protection & Detection System which shall be fully operational in every respect and intent. The contractor shall have before tendering verified ratings, sizes and dimensions of all components included and required in order to achieve the design criteria. The Contractor shall have when tendering verified all building and constructional details. The contractor shall dismantle and remove all temporory works, tools, equipment etc from site on completion of works. Bidder shall take into consideration that rates and prices quoted will be deemed to cover the entire work to be carried out under the scope of work, whether such items have been specially mentioned in the BOQ or not. Ancillaries are deemed to include valves, stopcocks, drain cocks, test points and pressure gauges, automatic air vents, flexible connections and the like.				

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
	Rates for all conduits shall be included supports, hangers, saddles, brackets, screw nails, tees, bends, sockets, reducers, fittings, other finishing materials and the like. All materials and equipment supplied shall be new, unused and without any defects and shall be approved by the Engineer. Prices and rates for equipment and other materials to be imported shall include for customs dues, taxes, transport charges, handling and clearing charges, shipping or air lifting charges, bank charges etc. Bidder's price for each item of work shall include for cost builders work such as making plinths, making and closing up holes, openings & blackouts, drilling, boring, anchoring, chasing covering up etc., including restoring all finishes and the like to the entire satisfaction of the Engineer. Bidders shall fill and submit technical data pertaining to equipment offered with supporting catalogues pertaining to same together with the bid. Failure to submit above technical details may be considered as grounds for rejection of the Bid. Unpriced Items: Cost relating to item which are not being priced will be deemed to have been included in the Total Amount of the bill of Quantities. For the full description of materials and workmanship refer "Technical Specification", "General Notes" and "Drawings". The bidder shall inspect the site before pricing mainly to assess the required length of piping and identify the relevant civil works and builders works, lifting of equipment and materials etc. Allow for Cost of providing security bonds, guarantees, performance bonds, insurance, property, material against accidents, damages, trespass or theft etc. The contractor shall take the utmost care to avoid any damages to existing properties (fire pipelines, drain pipelines, water supply pipelines, ducting and cables, etc.) The contractor shall take responsibility for those damages and shall replace the damaged items or shall pay the compensation as required and the supervision of the client. The quantities set out in Bill of Quantities are estimated values and to cover the anticipated scope of work to be performed by Contractor. The actual quantities used at the installation will be determined by joint measurements carried out by the Engineer and Contractor and payments would be made for the actual quantites used at the installation.				

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
7.1	**Fire Pump Set** Supply and installation of two, Fire Pumps (one duty and one standby) with a capacity of **1500 L/min** at **9 bar** pressure and a jockey pump with a capacity of **60 L/min** at **9.5 bar** pressure and complete with following items. - Pressure gauges - Pressure vessel - Level switch - level gauge at low water level of under ground tank to switch off the pump. - Pressure switches to pressurize the system if the pressure drops beyond a preset value and switch off the pump if the pressure reaches a preset value in the system and couplings, fixtures and fittings for the completion of pump installation. - flow switches, priming tank, suction & delivery headers, testing assembly & all other fittings & accessories such as gate valve, flexible coupling, strainers, check valves etc.	1	Item		
7.2	**Pump Control Panel for Wet Riser Pump Set** Supply and installation of Pump Control Panel for wet riser pumping system and a control panel complete with, - Control Panel construction and main components including Control panel shall be powder coated sheet steel panel rated IP 54 with lockable door, Star-Delta / DOL starters for pumps, Main incomer breaker, Breakers for all out going feeders to pumps, Main bus bars and earthling bus, Programmed switch for automatic change over and delayed cut-out signal, Contactors, relays, interlocks, CT's fuses, etc. - Protection and interfacing including Pump set dry run protection by float switch, Single phasing cut off, Thermal over load protection for each pump motor, interfacing with fire detection and alarm system for status indication. - Indicator Lamps, Controls and Instruments on Pump Control Panel including L1, L2 and L3 phase indication with R, Y, B lamps, On / Off / Fail lamps for each pump, Indicator lamps and lamp test switches, Lead / Lag pump selector switch, Auto / Off / Manual mode selector switch, Main ON / OFF switch, Fail alarm and mute switch, Voltmeter with phase selector switch, Ammeters for each phase with maximum demand indicator, Water sump level indicator (Audio & Visual) and with all necessary electrical connections, controls and associated electrical works.	1	Item		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
	The rate shall include for the power supply cabling from sub distribution panel/ isolator provided in the pump room.				
	Pipes				
	Under Ground Piping				
7.3	Supply and installation of ASTM A53 GI, Schedule 40, Heavy duty or Seamless pipes (including welding joints to protect the pipe lines from corrosion) wrapping with grease impregnated jute wrappings (Denso or equivalent) having minimum 50% overlap for underground piping with following pipe sizes. The rate shall be complete with all necessary fittings such as bends, tees, reducers etc and Excavation of trench, directly backfilling of the same inserting warning tape after laying the pipes as shown in the drawings and specifications				
7.3.1	150 mm dia. Pipes	40	m		
7.3.2	100 mm dia. Pipes	75	m		
7.4	Construction of under ground valve pit for external hydrants including all valves and neccessary accessories as per the drawing and specifications.	2	nr		
	Above Ground Piping				
7.5	Supply and installation of **ASTM A53 Schedule 40 Seamless GI pipes or Heavy Duty GI Pipes complied to BS 1387/ BS EN 10255** complete with all necessary fittings such as bends, tees, reducers etc. with protective paint outside, cathodic protection and supports and fixing materials as per the specification;				
7.5.1	150mm dia. pipe.	20	m		
7.5.2	100mm dia. pipe.	50	m		
7.5.3	65mm dia. pipe.	40	m		
7.5.4	50mm dia. pipe.	10	m		
7.5.5	32mm dia. pipe.	20	m		
7.5.6	25mm dia. pipe.	10	m		
7.6	**Valves**				
7.6.1	Supply and installation of 150 mm dia. cast iron Gate Valve.	2	nr		
7.6.2	Supply and installation of 100 mm dia. cast iron Gate Valve.	2	nr		
7.6.3	Supply and installation of 65 mm dia. Lockable cast iron gate valve.	6	nr		
7.6.4	Supply and installation of 50 mm dia. bronze gate valve.	2	nr		
7.6.5	Supply and installation of 25 mm dia. bronze gate valve.	12	nr		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
7.6.6	Supply and installation of 25 mm dia. automatic air release valves c/w ball cock valve 25 mm dia at top of the Wet riser.	2	nr		
7.6.7	Supply and installation of pressure gauge at top of the Wet risers.	2	nr		
7.7	**Landing Valve** Supply and installation of **65 mm** dia. Pressure regulating type landing valve with **3** Nos of 65mm dia **15 m** length synthetic fire hoses with spray jet nozzle complete with all pipes and fittings.	6	nr		
7.8	**Fire Hose Reel** Supply and installation of fixed type, **25 mm** dia, **30 m** length, non-kinking reinforced rubber, swinging type fire hose reel terminating in shut off branch with spray jet nozzle complying with BS 3169 :1981 and complete with shut off controlled valve, pressure reducing valve (PRV), union and all necessary supports and fixing materials etc.	11	nr		
7.9	**Hose reel cabinet** Supply & installation of two compartment hose reel cabinet system as indicated in fire protection system drawing & as per specification and shall be compatibal with BS EN 671-1 or NFPA 14.				
7.9.1	Type 01 (For LV, HR, 6kg ABC Power & 5Kg CO2 Fire Extinguishers)	6	nr		
7.9.2	Type 02 (For HR, 6kg ABC Power & 5Kg CO2 Fire Extinguishers)	5	nr		
7.10	**Pillar Fire Hydrant** Supply and installation of pillar type external fire hydrant with **lockable two** landing valves, **03** Nos. of **65 mm** dia. **15 m** length fire hoses, spray jet nozzle complete with Cabinet to house fire hoses and nozzles all necessary fixing materials.	2	nr		
7.11	**Fire Service Inlet** Supply and installation of **4-way** fire service inlet complete with isolation valve and all accessories.	1	nr		
7.12	**Portable Fire Extinguishers**				
7.12.1	Supply and installation of **9 liter**, **Water/CO_2** portable fire extinguisher complete with all necessary fixing materials.	1	nr		
7.12.2	Supply and installation of **5 kg CO_2** portable fire extinguisher complete with all necessary fixing materials.	18	nr		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
7.12.3	Supply and installation of **6 kg ABC** portable fire extinguishers (Stored Pressure Type) complete with all necessary fixing materials.	11	nr		
7.12.4	Supply and installation of **9L Form** fire extinguishers (Stored Pressure Type) complete with all necessary fixing materials.	2	nr		
7.13	Design, Supply, installation & testing & commissioning of Suitable Fire suppression System FM 200 for Equipment room (ATM/LINK/AWOS/AMHS/VCCS) & VHF Equipment room of floor area as indicated in Architectural drawings as per the technical specifications given & to the compliance with relevant Local and BS EN Standards.	1	Item		
7.14	Tools and Spare Parts	1	Item		
7.15	Any other items deemed necessary for proper functioning of the systems as indicated in the specification and drawings.	1	Item		
7.16	Testing and commissioning of the Fire Protection System at the site premises including measurement and verifications by using proper test equipment.	1	Item		
	FIRE PROTECTION SYSTEM CARRIED TO SUMMARY				

BILL OF QUANTITIES

NAVIGATIONAL SERVICE COMPLEX AT CIAR, RATMALANA

Bill No : 08 - INFORMATION TECHNOLOGY SYSTEM WORK

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
8.1	FIRE DETECTION AND ALARM SYSTEM				
8.1.1	Supply, Installation, Testing and Commissioning of analog addressable main control panel with battery backup.	Nos.	1		
8.1.2	Supply, Installation, Testing and Commissioning of Fire Alarm Repeater Panel	Nos.	1		
8.1.3	Supply & Installation of analog addressable type smoke detector including base with Fire resistant cables in GI conduits (embeded and surface mounted)	Nos.	185		
8.1.4	Supply & Installation of analog addressable type multi sensor detector including base with Fire resistant cables in GI conduits (embeded and surface mounted)	Nos.	3		
8.1.5	Supply & Installation of analog addressable type manual call points with Fire resistant cables in GI conduits (embeded and surface mounted)	Nos.	14		
	FIRE DETECTION AND ALARM SYSTEM WORK CARRIED TO SUB SUMMARY 4				
8.2	NETWORK CONNECTIVITY FOR DATA, TELEPHONE				
8.2.1	Supply & Installation of 48 port PoE network switches with SFP modules	Nos.	12		
8.2.2	Supply & Installation of 24 port, Cat 6 UTP patch panel	Nos.	24		
8.2.3	Supply, Installation and Terminating of RJ 45 Network Outlets with Cat 6 Cabling in embaded GI conduits and tray	Nos.	433		
8.2.4	Supply & Installation of RJ45 patch cords, 0.5 mtrs	Nos.	433		
8.2.5	Supply & Installation of RJ45 patch cords, 3 mtrs	Nos.	433		
8.2.6	Supply & Installationnof Optical Switch (24 Port)	Nos.	2		
8.2.7	Supply & Installation of Fiber patch panels 24 port	Nos.	7		
8.2.8	Supply & Installation of Fiber cable 24 core SM outdoor	Mtrs.	50		
8.2.9	Supply & Installation of fiber cable 12 core SM outdoor	Mtrs.	75		
8.2.1	Supply & Installation of Fiber patch cords	Nos.	16		
8.2.11	Supply & Installation of WIFI access points with license	Nos.	17		
8.2.12	Configuration, Licensing, Testing & Commissioning of WLAN system	Item	1		
8.2.13	Supply & Installation of 5 KVA UPS Units	Nos.	6		
8.2.14	Supply & Installation of 42U data rack	Nos.	6		
8.2.15	Supply & Installation of SIP Phone (Executive)	Nos.	25		

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
8.2.16	Supply & Installation of IP phones (Black)	Nos.	50		
8.2.17	Supply & Installation of Distribution Box, 500 Pair	Nos.	1		
8.2.18	Supply & Installation of Distribution Box, 100 Pair	Nos.	7		
8.2.19	Supply & Installation of Distribution Box, 50 Pair	Nos.	1		
8.2.2	Supply & Installation of 100 pair Telephone Underground Cable	Mtrs.	150		
8.2.21	Supply & Installation of Telephone Cable, 50 Pair in embaded GI conduits and tray	Mtrs.	150		
8.2.22	Supply & Installation of Telephone Cable, 20 Pair in embaded GI conduits and tray	Mtrs.	150		
8.2.23	Supply & Installation of Telephone Cable, 10 Pair in embaded GI conduits and tray	Mtrs.	25		
8.2.24	Supply & Installation of Telephone Cable, 2 Pair in embaded GI conduits and tray	Mtrs.	250		
8.2.25	Supply & Installation of PVC trunking 2 way 100mm x 100mm	Mtrs.	50		
8.2.26	Supply & Installation of PVC trunking 2 way 100mm x 50mm	Mtrs.	50		
8.2.27	Supply & Installation of power coated steel trunking 50mm x 50mm	Mtrs.	200		
8.2.28	Supply & Installation of RJ 11 Dual Telephone Outlets	Nos.	54		
8.2.29	Supply & Installation of cable trays 50x300mm	Mtrs.	715		
8.2.3	Supply & vertical Installation of cable trays for cable riser 50x300mm	Mtrs.	50		
8.2.31	Supply & Installation of underfloor trunking	Mtrs.	100		
8.2.32	Supply & Installation of underfloor service box	Nos.	10		
8.2.33	Supply & Installation of underfloor junction box	Nos.	10		
8.2.34	Supply & Installation of concrete encased, 2 way, 100mm PVC cable duct	Mtrs.	75		
8.2.35	Constuction of Manholes 1000x700mm	Nos.	5		
	NETWORK CONNECTIVITY FOR DATA, TELEPHONE WORK CARRIED TO SUB SUMMARY 4				
8.3	EVACUATION SIREN SYSTEM				
8.3.1	Supply & Installation of Fire Manual Call Point for Push Switches with 2 pair Telephone cable in embaded GI Conduits and Treay	Nos	12		
8.3.2	Supply & Installation of Sounders with 2 pair Telephone cable in embaded GI Conduits and Treay	Nos	12		
	EVACUATION SIREN SYSTEM CARRIED TO SUB SUMMARY 4				

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
8.4	DIGITAL CLOCK SYSTEM				
8.4.1	Supply & Installation of Digital clock	Nos.	11		
	DIGITAL CLOCK SYSTEM CARRIED TO SUB SUMMARY 4				
8.5	ACCESS CONTROL SYSTEM				
8.5.1	Supply & Installation of 20 mm PVC conduit embaded with 100x100 ABC box & blank plate	Nos.	6		
	ACCESS CONTROL SYSTEM CARRIED TO SUB SUMMARY 4				
8.6	FLIGHT INFORMATION DISPLAY SYSTEM				
8.6.1	Supply and Insttation of Thin Client Personal computer	Nos.	4		
8.6.2	Supply and Installation of 24" Monitor	Nos.	4		
	FLIGHT INFORMATION DISPLAY SYSTEM CARRIED TO SUB SUMMARY 4				
8.6	CCTV				
8.6.1	Supply & Installation of Dome Camera	Nos.	22		
8.6.2	Supply & Installation of Bullet Camera	Nos.	3		
	CCTV CARRIED TO SUB SUMMARY 4				

Bill No : 08 - INFORMATION TECHNOLOGY SYSTEM WORK SUB SUMMARY 4

8.1	FIRE DETECTION AND ALARM SYSTEM	.....
8.2	NETWORK CONNECTIVITY FOR DATA, TELEPHONE	.....
8.3	EVACUATION SIREN SYSTEM	.....
8.4	DIGITAL CLOCK SYSTEM	.....
8.5	ACCESS CONTROL SYSTEM	.....
8.6	FLIGHT INFORMATION DISPLAY SYSTEM	.....
8.7	CCTV	
	INFORMATION TECHNOLOGY SYSTEM WORK CARRIED TO SUMMARY	

BILL OF QUANTITIES

NAVIGATIONAL SERVICE COMPLEX AT CIAR, RATMALANA

Bill No : 9 - ELEVATOR

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
9.0	ELEVATOR				
9.1	Supply and Installation of 1000 Kg, 1.5 ms-1 Heavy Duty Dual purpose (Passenger) Machine-Room-Less standard Elevator	Nos	1		
9.2	Tools and Spare Parts	Sum	1		
9.3	Testing and Commissioning	Sum	1		
9.4	Training of Employer's Personnel	Sum	1		
	ELEVATOR WORK CARRIED TO SUMMARY				

BILL OF QUANTITIES

NAVIGATIONAL SERVICE COMPLEX AT CIAR, RATMALANA

Bill No : 10 - DAYWORKS SCHEDULE

ITEM	DESCRIPTION	UNIT	QTY	RATE Rs. Cts.	AMOUNT Rs. Cts.
11.0	DAYWORKS SCHEDULE ***Note :*** *1)Day Work rates quoted below shall also cover all the expenses of the Contractor and particularly his overhead expenses, profits and supervision, repairing and maintaining the tools necessary to each class of workman.* *2)The Contractor shall state under Item 4 to 15 below, the rate per hour for use of plant in good working condition and include for the cost of fuel, lubricants, transport to and from site, wages and allowances of the operator. Contractor's overheads and profit and any other expenses and charges.*				
10.1	Skilled labours	hours	100		
10.2	Semi skilled labour	hours	100		
10.3	Unskilled labour	hours	100		
10.4	Welding plant (Electric)	hours	20		
10.5	Porker vibrator	hours	40		
10.6	Plate Compactor	hours	40		
10.7	Vibrating rammer	hours	40		
10.8	Tractor & trailer	hours	80		
10.9	Concrete cutter	hours	30		
10.10	Bachore JCB	hours	75		
10.11	Farm tractor with water bowser	hours	100		
10.12	Hand held Breaker	hours	40		
10.13	Compressor 250 CFM	hours	30		
10.14	Dump Truck (1 cube)	hours	50		
10.15	Dump Truck (3 cube)	hours	50		
	DAYWORKS CARRIED TO SUMMARY				

NAVIGATIONAL SERVICE COMPLEX AT CIAR, RATMALANA

S U M M A R Y			
1.0	PRELIMINARIES	Rs.	
2.0	DEMOLITION	Rs.	
3.0	CIVIL WORKS	Rs.	
4.0	INTERNAL WATER SUPPLY, WASTE WATER DISPOSAL & SEWAGE DISPOSAL WORK	Rs.	
5.0	ELECTRICAL INSTALLATION	Rs.	
6.0	AIR CONDITION WORKS - VRV / VRF SYSTEM	Rs.	
7.0	FIRE PROTECTION SYSTEM	Rs.	
8.0	INFORMATION TECHNOLOGY SYSTEM WORK	Rs.	
9.0	ELEVATOR	Rs.	
10.0	DAYWORKS	Rs.	
	SUB TOTAL 1	Rs.	
	Ddt : Provisional Sums	Rs.	27,200,000.00
	SUB TOTAL 2	Rs.	
	Ddt : Discount if any (……..)	Rs.	
	SUB TOTAL 3	Rs.	
	Add : Provisional Sums	Rs.	27,200,000.00
	SUB TOTAL 4	Rs.	
	Add 10% Physical Contingencies	Rs.	
	Add 15% Price Contingencies	Rs.	
	T O T A L Excluding VAT	Rs.	
	ADD VAT 18 %	*Rs.*	
	T O T A L Including VAT	Rs.	

VAT. Registration No. :- _____

Amount in words Rupees :- _____

_____

_____

Name and Address of Bidder :- _____

_____

_____

_____

Signature of Bidder

Date: _____

SECTION - 9
SCHEDULES

Schedule 1 – General Information

(i) If pre-qualification is done the bidders are required to include information subsequent to that submitted with the pre-qualification application.
(ii) For joint ventures, each joint venture partner shall furnish information separately.

ITB Clause reference	Description	Information *(to be filled by the Bidder)*	Remarks
4.1 (a)	**Legal Status**		*Provide certified copies of Registration*
	Written power of attorney of the signatory to the Bid	*Provide original or certified copy of the power of attorney attested by a Notary and label as attachment to Clause 4.1(a)*	
	If a Joint Venture, names and addresses of Joint Venture Partners	1. …… 2. …….. 3. ……	*Provide a draft copy of the Joint Venture Agreement or alternatively the memorandum of understanding*
	If a Joint Venture, name of Lead Partner		
	For joint ventures, each joint venture partner shall furnish Legal Status separately		
	Name (Lead partner)		*Provide certified copies and label as attachment to Clause 4.1(a)*
	Legal status		
	Place of registration		
	Principle place of business		
	Written power of attorney of the signatory to the Bid	*Provide original or certified copy of the power of attorney attested by a Notary and label as attachment to Clause 5.1*	
	VAT Registration Number		
	Name (Partner 2)		*Provide certified copies and label as attachment to Clause 4.1 (a)*
	Legal status		
	Place of registration		
	Principle place of business		

ITB Clause reference	Description	Information *(to be filled by the Bidder)*	
	Written power of attorney of the signatory to the Bid	*Provide original or certified copy of the power of attorney attested by a Notary and label as attachment to Clause 4.1 (a)*	
	VAT Registration Number		
	Name (Partner 3)		*Provide certified copies and label as attachment to Clause 4.1 (a)*
	Legal status		
	Place of registration		
	Principle place of business		
	Written power of attorney of the signatory to the Bid	*Provide original or certified copy of the power of attorney attested by a Notary and label as attachment to Clause 4.1 (a)*	
	VAT Registration Number		
4.2 (a)	**ICTAD Registration**		*Provide certified copies and label as attachment to Clause 4.2(a)*
	Registration number		
	Grade		
	Specialty		
	Expiry Date		

Schedule 2 – Annual Turn-over Information
(Construction only – Last five years)

(i) If pre-qualification is done the bidders are required to include information subsequent to that submitted with the pre-qualification application.

(ii) For joint ventures, each joint venture partner shall furnish information separately.

Year	Turn-over	Remarks
1		*Attach audited reports and label as attachment to Clause 4.2*
2		
3		
4		
5		

Schedule 3 – Adequacy of Working Capital

If pre-qualification is done the bidders are required to include information subsequent to that submitted with the pre-qualification application

Source of credit line	Amount	Remarks
		Provide documentary evidence and label as attachment to Clause 4.2
Total		

Schedule 4 – Construction Experience in last five years

(i) If pre-qualification is done the bidders are required to include information subsequent to that submitted with the pre-qualification application.

(ii) For joint ventures, each joint venture partner shall furnish information separately.

Year	Employer	Description of Works	Amount	Contractor's Responsibility (%)
		Total		

- *Provide documentary evidence and label as attachment to Clause 4.2*

LIST OF WORKS IN HAND BY THE MAIN CONTRACTOR

Please attach copies of the relevant pages of the contractor's record book too.

No	Project	Contract Sum (Rs. M.)	Duration (Months)	Scheduled Date Of Completion	% Completed	Client	Consultant

AASL

Schedule 5 – Major Items of Construction Equipment Proposed	
Type	**Capacity**

ASL

Schedule 6 – Construction Management Staff		
A. Key Professionals		
Name	**Position**	**Task**
B. Support Staff		
Name	**Position**	**Task**

Schedule 7 – Time Schedule for Key Staff

			Months (in the form of a Bar Chart)															
Name	**Position**	**Activities**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**Number of Months**

Full-time: _____ Part-time: ……

Schedule 8 – Work Programme Sheet 1 of ……															
	[1st, 2nd, etc. are months from the Start Date.]														
Construction Activity	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th

SECTION - 10
DRAWINGS

LIST OF DRAWINGS

DRAWING NO.		DESCRIPTION
AASL/ CIAR/ A,L&ID/ 1-18501	:	LAYOUT PLAN
AASL/ CIAR/ A,L&ID/ 1-18502	:	DEMOLISH PLAN
AASL/ CIAR/ A,L&ID/ 1-18503	:	3D IMAGES
AASL/ CIAR/ A,L&ID/ 1-18504	:	SETTINOUT PLAN (MAIN BUILDING & GENERATOR ROOM)
AASL/ CIAR/ A,L&ID/ 1-18505	:	GROUND FLOOR PLAN
AASL/ CIAR/ A,L&ID/ 1-18506	:	FIRST FLOOR PLAN
AASL/ CIAR/ A,L&ID/ 1-18507	:	SECOND FLOOR PLAN
AASL/ CIAR/ A,L&ID/ 1-18508	:	THIRD FLOOR PLAN
AASL/ CIAR/ A,L&ID/ 1-18509	:	FOURTH FLOOR PLAN
AASL/ CIAR/ A,L&ID/ 1-18510	:	FIFTH FLOOR PLAN
AASL/ CIAR/ A,L&ID/ 1-18511	:	ROOF PLAN
AASL/ CIAR/ A,L&ID/ 1-18512	:	PLAN OF TOWER @ +24350MM LEVEL/ TOWER ROOF PLAN
AASL/ CIAR/ A,L&ID/ 1-18513	:	FRONT ELEVATION
AASL/ CIAR/ A,L&ID/ 1-18514	:	SECTION A-A
AASL/ CIAR/ A,L&ID/ 1-18515	:	DETAILS OF FLOOR FINISHERS (GROUND FLOOR LEVEL)
AASL/ CIAR/ A,L&ID/ 1-18516	:	DETAILS OF FLOOR FINISHERS (FIRST FLOOR LEVEL)
AASL/ CIAR/ A,L&ID/ 1-18517	:	DETAILS OF FLOOR FINISHERS (SECOND FLOOR LEVEL)
AASL/ CIAR/ A,L&ID/ 1-18518	:	DETAILS OF FLOOR FINISHERS (THIRD FLOOR LEVEL)
AASL/ CIAR/ A,L&ID/ 1-18519	:	DETAILS OF FLOOR FINISHERS (FOURTH FLOOR LEVEL)
AASL/ CIAR/ A,L&ID/ 1-18520	:	DETAILS OF FLOOR FINISHERS (FIFTH FLOOR LEVEL)
AASL/ CIAR/ A,L&ID/ 1-18521	:	DETAILS OF FLOOR FINISHERS (TOWER FLOOR LEVEL)

AASL/ CIAR/ A,L&ID/ 1-18522	:	DETAILS OF DOORS AND WINDOWS – SHEET 01
AASL/ CIAR/ A,L&ID/ 1-18523	:	DETAILS OF DOORS AND WINDOWS – SHEET 02
AASL/ CIAR/ A,L&ID/ 1-18524	:	DETAILS OF DOORS AND WINDOWS – SHEET 03
AASL/ CIAR/ A,L&ID/ 1-18525	:	DETAILS OF DOORS AND WINDOWS – SHEET 04
AASL/ CIAR/ A,L&ID/ 1-18526	:	DETAILS OF DOORS AND WINDOWS – SHEET 05
AASL/ CIAR/ A,L&ID/ 1-18527	:	DETAILS OF DOORS AND WINDOWS – SHEET 06
AASL/ CIAR/ A,L&ID/ 1-18528	:	FIRE STAIRCASE DETAILS (ST-01)- SHEET 01
AASL/ CIAR/ A,L&ID/ 1-18529	:	FIRE STAIRCASE DETAILS (ST-01)- SHEET 02
AASL/ CIAR/ A,L&ID/ 1-18530	:	FIRE STAIRCASE DETAILS (ST-01)- SHEET 03
AASL/ CIAR/ A,L&ID/ 1-18531	:	STAIRCASE DETAILS (ST-02)- SHEET 04
AASL/ CIAR/ A,L&ID/ 1-18532	:	STAIRCASE DETAILS (ST-02)- SHEET 05
AASL/ CIAR/ A,L&ID/ 1-18533	:	STAIRCASE DETAILS (ST-02)- SHEET 06
AASL/ CIAR/ A,L&ID/ 1-18534	:	DETAILS OF TOILET (TYPE T1) – SHEET 01
AASL/ CIAR/ A,L&ID/ 1-18535	:	DETAILS OF TOILET (TYPE T2) – SHEET 02
AASL/ CIAR/ A,L&ID/ 1-18536	:	DETAILS OF TOILET (TYPE T3) – SHEET 03
AASL/ CIAR/ A,L&ID/ 1-18537	:	DETAILS OF TOILET (TYPE T4) – SHEET 04
AASL/ CIAR/ A,L&ID/ 1-18538	:	DETAILS OF TOILET (TYPE T4) – SHEET 05
AASL/ CIAR/ A,L&ID/ 1-18539	:	DETAILS OF TOILET (TYPE T5) – SHEET 06
AASL/ CIAR/ A,L&ID/ 1-18540	:	DETAILS OF TOILET (TYPE T6) – SHEET 07
AASL/ CIAR/ A,L&ID/ 1-18541	:	DETAILS OF TOILET (TYPE T6) – SHEET 08
AASL/ CIAR/ A,L&ID/ 1-18542	:	DETAILS OF TOILET (TYPE T7) – SHEET 09
AASL/ CIAR/ A,L&ID/ 1-18543	:	DETAILS OF TOILET (TYPE T8) – SHEET 10
AASL/ CIAR/ A,L&ID/ 1-18544	:	DETAILS OF TOILET (TYPE T9) – SHEET 11
AASL/ CIAR/ A,L&ID/ 1-18545	:	DETAILS OF TOILET (TYPE T10) – SHEET 12

AASL/CIAR/3920201	:	General Notes
AASL/CIAR/3920202	:	Pile Foundation & Column Layout
AASL/CIAR/3920203	:	Details of Pile Foundation
AASL/CIAR/3920204	:	General Arrangement of First Floor & Second Floor Slab
AASL/CIAR/3920205	:	General Arrangement of Third Floor & Fourth Floor Slab
AASL/CIAR/3920206	:	General Arrangements of Fifth Floor & Roof Slab
AASL/CIAR/3920207	:	R/F Details of First Floor Slab
AASL/CIAR/3920208	:	R/F Details of Second Floor Slab
AASL/CIAR/3920209	:	R/F Details of Third Floor Slab
AASL/CIAR/3920210	:	R/F Details of Fourth Floor Slab
AASL/CIAR/3920211	:	R/F Details of Fifth Floor Slab
AASL/CIAR/3920212	:	R/F Details of Roof Slab
AASL/CIAR/3920213	:	Typical Details of Column
AASL/CIAR/3920214	:	R/F Details of Beams (Sheet 01 of 22)
AASL/CIAR/3920215	:	R/F Details of Beams (Sheet 02 of 22)
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AASL/CIAR/3920217	:	R/F Details of Beams (Sheet 04 of 22)
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AASL/CIAR/3920223	:	R/F Details of Beams (Sheet 10 of 22)
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AASL/CIAR/3920240	:	Details of Entrance Porch (Sheet 01 of 02)
AASL/CIAR/3920241	:	Details of Entrance Porch (Sheet 02 of 02)
AASL/CIAR/3920242	:	Details of Control Tower Cabin (Sheet 01 of 02)
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AASL/CIAR/3920244	:	R/F Details of Control Tower Ground & Roof Slab
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AASL/CIAR/3920246	:	R/F Details of Lift well (Sheet 01 of 02)
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AASL/CIAR/3920248	:	Details of staircase -1 & staircase -2

AASL/CIAR/3920249	:	Details of staircase – 3 & Fire Staircase - 4
AASL/CIAR/3920250	:	Ladder Details
AASL/CIAR/3920251	:	R/F Details of Electrical Panel Room
AASL/CIAR/3920252	:	Drainage Details
AASL/BIA/3920301	:	Legend
AASL/BIA/3920302	:	Lighting Layout – Ground Floor
AASL/BIA/3920303	:	Lighting Layout –First Floor
AASL/BIA/3920304	:	Lighting Layout – Second Floor
AASL/BIA/3920305	:	Lighting Layout –Third Floor
AASL/BIA/3920306	:	Lighting Layout – Fourth Floor
AASL/BIA/3920307	:	Lighting Layout – Fifth Floor & Control Tower
AASL/BIA/3920308	:	General Power Layout – Ground Floor
AASL/BIA/3920309	:	General Power Layout – First Floor
AASL/BIA/3920310	:	General Power Layout – Second Floor
AASL/BIA/3920311	:	General Power Layout – Third Floor
AASL/BIA/3920312	:	General Power Layout – Fourth Floor
AASL/BIA/3920313	:	General Power Layout – Fifth Floor & Control Tower
AASL/BIA/3920314	:	AC Power Layout – Ground Floor
AASL/BIA/3920315	:	AC Power Layout – First Floor
AASL/BIA/3920316	:	AC Power Layout – Second Floor
AASL/BIA/3920317	:	AC Power Layout – Third Floor
AASL/BIA/3920318	:	AC Power Layout – Fourth Floor
AASL/BIA/3920319	:	AC Power Layout – Fifth Floor & Control Tower
AASL/BIA/3920320	:	Cable Tray Layout – Ground Floor

AASL/BIA/3920321	:	Cable Tray Layout – Floor & First Floor
AASL/BIA/3920322	:	Cable Tray Layout – Second Floor
AASL/BIA/3920323	:	Cable Tray Layout – Third Floor
AASL/BIA/3920324	:	Cable Tray Layout – Fourth Floor
AASL/BIA/3920325	:	Cable Tray Layout – Fifth Floor
AASL/BIA/3920326	:	Floor/Wall Trunking Layout – Ground Floor
AASL/BIA/3920327	:	Floor/Wall Trunking Layout – First Floor
AASL/BIA/3920328	:	Floor/Wall Trunking Layout – Second Floor
AASL/BIA/3920329	:	Floor/Wall Trunking Layout – Third Floor
AASL/BIA/3920330	:	Floor/Wall Trunking Layout – Fifth Floor & Control Tower
AASL/BIA/3920331	:	Cable Trench/Duct Layout – Ground Floor
AASL/BIA/3920332	:	Feeder Cable Layout – Ground Floor
AASL/BIA/3920333	:	Feeder Cable Layout – First Floor
AASL/BIA/3920334	:	Feeder Cable Layout – Second Floor
AASL/BIA/3920335	:	Feeder Cable Layout – Third Floor
AASL/BIA/3920336	:	Feeder Cable Layout – Fourth Floor
AASL/BIA/3920337	:	Feeder Cable Layout – Fifth Floor
AASL/BIA/3920338	:	Single Line Diagrams – Main Power Distribution (MDB) - Sheet 01
AASL/BIA/3920339	:	Single Line Diagrams – Main Power Distribution {MDB-NSC-1(CHILLER), MDB-NSC-2(SB)} - Sheet 02

AASL/BIA/3920340	:	Single Line Diagrams – Main Power Distribution {SDB-PH2-3(HANGER), SDB-GF-3(PUMP)} - Sheet 03
AASL/BIA/3920341	:	Single Line Diagrams – Main Power Distribution {MDB-NSC-3(NSB)} - Sheet 04
AASL/BIA/3920342	:	Single Line Diagrams – Ground Floor {SDB-GF-1(SB), SDB-GF-2(NSB)} - Sheet 01
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AASL/BIA/3920345	:	Single Line Diagrams – Ground Floor {DB-GF-2(AC), DB-GF-3(SW)} - Sheet 04
AASL/BIA/3920346	:	Single Line Diagrams – Ground Floor {DB-GF-4, DB-GF-5(EM)} - Sheet 05
AASL/BIA/3920347	:	Single Line Diagrams – Ground Floor {DB-GF-8(UPS-DB)} - Sheet 06
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AASL/BIA/3920349	:	Single Line Diagrams – Ground Floor Power House {DB-PH-1(SB)} - Sheet 08
AASL/BIA/3920350	:	Single Line Diagrams – First Floor {SDB-1F-1(SB), SDB-1F-2(NSB)} - Sheet 01
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AASL/BIA/3920352	:	Single Line Diagrams – First Floor {DB-1F-3, DB-1F-4(EM)} - Sheet 03
AASL/BIA/3920353	:	Single Line Diagrams – First Floor {DB-1F-5(VRV), DB-1F-6(FCU)} - Sheet 04
AASL/BIA/3920354	:	Single Line Diagrams – First Floor {DB-1F-1(P) - Sheet 05
AASL/BIA/3920355	:	Single Line Diagrams – Second Floor {SDB-2F-1(SB), SDB-2F-2(NSB)} - Sheet 01
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AASL/BIA/3920358	:	Single Line Diagrams – Second Floor {DB-2F-5(VRV), DB-2F-6(FCU)} - Sheet 04
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AASL/BIA/3920360	:	Single Line Diagrams – Third Floor {DB-3F-3(L), DB-3F-3(SW)} - Sheet 02
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AASL/BIA/3920362	:	Single Line Diagrams – Third Floor {DB-3F-2, DB-3F-4(EM)} - Sheet 04
AASL/BIA/3920363	:	Single Line Diagrams – Third Floor {DB-3F-6(FCU)} - Sheet 05

AASL/BIA/3920364	:	Single Line Diagrams – Fourth Floor {SDB-4F-1(SB), SDB-4F-2(NSB)} - Sheet 01
AASL/BIA/3920365	:	Single Line Diagrams – Fourth Floor {DB-4F-1(L), DB-4F-4(EM)} - Sheet 02
AASL/BIA/3920366	:	Single Line Diagrams – Fourth Floor {DB-4F-1(P)} - Sheet 03
AASL/BIA/3920367	:	Single Line Diagrams – Fourth Floor {DB-4F-2(SW), DB-4F-6(FCU)} - Sheet 04
AASL/BIA/3920368	:	Single Line Diagrams – Fourth Floor {DB-4F-3, DB-4F-5(VRV)} - Sheet 05
AASL/BIA/3920369	:	Single Line Diagrams – Fifth Floor {SDB-5F-1(SB), SDB-5F-2(NSB)} - Sheet 01
AASL/BIA/3920370	:	Single Line Diagrams – Fifth Floor {DB-5F-1(L), DB-5F-3(EM)} - Sheet 02
AASL/BIA/3920371	:	Single Line Diagrams – Fifth Floor {DB-5F-1(P)} - Sheet 03
AASL/BIA/3920372	:	Single Line Diagrams – Fifth Floor {DB-5F-2(SW), DB-5F-4(VRV)} - Sheet 04
AASL/BIA/3920373	:	Single Line Diagrams – Fifth Floor & Control Tower {DB-5F-6(FCU), DB-6F-1(TWR)} - Sheet 05
AASL/CIAR/3920401	:	Air Conditioning & Exhaust System – Ground Floor
AASL/CIAR/3920402	:	Air Conditioning & Exhaust System – First Floor
AASL/CIAR/3920403	:	Air Conditioning & Mechanical Ventilation System – Second Floor

AASL/CIAR/3920404	:	Air Conditioning & Exhaust System – Third Floor
AASL/CIAR/3920405	:	Air Conditioning & Exhaust System – Fourth Floor
AASL/CIAR/3920406	:	Air Conditioning & Exhaust System – Fifth Floor
AASL/CIAR/3920407	:	Air Conditioning & Exhaust System – Control Tower
AASL/CIAR/3920408	:	Fresh Air System Schematic Diagram & Corridors Exhaust System
AASL/CIAR/3920409	:	
AASL/CIAR/3920501	:	Water Supply, Sewer & Waste Water Disposal System – Ground Floor
AASL/CIAR/3920502	:	
AASL/CIAR/3920503	:	
AASL/CIAR/3920601	:	Network connectivity for data & telephone – Site Layout
AASL/CIAR/3920602	:	Network connectivity for data & telephone Layout – Ground Floor
AASL/CIAR/3920603	:	Network connectivity for data & telephone Layout – First Floor
AASL/CIAR/3920604	:	Network connectivity for data & telephone Layout – Second Floor
AASL/CIAR/3920605	:	Network connectivity for data & telephone Layout – Third Floor
AASL/CIAR/3920606	:	Network connectivity for data & telephone Layout – Fourth Floor
AASL/CIAR/3920607	:	Network connectivity for data & telephone Layout – Fifth Floor
AASL/CIAR/3920608	:	Network connectivity for data & telephone Layout – Roof Level & Tower at +21350 Levels

AASL/CIAR/3920609	:	Cable Tray Layout – Ground Floor
AASL/CIAR/3920610	:	Cable Tray Layout – First Floor
AASL/CIAR/3920611	:	Cable Tray Layout – Second Floor
AASL/CIAR/3920612	:	Cable Tray Layout – Third Floor
AASL/CIAR/3920613	:	Cable Tray Layout – Fourth Floor
AASL/CIAR/3920614	:	Cable Tray Layout – Fifth Floor
AASL/CIAR/3920615	:	Under Floor PVC Trunking for Network & ELV Distribution Layout – First Floor
AASL/CIAR/3920616	:	Under Floor PVC Trunking for Network & ELV Distribution Lyout – Second Floor
AASL/CIAR/3920617	:	Clock & S. V. D. S. Layout – Ground Floor
AASL/CIAR/3920618	:	Clock & S. V. D. S. Layout – First Floor
AASL/CIAR/3920619	:	Clock & S. V. D. S. Layout – Second Floor
AASL/CIAR/3920620	:	Clock & S. V. D. S. Layout – Third Floor
AASL/CIAR/3920621	:	Clock & S. V. D. S. Layout – Fourth Floor
AASL/CIAR/3920622	:	Clock & S. V. D. S. Layout – Fifth Floor
AASL/CIAR/3920623	:	Clock & S. V. D. S. Layout – Roof Level & Tower at +21350 Levels
AASL/CIAR/3920624	:	Evacuation Siren System Layout – Ground Floor
AASL/CIAR/3920625	:	Evacuation Siren System Layout – First Floor
AASL/CIAR/3920626	:	Evacuation Siren System Layout – Second Floor
AASL/CIAR/3920627	:	Evacuation Siren System Layout – Third Floor

AASL/CIAR/3920628	:	Evacuation Siren System Layout – Fourth Floor
AASL/CIAR/3920629	:	Evacuation Siren System Layout – Fifth Floor
AASL/CIAR/3920630	:	CCTV Layout – Ground Floor
AASL/CIAR/3920631	:	CCTV Layout – First Floor
AASL/CIAR/3920632	:	CCTV Layout – Second Floor
AASL/CIAR/3920633	:	CCTV Layout – Third Floor
AASL/CIAR/3920634	:	CCTV Layout – Fourth Floor
AASL/CIAR/3920635	:	CCTV Layout – Fifth Floor
AASL/CIAR/3920636	:	Manhole & Hand hole Details
AASL/CIAR/3920701	:	Fire Detection System – Ground Floor
AASL/CIAR/3920702	:	Fire Detection System – First Floor
AASL/CIAR/3920703	:	Fire Detection System – Second Floor
AASL/CIAR/3920704	:	Fire Detection System – Third Floor
AASL/CIAR/3920705	:	Fire Detection System – Fourth Floor
AASL/CIAR/3920706	:	Fire Detection System – Fifth Floor & Control Tower
AASL/CIAR/3920707	:	Fire Detection System – Roof Level & Tower at +21350 Levels

AASL/CIAR/3920708	:	Fire Protection System – Ground Floor
AASL/CIAR/3920709	:	Fire Protection System – First Floor
AASL/CIAR/3920710	:	Fire Protection System – Second Floor
AASL/CIAR/3920711	:	Fire Protection System – Third Floor
AASL/CIAR/3920712	:	Fire Protection System – Fourth Floor
AASL/CIAR/3920713	:	Fire Protection System – Fifth Floor
AASL/CIAR/3920714	:	Fire Protection System – Control Tower
AASL/CIAR/3920715	:	

AASL

SECTION - 11
STANDARD FORMS (BID)

- **Bid Security**

Note:

The bidders are advised to fill the Check List for Bidders when submitting the bid. However it is the responsibility of the bidders to comply with all the requirements given in the bidding document. Failure to non compliance with any of them may be a reason for rejection of the Bid.

Notes on Standard Forms:-

- ***Bidders shall submit the completed Form of Bid Security in compliance with the requirements of the bidding documents.***
- ***Bidders should not complete the Form of Agreement at the time of preparation of bids***.
- ***The successful bidder will be required to sign the Form of Agreement, after the award of Contract.***
- ***Any corrections or modifications to the accepted bid resulting from arithmetic corrections, acceptable deviations or quantity variations in accordance with the requirements of the bidding documents should be incorporated into the Agreement.***
- ***The Form of Performance Security, Form of Advance Payment Security and Form of Retention Money Guarantee should not be completed by the bidders at the time of submission of bids.***
- ***The successful bidder will be required to provide these securities in compliance with the requirements herein or as acceptable to the Employer.***

FORM OF BID SECURITY

[this Guarantee form shall be filled in accordance with the instructions indicated in brackets]

---------- [insert issuing agency's name, and address of issuing branch or office]

Beneficiary: Chairman, Airport and Aviation Services (Sri Lanka) (Private) Limited, Bandaranaike International Airport, Katunayake

Date: ---------- *[insert (by issuing agency) date]*

BID GUARANTEE No.: ---------- *[insert (by issuing agency) number]*

We have been informed that ---------- *[insert (by issuing agency) name of the Bidder]* (hereinafter called "the Bidder") has submitted to you its bid dated ---------- *[insert (by issuing agency) date]*(hereinafter called "the Bid") for the execution of *[insert name of Contract]* under Invitation for Bids No. ---------- *[insert IFB number]* ("the IFB").

Further more, we understand that, according to your conditions, Bids must be supported by a Bid Guarantee.

At the request of the Bidder, we ---------- *[insert name of issuing agency]* hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of ---------- *[insert amount in figures]* ---------- *[insert amount in words]*) upon receipt by us of your first demand in writing stating that the Bidder:

(a) has withdrawn its Bid during the period of bid validity specified; or

(b) does not accept the correction of errors in accordance with the Instructions to Bidders (hereinafter "the ITB") of the IFB; or

(c) having been notified of the acceptance of its Bid by the Employer/Purchaser during the period of bid validity, (i) fails or refuses to execute the Contract Form, if required, or (ii) fails or refuses to furnish the Performance Security, in accordance with the ITB.

This Guarantee shall expire: (a) if the Bidder is the successful bidder, upon our receipt of copies of the Contract signed by the Bidder and of the Performance Security issued to you by the Bidder; or (b) if the Bidder is not the successful bidder, upon the earlier of the successful bidder furnishing the performance security, otherwise it will remain in force up to ---------- *(insert date)*

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

Signature : ----------

Check List for Bidders

Bidders are advised to fill the following table :

ITEM		ITB Clause	YES (tick)	REFERENCE
Form of Bid				
	Addressed to the **Employer ?**	**18**		
	Completed ?	**18**		
	Signed ?	**18**		
Bid Securing Declaration Form (if required)				
	Properly filled and signed	**16**		
Bid Security (if required)				
	Addressed to the **Employer ?**	**16**		
	Format as required ?	**16**		
	Issuing Agency as specified ?	**16**		
	Amount as requested ?	**16**		
	Validity **30 days beyond** the validity of Bid	**16**		
Qu**alification Information**				
	All relevant information completed ?	**4**		
	Signed ?	**4**		
Addendum				
	Contents of the addendum (if any) taken into account ?	**10**		
BID Package				
	All the documents given in ITB Clause 12 enclosed in the original and copy ?	**12**		
	ITB Clause 19 followed before sealing the Bid Package ?	**19**		