REPUBLIC OF THE PHILIPPINES
NATIONAL POWER CORPORATION
(Pambansang Korporasyon sa Elektrisidad)

BID DOCUMENTS

Name of Project	:	**UPRATING VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA**
Project Location	:	**NPC VIRAC (MARINAWA) SUBSTATION, MARINAWA, BATO, CATANDUANES**
Specification No	:	**LuzP22Z1478Se**
Contents	:	

Design and Development Department

SECTION I

INVITATION TO BID

National Power Corporation
INVITATION TO BID
PUBLIC BIDDING – BCS 2023-0549

1. The NATIONAL POWER CORPORATION (NPC), through its approved Corporate Budget of CY 2023 intends to apply the sum of **(Please see schedule below)** being the Approved Budget for the Contract (ABC) to payments under the contract. Bids received in excess of the ABC shall be automatically rejected at Bid opening.

PR Nos./PB Ref No. & Description	Similar Contracts	Pre-bid Conference	Bid Submission / Opening	ABC/ Amt. of Bid Docs
HO-WIT24-001 / PB231109-NA00344 Twelve (12) Months Supply and Delivery of Fuel Requirements for NPC-HO for CY 2024	Supply and Delivery of Biodiesel and/or E-10 Gasoline Fuel	26 October 2023 9:30 A.M.	09 November 2023 9:30 A.M.	₱ 13,063,848.04 / ₱ 25,000.00
MG-PAT23-004 / PB231109-RA00345 Supply and Delivery of Fourteen (14) Pieces of Segmented Thrust Bearing in Pulangi IV HEP	Supply and Delivery of Segmented Generator Thrust Bearing or Generator Parts / Components / Equipments for Hydro-Electric Power Plants	26 October 2023 9:30 A.M.	09 November 2023 9:30 A.M.	₱ 19,600,000.00 / ₱ 25,000.00
HO-PIG24-001 / PB231109-DM00346 Uprating of Virac (Marinawa) Substation from 10MVA to 20MVA • PCAB License: License Category of at least **"Category B – Electrical Work"** and registration classification of at least **"Medium A – Electrical Work"**	Supply, Delivery, Installation, Test and Commissioning or Uprating of 69kV Substation	26 October 2023 9:30 A.M.	09 November 2023 9:30 A.M.	₱39,247,000.00 / ₱ 25,000.00
Venue: Kañao Function Room, NPC Bldg. Diliman, Quezon City				

2. The NPC now invites bids for Items listed above. Delivery of the Goods is required **(see table below)** specified in the Technical Specifications. Bidders should have completed, within **(see table below)** from the date of submission and receipt of bids, a contract similar to the Project. The description of an eligible bidder is contained in the Bidding Documents, particularly, in Section II. (Instruction to Bidders).

PR No/s. / PB Ref No/s.	Delivery Period / Contract Duration	Relevant Period of SLCC reckoned from the date of submission & receipt of bids
HO-WIT24-001	Twelve (12) Months	Five (5) Years
MG-PAT23-004	Two Hundred Forty (240) Calendar Days	Fifteen (15) Years
HO-PIG24-001	One Hundred Eighty (180) Calendar Days	-

3. Bidding will be conducted through open competitive bidding procedures using a non-discretionary "*pass/fail*" criterion as specified in the 2016 revised Implementing Rules and Regulations (IRR) of Republic Act (RA) No. 9184.

   Bidding is restricted to Filipino citizens/sole proprietorships, partnerships, or organizations with at least sixty percent (60%) interest or outstanding capital stock belonging to citizens of the Philippines, and to citizens or organizations of a country the laws or regulations of which grant similar rights or privileges to Filipino citizens, pursuant to RA 5183.

4. Prospective Bidders may obtain further information from National Power Corporation, Bids and Contracts Services Division and inspect the Bidding Documents at the address given below during office hours (8:00AM to 5:00PM), Monday to Friday.

5. A complete set of Bidding Documents may be acquired by interested Bidders from the given address and website(s) and upon payment of the applicable fee for the Bidding Documents, pursuant to the latest Guidelines issued by the GPPB. *Bidding fee may be refunded in accordance with the guidelines based on the grounds provided under Section 41 of R.A. 9184 and its Revised IRR.*

6. The National Power Corporation will hold Pre-Bid Conference **(see table above)** and/or through video conferencing or webcasting which shall be open to prospective bidders. Only registered bidder/s shall be allowed to participate in the conduct of virtual pre-bid conference. **Unregistered bidders** may attend the Pre-Bid Conference at the Kañao Room, NPC subject to the following:

   a. Only a maximum of two (2) representatives from each bidder / company shall be allowed to participate during the virtual pre-bid conference.
   b. Wearing of Face Masks is recommended but not required in view of Proclamation No. 297 S.2023 lifting the State of Public Health Emergency Throughout the Philippines
   c. The requirements herein stated including the medium of submission shall be subject to GPPB Resolution No. 09-2020 dated 07 May 2020
   d. The Guidelines on the Implementation of Early Procurement Activities (EPA) shall be subject to GPPB Circular No. 06-2019 dated 17 July 2019

7. Bids must be duly received by the BAC Secretariat through (i) manual submission at the office address indicated below; (ii) online or electronic submission before the specified time stated in the table above for opening of bids. Late bids shall not be accepted.

8. All Bids must be accompanied by a bid security in any of the acceptable forms and in the amount stated in **ITB** Clause 14.

9. Bid opening shall be in the Kañao Function Room, NPC Head Office, Diliman, Quezon City and/or via online platform to be announced by NPC. Bids will be opened in the presence of the bidders' representatives who choose to attend the activity.

10. The National Power Corporation reserves the right to reject any and all bids, declare a failure of bidding, or not award the contract at any time prior to contract award in accordance with Sections 35.6 and 41 of the 2016 revised IRR of R.A. No. 9184, without thereby incurring any liability to the affected bidder or bidders.

11. For further information, please refer to:

    Bids and Contracts Services Division,
    Logistics Department

    BIR Road cor. Quezon Avenue
    Diliman, Quezon City
    Tel Nos.: 8924-5211 and 8921-3541 local 5564/5211
    Email: bcsd@napocor.gov.ph /

12. You may visit the following websites:

    For downloading of Bidding Documents: https://www.napocor.gov.ph/bcsd/bids.php

ATTY. MELCHOR P. RIDULME
Vice President, Office of the Legal Counsel and
Chairman, Bids and Awards Committee

SECTION II

INSTRUCTIONS TO BIDDERS

SECTION II - INSTRUCTIONS TO BIDDERS

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SECTION II - INSTRUCTIONS TO BIDDERS

1. Scope of Bid

NPC invites Bids for the **UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA** , with Project Identification Number **LuzP22Z1478Se.**

The Procurement Project (referred to herein as "Project") is for the construction of Works, as described in Section VI (Specifications).

2. Funding Information

The GOP through the source of funding as indicated below for CY 2023 in the amount of **THIRTY NINE MILLION TWO HUNDRED FORTY SEVEN THOUSAND PESOS (₱ 39,247,000.00).** The source of funding is the proposed Corporate Operating Budget of the National Power Corporation (NPC).

3. Bidding Requirements

The Bidding for the Project shall be governed by all the provisions of RA No. 9184 and its 2016 revised IRR, including its Generic Procurement Manual and associated policies, rules and regulations as the primary source thereof, while the herein clauses shall serve as the secondary source thereof.

Any amendments made to the IRR and other GPPB issuances shall be applicable only to the ongoing posting, advertisement, or invitation to bid by the BAC through the issuance of a supplemental or bid bulletin.

The Bidder, by the act of submitting its Bid, shall be deemed to have inspected the site, determined the general characteristics of the contracted Works and the conditions for this Project, such as the location and the nature of the work; (b) climatic conditions; (c) transportation facilities; (c) nature and condition of the terrain, geological conditions at the site communication facilities, requirements, location and availability of construction aggregates and other materials, labor, water, electric power and access roads; and (d) other factors that may affect the cost, duration and execution or implementation of the contract, project, or work and examine all instructions, forms, terms, and project requirements in the Bidding Documents.

4. Corrupt, Fraudulent, Collusive, Coercive, and Obstructive Practices

The Procuring Entity, as well as the Bidders and Contractors, shall observe the highest standard of ethics during the procurement and execution of the contract. They or through an agent shall not engage in corrupt, fraudulent, collusive, coercive, and obstructive practices defined under Annex "I" of the 2016 revised IRR of RA No. 9184 or other integrity violations in competing for the Project.

5. Eligible Bidders

5.1. Only Bids of Bidders found to be legally, technically, and financially capable will be evaluated.

5.2. The bidder must have completed an SLCC that is similar to the contract to be bid, and whose value, adjusted to current prices using the PSA consumer price indices, must be at least fifty percent (50%) of the ABC to be bid: Provided, however, That contractors under Small A and Small B categories without similar experience on the contract to be bid may be allowed to bid if

the cost of such contract is not more than the Allowable Range of Contract Cost (ARCC) of their registration based on the guidelines as prescribed by the PCAB. For Foreign-funded Procurement, the GoP and the foreign government/foreign or international financing institution may agree on another track record requirement.

A contract is considered to be "similar" to the contract to be bid if it has the major categories of work stated in the **BDS**.

5.3. For Foreign-funded Procurement, the Procuring Entity and the foreign government/foreign or international financing institution may agree on another track record requirement, as specified in the Bidding Document prepared for this purpose.

5.4. The Bidders shall comply with the eligibility criteria under Section 23.4.2 of the 2016 IRR of RA No. 9184.

6. Origin of Associated Goods

There is no restriction on the origin of Goods other than those prohibited by a decision of the UN Security Council taken under Chapter VII of the Charter of the UN.

7. Subcontracts

7.1. The Bidder may subcontract portions of the Project to the extent allowed by the Procuring Entity as stated herein, but in no case more than fifty percent (50%) of the Project.

7.1. The Bidder must submit together with its Bid the documentary requirements of the subcontractor(s) complying with the eligibility criterial stated in **ITB** Clause 5 in accordance with Section 23.4 of the 2016 revised IRR of RA No. 9184 pursuant to Section 23.1 thereof.

7.2. Subcontracting of any portion of the Project does not relieve the Contractor of any liability or obligation under the Contract. The Supplier will be responsible for the acts, defaults, and negligence of any subcontractor, its agents, servants, or workmen as fully as if these were the Contractor's own acts, defaults, or negligence, or those of its agents, servants, or workmen.

8. Pre-Bid Conference

The Procuring Entity will hold a pre-bid conference for this Project on the specified date and time and either at its physical address and/or through videoconferencing/webcasting} as indicated in paragraph 6 of the **IB.**

9. Clarification and Amendment of Bidding Documents

Prospective bidders may request for clarification on and/or interpretation of any part of the Bidding Documents. Such requests must be in writing and received by the Procuring Entity, either at its given address or through electronic mail indicated in the **IB**, at least ten (10) calendar days before the deadline set for the submission and receipt of Bids.

10. Documents Comprising the Bid: Eligibility and Technical Components

10.1. The first envelope shall contain the eligibility and technical documents of the Bid as specified in **Form NPCSF-INFR-01 - Checklist of Technical and Financial Documents, Section VIII - Bidding Forms.**

10.2. If the eligibility requirements or statements, the bids, and all other documents for submission to the BAC are in foreign language other than English, it must be accompanied by a translation in English, which shall be authenticated by the appropriate Philippine foreign service establishment, post, or the equivalent office having jurisdiction over the foreign bidder's affairs in the Philippines. For Contracting Parties to the Apostille Convention, only the translated documents shall be authenticated through an apostille pursuant to GPPB Resolution No. 13-2019 dated 23 May 2019. The English translation shall govern, for purposes of interpretation of the bid.

10.3. A valid PCAB License is required, and in case of joint ventures, a valid special PCAB License, and registration for the type and cost of the contract for this Project. Any additional type of Contractor license or permit shall be indicated in the **BDS**.

10.4. A List of Contractor's key personnel (e.g., Project Manager, Project Engineers, Materials Engineers, and Foremen) assigned to the contract to be bid, with their complete qualification and experience data shall be provided. These key personnel must meet the required minimum years of experience set in the **BDS**.

10.5. A List of Contractor's major equipment units, which are owned, leased, and/or under purchase agreements, supported by proof of ownership, certification of availability of equipment from the equipment lessor/vendor for the duration of the project, as the case may be, must meet the minimum requirements for the contract set in the **BDS**.

11. Documents Comprising the Bid: Financial Component

11.1. The second bid envelope shall contain the financial documents for the Bid as specified in **Form NPCSF-INFR-01 - Checklist of Technical and Financial Documents, Section VIII - Bidding Forms.**

11.2. Any bid exceeding the ABC indicated in paragraph 1 of the **IB** shall not be accepted.

11.3. For Foreign-funded procurement, a ceiling may be applied to bid prices provided the conditions are met under Section 31.2 of the 2016 revised IRR of RA No. 9184.

12. Alternative Bids

Bidders shall submit offers that comply with the requirements of the Bidding Documents, including the basic technical design as indicated in the drawings and specifications. Unless there is a value engineering clause in the **BDS**, alternative Bids shall not be accepted.

13. Bid Prices

All bid prices for the given scope of work in the Project as awarded shall be considered as fixed prices, and therefore not subject to price escalation during contract implementation, except under extraordinary circumstances as determined by the NEDA and approved by the GPPB pursuant to the revised Guidelines for Contract Price Escalation guidelines.

14. Bid and Payment Currencies

14.1. Bid prices may be quoted in the local currency or tradeable currency accepted by the BSP at the discretion of the Bidder. However, for purposes of bid evaluation, Bids denominated in foreign currencies shall be converted to Philippine currency based on the exchange rate as published in the BSP reference rate bulletin on the day of the bid opening.

14.2. Payment of the contract price shall be made in Philippine Pesos.

15. Bid Security

15.1. The Bidder shall submit a Bid Securing Declaration or any form of Bid Security in the amount indicated in the **BDS**, which shall be not less than the percentage of the ABC in accordance with the schedule in the **BDS**.

15.2. The Bid and bid security shall be valid until **One Hundred Twenty (120) calendar days** from the date of opening of bids. Any bid not accompanied by an acceptable bid security shall be rejected by the Procuring Entity as non-responsive.

16. Sealing and Marking of Bids

Each Bidder shall submit Two (2) copies of the first and second components of its Bid, marked **Original** and photocopy. Only the original copy will be read and considered for the bid.

Any misplaced document outside of the **Original** copy will not be considered. The photocopy is ONLY FOR REFERENCE.

The Procuring Entity may request additional hard copies and/or electronic copies of the Bid. However, failure of the Bidders to comply with the said request shall not be a ground for disqualification.

If the Procuring Entity allows the submission of bids through online submission to the given website or any other electronic means, the Bidder shall submit an electronic copy of its Bid, which must be digitally signed. An electronic copy that cannot be opened or is corrupted shall be considered non-responsive and, thus, automatically disqualified.
Bidders must also comply with the Disclaimer and Data Privacy Notice specified in the **BDS**.

17. Deadline for Submission of Bids

The Bidders shall submit on the specified date and time and either at its physical address or through online submission as indicated in paragraph 7 of the **IB.**

18. Opening and Preliminary Examination of Bids

18.1. The BAC shall open the Bids in public at the time, on the date, and at the place specified in paragraph 9 of the **IB**. The Bidders' representatives who are present shall sign a register evidencing their attendance. In case videoconferencing, webcasting or other similar technologies will be used, attendance of participants shall likewise be recorded by the BAC Secretariat.

In case the Bids cannot be opened as scheduled due to justifiable reasons, the rescheduling requirements under Section 29 of the 2016 revised IRR of RA No. 9184 shall prevail.

18.2. The preliminary examination of Bids shall be governed by Section 30 of the 2016 revised IRR of RA No. 9184.

19. Detailed Evaluation and Comparison of Bids

19.1. The Procuring Entity's BAC shall immediately conduct a detailed evaluation of all Bids rated "*passed*" using non-discretionary pass/fail criteria. The BAC shall consider the conditions in the evaluation of Bids under Section 32.2 of 2016 revised IRR of RA No. 9184.

19.2. If the Project allows partial bids, all Bids and combinations of Bids as indicated in the **BDS** shall be received by the same deadline and opened and evaluated simultaneously so as to determine the Bid or combination of Bids offering the lowest calculated cost to the Procuring Entity. Bid Security as required by **ITB** Clause 15 shall be submitted for each contract (lot) separately.

19.3. In all cases, the NFCC computation pursuant to Section 23.4.2.6 of the 2016 revised IRR of RA No. 9184 must be sufficient for the total of the ABCs for all the lots participated in by the prospective Bidder.

20. Post Qualification

Within a non-extendible period of five (5) calendar days from receipt by the Bidder of the notice from the BAC that it submitted the Lowest Calculated Bid, the Bidder shall submit its latest income and business tax returns filed and paid through the BIR Electronic Filing and Payment System (eFPS), and other appropriate licenses and permits required by law and stated in the **BDS**.

21. Signing of the Contract

The documents required in Section 37.2 of the 2016 revised IRR of RA No. 9184 shall form part of the Contract. Additional Contract documents are indicated in the **BDS**.

SECTION III

BID DATA SHEETS

SECTION III - BID DATA SHEET

ITB Clause	
5.2	For this purpose, contracts similar to the Project refer to supply, delivery, installation, test and commissioning or uprating of 69 kV Substation. The Single Largest Completed Contract (SLCC) as declared by the bidder shall be verified and validated to ascertain such completed contract. Hence, bidders must ensure access to sites of such projects/equipment to NPC representatives for verification and validation purposes during post-qualification process. It shall be a ground for disqualification, if verification and validation cannot be conducted for reasons attributable to the Bidder. Bidders must also comply with the Equipment and Manufacturer's Experience requirements specified under Section VI, Part II – Technical Data Sheets, E.1.2. : POWER TRANSFORMER, Clause B.2.3 (Equipment and Manufacturer's Experience).
7.1	Only a maximum of fifty percent (50%) of the Works may be subcontracted. All Subcontractors must be approved by NPC.
10.1	The prospective bidder shall submit a valid and updated Certificate of PhilGEPs Registration under Platinum Membership (all pages including the Annex A of the said Certificate). **Non-compliance shall be a ground for disqualification.**
	The list of on-going contracts (Form No. NPCSF-INFR-02) shall be supported by the following documents for each on-going contract to be submitted during Post-Qualification: 1. Contract/Purchase Order and/or Notice of Award 2. Certification coming from the project owner/client that the performance is satisfactory as of the bidding date. The bidder shall declare in this form all his on-going government and private contracts including contracts where the bidder (either as individual or as a Joint Venture) is a partner in a Joint Venture agreement other than his current joint venture where he is a partner. Non declaration will be a ground for disqualification of bid.
	The Statement of the bidder's Single Largest Completed Contract (SLCC) similar to the contract to be bid (Form No. NPCSF-INFR-03) shall be supported by the following documents to be submitted during Bid Opening: 1. Contract/Purchase Order 2. Owner's Certificate of Final Acceptance issued by the project owner other than the contractor or a final rating of at least Satisfactory in the Constructors Performance Evaluation System (CPES). In case of contracts with the private sector, an equivalent document (Ex. Official Receipt *or* Sales Invoice) shall be submitted.

10.3	The required License issued by the Philippine Contractors Accreditation Board (PCAB): License Category of at least **"CATEGORY B – ELECTRICAL WORK"** and registration classification of at least **"MEDIUM A – ELECTRICAL WORK".**
10.4	The list of key personnel shall include the following minimum requirements: **a. One (1) Project Manager** Professional Electrical Engineer (PEE) who had managed or supervised at least a similar project within the last ten (10) years. **b. One (1) Project/Site Engineer** Registered Electrical Engineer (REE) or Registered Civil Engineer who had supervised at least one (1) similar project within the last ten (10) years. Must have five (5) years professional experience on similar project. **c. One (1) Safety Officer 2** Construction Safety Officer who has completed at least forty (40) hours of Construction Safety and Health Training (COSH) from Occupational Safety and Health Center (OSHC) or Safety Training Organizations (STOs) accredited by the Department of Labor and Employment (DOLE) The above key personnel must either be employed by the Bidder or contracted by the Bidder to be employed for the contract to be bid.
10.5	The list of construction equipment (owned or leased) shall include the following minimum requirements: 1. Truck Mounted Crane (35 Tons Cap.) - 1 unit 2. Delivery/Transport Vehicle (Van or Pick-up) - 1 unit 3. Concrete Mixer, 1-bagger - 1 unit 4. Concrete Vibrator, Engine driven - 1 unit
10.6	Bidders shall also submit the following requirements in their first envelope, Eligibility and Technical Component of their bid: 1. Documents to be submitted with the Bid Proposal as specified in Annex A of Section VI – Part II, Technical Data Sheet (Electrical Works) 2. Complete eligibility documents of the proposed sub-contractor, if any
10.7	Any single bidder/s who already procured/secured the bidding documents but want to avail the Joint Venture Agreement (JVA) shall inform the BAC in writing prior to the bid opening for records and documentation purposes.
12	No further instructions

15.1	The bid security shall be in the form of a Bid Securing Declaration or any of the following forms and amounts: 1. The amount of not less than *2% of ABC,* if bid security is in cash, cashier's/manager's check, bank draft/guarantee or irrevocable letter of credit; 2. The amount of not less than *5% of ABC* if bid security is in Surety Bond.
16.0	All bid submissions and related correspondences are confidential and for viewing only by the intended recipient/s. Any unauthorized access to review, reproduce, or disseminate the information contained therein is strictly prohibited. The National Power Corporation (NAPOCOR) does not guarantee the security of any information electronically transmitted. Bid submissions and related correspondences may contain personal and sensitive personal information, and are subject to the Data Privacy Act of 2012, its implementing rules, regulations and issuances of the National Privacy Commission of the Philippines ("Privacy Laws"). By viewing, using, storing, sharing and disposing (collectively "Processing"), such bids submissions and correspondences, you agree to comply with the Privacy Laws. By responding to correspondence, you consent to the Processing by NAPOCOR of the Personal Data contained in your submission/reply in accordance with NAPOCOR's Personal Data Privacy Policy which you can find at **http://www.napocor.gov.ph**. To report any privacy issue, contact the Data Privacy Officer at **dpo@napocor.gov.ph**. NAPOCOR is not liable for the proper and complete transmission of the information contained in bid submission/correspondences nor for any delay in its receipt.
19.2	Partial Bid is not allowed. The project is grouped in a single lot and the lot shall not be divided into sub-lots for the purpose of bidding, evaluation, and contract award. Bids shall also be further evaluated based on the computed Capitalized Cost of Transformer Losses. Its application and the formula are stated in the following clauses: 1. Section VI – Part I Technical Specification, Section E 1.2 - Power Transformer, Clause – 1.2.2.2.8 (Transformer Loss Evaluation) 2. Section VI – Part II Technical Data Sheets, Annex A, Section E 1.2 - Power Transformer, Clause B.1.2 (Capitalized Cost for Transformer Losses) In the bid evaluation, the figures stated in the said Clauses shall be multiplied by its respective guaranteed loss value in kilowatts, and the resulting figures will be added to the bid price to give a total evaluated price for bid comparison. The corrected bid price (calculated bid) due to computational errors, omissions and discounts or its submitted bid price; PLUS: the computed Cost of Transformer Losses, shall become the total evaluated bid price, for bid comparison purposes.

	Based on the detailed evaluation of bids, those that comply with the above-mentioned requirements shall be ranked in the ascending order of their total evaluated bid prices, to identify the lowest evaluated bid price. It is understood however, that the award of contract shall be at the Bidder's submitted bid price or its calculated bid price due to computational errors, omissions and discount, whichever is lower, which shall be exclusive of computed cost of transformer losses.
20	a. Class A – Eligibility Documents listed on the Annex A of Certificate of PhilGEPs Registration under Platinum Membership pursuant to Section 34.3 of the Revised IRR of R.A. 9184 b. Contract/Purchase Order and/or Notice of Award for the contracts stated in the List of all Ongoing Government & Private Contracts Including Contracts Awarded but not yet Started (NPCSF-INFR-02); c. Certification coming from the project owner/client that the performance is satisfactory as of the bidding date for all ongoing contracts stated in form NPCSF-INFR-02. d. Documents and Calculations to be submitted during post-qualification as specified in Annex B of Section VI – Part II, Technical Data Sheet (Electrical Works); Manufacturer's brochures, manuals and other supporting documents of equipment, materials, hardware and tools proposed by the bidders must comply with the technical specifications of such equipment, materials, hardware and tools. It shall be a ground for disqualification if the submitted brochures, manuals and other supporting documents are determined not complying with the specifications during technical evaluation and post-qualification process. Equipment, materials, hardware and tools proposed by the winning bidder to be supplied, which were evaluated to be complying with the technical specifications, shall not be replaced and must be the same items to be delivered/installed/used during the contract implementation. Any proposed changes/replacement of said items may be allowed on meritorious reasons subject to validation and prior approval by NPC. e. Certificate of Employment, Bio Data and valid PRC License of the (professional) personnel (NPCSF-INFR-10a, NPCSF-INFR-11) f. Certificate of Employment, Bio Data and Construction Safety and Construction Safety and Health Training Certificate from OSHC/STOs accredited by DOLE of the Safety Officer (NPCSF-INFR-10b, NPCSF-INFR-11) g. The licenses and permits relevant to the Project and the corresponding law requiring it as specified in the Technical Specifications, if any.

21	The following documents shall form part of the contract: 1. Notice to Proceed 2. Construction schedule and S-curve 3. Manpower Schedule 4. Construction Methods 5. Equipment Utilization Schedule 6. Construction safety and health program of the contractor duly approved by the Bureau of Working Condition (BWC) of the Department of Labor and Employment (DOLE) or proof of submission to BWC 7. PERT/CPM.

SECTION IV

GENERAL CONDITIONS OF CONTRACT

SECTION IV – GENERAL CONDITIONS OF CONTRACT

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SECTION IV – GENERAL CONDITIONS OF CONTRACT

1. Scope of Contract

This Contract shall include all such items, although not specifically mentioned, that can be reasonably inferred as being required for its completion as if such items were expressly mentioned herein. All the provisions of RA No. 9184 and its 2016 revised IRR, including the Generic Procurement Manual, and associated issuances, constitute the primary source for the terms and conditions of the Contract, and thus, applicable in contract implementation. Herein clauses shall serve as the secondary source for the terms and conditions of the Contract.

This is without prejudice to Sections 74.1 and 74.2 of the 2016 revised IRR of RA No. 9184 allowing the GPPB to amend the IRR, which shall be applied to all procurement activities, the advertisement, posting, or invitation of which were issued after the effectivity of the said amendment.

2. Sectional Completion of Works

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

3. Possession of Site

3.1 The Procuring Entity shall give possession of all or parts of the Site to the Contractor based on the schedule of delivery indicated in the **SCC,** which corresponds to the execution of the Works. If the Contractor suffers delay or incurs cost from failure on the part of the Procuring Entity to give possession in accordance with the terms of this clause, the Procuring Entity's Representative shall give the Contractor a Contract Time Extension and certify such sum as fair to cover the cost incurred, which sum shall be paid by Procuring Entity.

3.2 If possession of a portion is not given by the above date, the Procuring Entity will be deemed to have delayed the start of the relevant activities. The resulting adjustments in contract time to address such delay may be addressed through contract extension provided under Annex "E" of the 2016 revised IRR of RA No. 9184.

4. The Contractor's Obligations

The Contractor shall employ the key personnel named in the Schedule of Key Personnel indicating their designation, in accordance with **ITB** Clause 10.3 and specified in the **BDS**, to carry out the supervision of the Works.

The Procuring Entity will approve any proposed replacement of key personnel only if their relevant qualifications and abilities are equal to or better than those of the personnel listed in the Schedule.

5. Performance Security

5.1. Within ten (10) calendar days from receipt of the Notice of Award from the Procuring Entity but in no case later than the signing of the contract by both parties, the successful Bidder shall furnish the performance security in any of the forms prescribed in Section 39 of the 2016 revised IRR.

5.2. The Contractor, by entering into the Contract with the Procuring Entity, acknowledges the right of the Procuring Entity to institute action pursuant to RA No. 3688 against any subcontractor be they an individual, firm, partnership, corporation, or association supplying the Contractor with labor, materials and/or equipment for the performance of this Contract.

6. Site Investigation Reports

The Contractor, in preparing the Bid, shall rely on any Site Investigation Reports referred to in the **SCC** supplemented by any information obtained by the Contractor.

7. Warranty

7.1. In case the Contractor fails to undertake the repair works under Section 62.2.2 of the 2016 revised IRR, the Procuring Entity shall forfeit its performance security, subject its property(ies) to attachment or garnishment proceedings, and perpetually disqualify it from participating in any public bidding. All payables of the GOP in his favor shall be offset to recover the costs.

7.2. The warranty against Structural Defects/Failures, except that occasioned-on force majeure, shall cover the period from the date of issuance of the Certificate of Final Acceptance by the Procuring Entity. Specific duration of the warranty is found in the **SCC**.

8. Liability of the Contractor

Subject to additional provisions, if any, set forth in the **SCC**, the Contractor's liability under this Contract shall be as provided by the laws of the Republic of the Philippines.

If the Contractor is a joint venture, all partners to the joint venture shall be jointly and severally liable to the Procuring Entity.

9. Termination for Other Causes

Contract termination shall be initiated in case it is determined *prima facie* by the Procuring Entity that the Contractor has engaged, before, or during the implementation of the contract, in unlawful deeds and behaviors relative to contract acquisition and implementation, such as, but not limited to corrupt, fraudulent, collusive, coercive, and obstructive practices as stated in **ITB** Clause 4.

10. Dayworks

Subject to the guidelines on Variation Order in Annex "E" of the 2016 revised IRR of RA No. 9184, and if applicable as indicated in the **SCC**, the Dayworks rates in the Contractor's Bid shall be used for small additional amounts of work only when the

Procuring Entity's Representative has given written instructions in advance for additional work to be paid for in that way.

11. Program of Work

11.1. The Contractor shall submit to the Procuring Entity's Representative for approval the said Program of Work showing the general methods, arrangements, order, and timing for all the activities in the Works. The submissions of the Program of Work are indicated in the **SCC.**

11.2. The Contractor shall submit to the Procuring Entity's Representative for approval an updated Program of Work at intervals no longer than the period stated in the **SCC.** If the Contractor does not submit an updated Program of Work within this period, the Procuring Entity's Representative may withhold the amount stated in the **SCC** from the next payment certificate and continue to withhold this amount until the next payment after the date on which the overdue Program of Work has been submitted.

12. Instructions, Inspections and Audits

The Contractor shall permit the GOP or the Procuring Entity to inspect the Contractor's accounts and records relating to the performance of the Contractor and to have them audited by auditors of the GOP or the Procuring Entity, as may be required.

13. Advance Payment

The Procuring Entity shall, upon a written request of the Contractor which shall be submitted as a Contract document, make an advance payment to the Contractor in an amount not exceeding fifteen percent (15%) of the total contract price, to be made in lump sum, or at the most two installments according to a schedule specified in the **SCC**, subject to the requirements in Annex "E" of the 2016 revised IRR of RA No. 9184.

14. Progress Payments

The Contractor may submit a request for payment for Work accomplished. Such requests for payment shall be verified and certified by the Procuring Entity's Representative/Project Engineer. Except as otherwise stipulated in the **SCC**, materials and equipment delivered on the site but not completely put in place shall not be included for payment.

15. Operating and Maintenance Manuals

15.1. If required, the Contractor will provide "as built" Drawings and/or operating and maintenance manuals as specified in the **SCC.**

15.2. If the Contractor does not provide the Drawings and/or manuals by the dates stated above, or they do not receive the Procuring Entity's Representative's approval, the Procuring Entity's Representative may withhold the amount stated in the **SCC** from payments due to the Contractor.

SECTION V

SPECIAL CONDITIONS OF CONTRACT

SECTION V – SPECIAL CONDITIONS OF CONTRACT

GCC Clause	
2	Sectional completion is not specified.
3.1	NPC shall give access to the Site for the Contractor to commence and proceed with the works on the start date. The access to the site referred herein shall not be exclusive to the Contractor but only to enable him to execute the Work.
4	It shall also be the obligation and responsibility of the Contractor to carry out the Works properly and in accordance with this Contract, including but not limited to the following conditions: a. The Contractor shall conduct the Works with due regard to safety and health in accordance with its Construction Safety and Health Program (CSHP) duly approved by the Department of Labor & Employment (DOLE) and in compliance with the DOLE Department Order No. 13 – The Guidelines Governing Occupational Safety and Health in the Construction Industry. Failure to comply with the approved CSHP will be considered as non-compliance with the Contract and shall result to the imposition of Section 19, Violation and Penalties of the DOLE Department Order No. 13 and any appropriate sanctions such as, but not limited to: 1. Suspend the work until the Contractor complies with the approved CSHP with the condition that the work resumption will not incur additional cost to the Corporation; 2. Suspend payment of the portion of work under question; 3. Correct the situation by employing 3rd party and charge all expenses incurred to the Contractor's collectibles/securities; and 4. Report the condition to the Bureau of Working Conditions of the DOLE for their appropriate action. b. The Contractor shall be responsible for the strict compliance with the provision of the Philippine Laws affecting labor and operation of Work under the contract and shall be responsible for the payment of all indemnities arising out of any labor accident which may occur in the execution of the Works and for which he may be responsible under Republic Act 3428, as amended, known as the Workmen's Compensation Law. c. The Contractor is obliged to exercise due care so as not to endanger life and property in the vicinity of the Works where he operates in connection with this Contract. He shall be liable for all damages incurred in any manner by acts of negligence of his own, or his agents, employees, or workmen. d. It is the responsibility of the Contractor for the strict compliance with the requirements of the Philippine Clean Air Act of 1999 (R.A. 8749) and Philippine Clean Water Act of 2004 (R.A. 9275). The Contractor shall be liable for any damages/destructions to the environment

	including penalties that will be imposed by the Department of Environment and Natural Resources (DENR) arising from non-compliance of the requirements thereof. e. The Contractor shall be responsible for the strict compliance with the requirements of the Environmental Compliance Certificate (ECC) issued for this project (if any) and DENR Administrative Order No. 26. He shall be liable for any damages/destructions to the environment including penalties that will be imposed by the DENR arising from non-compliance thereof, in any manner by his acts or negligence, or by his agents, employees, or workmen in the execution of the Works. The Contractor may employ a Pollution Control Officer accredited with the DENR for the duration of the project, if so required by the DENR Administrative Order No. 26 f. It shall be the Contractor's responsibility for the correctness, accuracy and quality of works. NPC's approval does not relieve his contractual obligation and responsibility under this contract. g. Payment of all forms of taxes, such as value added tax (VAT) including municipal licenses and permits, and others that may be imposed by the Philippine Government or any of its agencies and political subdivisions in connection with the Contract shall be for the account of the Contractor. h. In general, the Contractor is totally responsible for the execution of the Works and therefore, takes upon himself all the technical, legal and economic risks and all obligations which could arise therefrom or connected therewith. The overall responsibility of the Contractor includes the responsibility for actions or omissions of his own personnel as well as the personnel of the sub-contractors.
5	1. The following must be indicated in the performance bond to be posted by the Contractor: i. Company Name ii. Correct amount of the Bond iii. Contract/Purchase Order Reference Number iv. Purpose of the Bond: "To guarantee the faithful performance of the Principal's obligation to undertake *(Contract/Purchase Order Description)* in accordance with the terms and conditions of *(Contract No. & Schedule/Purchase Order No.)* entered into by the parties." 2. The bond shall remain valid and effective until the duration of the contract *(should be specific date reckoned from the contract effectivity)* plus sixty (60) days after NPC's acceptance of the last delivery/final acceptance of the project. 3. In case of surety bond, any extension of the contract duration or delivery period granted to the CONTRACTOR shall be considered as given, and any modification of the contract shall be considered as authorized, as if with the expressed consent of the surety, provided that such extension or modifications falls within the effective period of the said surety bond. However, in the event that the extension of the contract duration or delivery schedule would be beyond the

	effective period of the surety bond first posted, it shall be the sole obligation of the CONTRACTOR to post an acceptable Performance Security within ten (10) calendar days after the contract duration/delivery period extension has been granted by NPC. 4. Other required conditions in addition to the standard policy terms issued by the Bonding Company: i. The bond is a penal bond, callable on demand and the entire amount thereof shall be forfeited in favor of the Obligee upon default of the Principal without the need to prove or to show grounds or reasons for demand for the sum specified therein; ii. The amount claimed by the Obligee under this bond shall be paid in full and shall never be subject to any adjustment by the Surety; iii. In case of claim, the Surety shall pay such claim within sixty (60) days from receipt by the Surety of the Obligee's notice of claim/demand letter notwithstanding any objection thereto by the Principal.
6	No site investigation report.
7.2	In case of permanent structures, such as buildings of types 4 and 5 as classified under the National Building Code of the Philippines and other structures made of steel, iron, or concrete which comply with relevant structural codes (e.g., DPWH Standard Specifications), such as, but not limited to, steel/concrete bridges, flyovers, aircraft movement areas, ports, dams, tunnels, filtration and treatment plants, sewerage systems, power plants, transmission and communication towers, railway system, and other similar permanent structures: Fifteen (15) years. In case of semi-permanent structures, such as buildings of types 1, 2, and 3 as classified under the National Building Code of the Philippines, concrete/asphalt roads, concrete river control, drainage, irrigation lined canals, river landing, deep wells, rock causeway, pedestrian overpass, and other similar semi-permanent structures: Five (5) years. In case of other structures, such as Bailey and wooden bridges, shallow wells, spring developments, and other similar structures: Two (2) years.
8.0	Aside from the Liquidated Damages, the PROCURING ENTITY shall also impose a penalty in case the Contractor fails to meet the transformer guarantees. The penalty to be imposed to the Supplier shall be in accordance with Section VI - Part I, Technical Specifications (Electrical Works).
	CORRECTION OF PUNCHLIST ITEMS: After to the conduct of Test and Commissioning/Joint Final Inspection or upon the advice by the NPC, the Contractor/Supplier must correct any remaining works and work deficiencies identified in the punchlist issued for the project within one (1) month considering the approved remaining contract time. Failure to comply with this provision shall be grounds for non-issuance of Certificate of Satisfactory Performance which is a requirement for future bidding with the NPC. This, however, shall not preclude NPC's claim for

	liquidated damages, imposition of any other penalties and/or filing of blacklisting actions in accordance with the blacklisting guidelines issued by the Government Procurement Policy Board (GPPB).
10	No dayworks are applicable to the contract.
11.1	The Contractor shall submit the Program of Work to the Procuring Entity's Representative within Ten (10) calendar days of delivery of the Notice of Award/Letter of Acceptance.
11.2	The period between Program of Work updates is Thirty (30) calendar days. The amount to be withheld for late submission of an updated Program of Work is One percent (1%) of contract amount.
12	During contract implementation, the Procuring Entity shall conduct Constructors Performance Evaluation in accordance with Section 12, Annex E of the Revised Implementing Rules and Regulation of R.A. 9184 using the NPC Constructors Performance Evaluation System (CPES) Guidelines. CPES ratings shall be used for the following purposes: a) eligibility screening/post-qualification; b) awarding of contracts; c) project monitoring & control; d) issuance of Certificate of Completion; and in adopting measures to further improve performance of contractors in the prosecution of government projects. Qualified Constructors Performance Evaluators (CPE) shall conduct project evaluation as follows: (a) During Construction - Except for those projects with a duration of 90 calendar days and below which may be subjected to at least one (1) visit, all projects shall be subjected to a minimum of two (2) evaluations to be performed by the CPE. The number of evaluations beyond the prescribed minimum shall be determined by the CPES-Implementing Unit based on the size, nature and complexity of the project and shall be subject to approval by the proper authorities within the agency. The first evaluation shall be performed when the project is at least thirty percent (30%) physically complete or as maybe required by the CPES-IU using the S-curve or other appropriate means to determine whether there is substantial work completed for evaluation. (b) Upon Completion - only one evaluation shall be performed by the CPE right after the Project Implementation Group reports one hundred percent (100%) completion of the project.
13	The maximum amount of advance payment is fifteen percent (15%) of the Contract Price and paid in lump sum.
14	No further instructions.
15.1	The date by which "as built" drawings and operating and maintenance manuals are required is within thirty (30) calendar days after completion of contract.
15.2	The amount to be withheld for failing to produce "as built" drawings and/or operating and maintenance manuals by the date required is Five percent (5%) of contract amount.

SECTION VI

TECHNICAL SPECIFICATIONS

SECTION VI

PART I

TECHNICAL SPECIFICATIONS

(ELECTRICAL WORKS)

(CIVIL WORKS)

(ARCHITECTURAL WORKS)

(MECHANICAL WORKS)

TECHNICAL SPECIFICATIONS

(ELECTRICAL WORKS)

E.1.0: GENERAL ADMINISTRATIVE REQUIREMENTS

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E.1.0: GENERAL ADMINISTRATIVE REQUIREMENTS

1.0.0 GENERAL

1.0.0.1 Purpose

1.0.0.1.0 This Section specifies the general requirements applicable to engineering documentation, planning and scheduling, inspection, tests, materials, workmanship and standards related to the implementation of the Contract. Supplementary requirements of a special nature are contained in subsequent sections.

1.0.0.2 Correspondence

1.0.0.2.1 To expedite action or response to all communications pertaining to this Contract, the Contractor shall address all such communication to:

THE MANAGER
Design and Development Department
National Power Corporation
Quezon Avenue corner Agham Road
Diliman, Quezon City

with a copy furnished to the Vice President, Power Engineering Services.

1.0.0.2.2 The Contractor shall maintain a register for all correspondences which shall be accessible to the NPC for information. The Contractor shall forward correspondences to the NPC in one (1) original.

1.0.0.2.3 All correspondences between the NPC and the Contractor shall be numbered consecutively.

1.0.0.3 Language and System of Measurement

1.0.0.3.1 All documentation relative to this Contract shall be in English. Submitted drawings, literature, etc., which are not in English language will be considered as not submitted at all.

1.0.0.3.2 Metric units shall be used in all documents, correspondence, technical schedules and drawings. On drawings or printed pamphlets where other units have been used, the metric equivalent shall be marked in addition.

1.0.1 CONTRACTOR'S ORGANIZATION AND PERSONNEL

1.0.1.1 Organization

1.0.1.1.1 The Contractor shall maintain in its project site offices, the Contractor's project organization charts for management, control and execution of the Contract. The Contractor's organization and personnel shall be as stated in the proposal.

1.0.1.1.2 The Contractor shall maintain an up-to-date project organization charts, which shall be submitted to the NPC for approval in the event of any changes.

1.0.1.2 Key Positions

1.0.1.2.1 The key positions in the organization charts of the Contractor pertain to individuals assigned to management/supervisory positions, who at any time during the execution of the work can give decision and recommendation to the NPC on matters pertaining to the proper and early completion of the Work.

1.0.1.2.2 The appointment, transfer and replacement of personnel to all key positions shall be subject to the NPC's prior approval.

1.0.1.2.3 Engineering and procurement in key positions shall be committed to continue through the Contract period in order to maintain continuity.

1.0.2 PLANNING AND SCHEDULING

1.0.2.1 General

1.0.2.1.1 The Contractor shall be responsible for planning and scheduling, progress monitoring and reporting of all works and activities at sites.

1.0.2.1.2 The Contractor shall submit for approval by the NPC within thirty (30) days of the Effective Date of Contract, a detailed Contract Schedule resulting from the deployment of the Contractor's project management tool(s) for monitoring project activity progress, such as a Critical Path Method (CPM) Network or Project Evaluation and Review Technique (PERT) Diagram. The detailed schedule shall show commencement and completion dates for at least the following activities and "milestones":

a. Engineering Design;
b. Submittal of specifications and drawings for review and approval of NPC;
c. Fabrication or manufacture
d. System integration and shop testing;
e. Factory Acceptance Tests;
f. Shipments;
g. Civil works, erection;
h. Installation, testing and commissioning;
i. Trial operation;
j. Handover to the NPC.

1.0.2.2 Format and Presentation

1.0.2.2.1 The Contractor shall prepare an activity network with the activities listed in early start order and showing the following:

a. activity code
b. activity description
c. duration in days
d. early start and finish dates
e. late start and finish dates.

1.0.2.2.2 The Contractor shall also prepare a barchart identifying all activities which cannot be performed without the NPC's approval, and the need dates for the NPC's decision.

1.0.2.2.3 The Contract Schedule submitted shall meet the completion dates in the Construction Schedule and Schedule of Timings and shall clearly demonstrate the manner in which the various phases of the Works shall be completed.

1.0.2.2.4 All activities required for execution of the Works shall be carried out in accordance with the sequence and times and completion dates shown on the Contract Schedule or subsequent revisions thereto as approved by the NPC.

1.0.2.3 Progress Monitoring Principle and System

1.0.2.3.1 Throughout the duration of the Contract, the Contractor shall monitor progress of the Works, and shall immediately advise the NPC in advance of any anticipated schedule delays, and the reason therefore.

1.0.2.3.2 If the Contractor believes it is necessary or advantageous to change the sequence of events shown on the Contract Schedule, he shall submit a proposed revision accompanied by a full explanation of the reasons and ramification of the change to the NPC for approval. No change shall be made in the order in which the Works activities are being performed until the NPC's approval for the revised Contract Schedule has been obtained.

1.0.2.3.3 Actual progress of each activity of the Works shall be compared with progress indicated on the approved Contract Schedule at least once every month by the Contractor.

1.0.2.3.4 After the NPC approves the Contractor's detailed Contract Schedule and planned activity completion dates, the Contractor shall update and analyze the Contract Schedule once a month and submit updated revision to the NPC on or before the 5th day of the following month.

1.0.2.3.5 The Contractor shall not change the sequence of activities shown on the approved Contract Schedule without the NPC's prior approval.

1.0.3 MEETINGS

1.0.3.1 Progress Review Meetings

1.0.3.1.1 The NPC shall schedule and hold monthly progress review meetings with the Contractor to a mutually agreed agenda. The meetings shall normally take place at the Contractor's site offices.

1.0.3.2 Interface Meetings

1.0.3.2.1 The Contractor shall attend interface meetings with the NPC's other contractors as arranged by the NPC on a monthly or specifically called basis. The Contractor may also call for such meetings, if necessary.

1.0.3.3 Design Review Meetings

1.0.3.3.1 The Contractor may request for a design review meeting during the processing stage of seeking the approval of the NPC to all design drawings to review, clarify and evaluate the design submitted with reference to the tender, the final design and the Contract Specification. The Contractor shall submit a meeting agenda seven (7) days prior to the meeting.

1.0.3.4 Other Meetings

1.0.3.4.1 The Contractor shall arrange discipline meetings and other meetings as necessary with sub-contractors, etc. The NPC shall be notified in due time of such arrangements and given opportunity to attend.

1.0.3.4.2 The Contractor and the NPC shall as required, hold meetings on specific subjects.

1.0.3.5 Call for Meetings

1.0.3.5.1 Except for regular scheduled meetings, calls for meetings and agenda shall be sent out by the party calling the meeting to all requested attendees.

1.0.3.6 Minutes of Meetings

1.0.3.6.1 Minutes shall be prepared by the Contractor on an agreed form and be issued for the NPC's review the next working day after the meeting has taken place. Minutes shall be approved by the NPC before copies are distributed to all attendees.

1.0.3.6.2 Matters requiring action shall be assigned the responsible party with dates for completion of such action. Result of action from previous meetings shall be recorded.

1.0.3.6.3 Copies of minutes of meetings from interface meetings and other meetings, ref. Paragraphs 1.0.3.1 and 1.0.3.3 shall be sent to the NPC in six (6) copies.

1.0.4 REPORTS

1.0.4.1 Monthly Reports

1.0.4.1.1 The Contractor shall from the second month after Commencement Date, submit to the NPC a monthly report related to the Works performed during the previous month. The Contractor shall present the report with diagrams in printed format.

1.0.4.1.2 Cut-off date for the report shall be the last Sunday of each month. The monthly report shall be submitted to the NPC no later than 12.00 hours on Wednesday after the cut-off date. The monthly report shall include as a minimum the following items:

a. narrative of major achievements and any deviations from time schedule, reasons for delays and deviations, with recommended actions and potential effects;
b. the Contract Detail Schedule showing the status at the cut-off date by means of a front line or equivalent;

c. a systematic listing and analysis of all significant time critical activities;
d. a summary of HSE activities and reported incidents in own and major sub-contractor's activities;
e. report on interface activities; and
f. narrative report on quality management activities.

1.0.4.2 Close-out Reports

1.0.4.2.1 Project Control Close-out Report

1.0.4.2.1.1 The Contractor shall submit to the NPC a project control close-out report within ten (10) days after issue of the Completion Certificate which shall contain as a minimum the following items:

a. final as-is Contract Detail Schedule;
b. final as-is cost report; and
c. final as-is Contract amendment (if any) and Variation Order register, if any.

1.0.5 HEALTH, SAFETY AND ENVIRONMENT (HSE)

1.0.5.1 General

1.0.5.1.1 The Contractor shall at all times during the performance of the Contract be responsible for the safety of all personnel involved therewith.

1.0.5.1.2 Safe working practice for engineering and manufacturing shall be based on regulations, standards and HSE objectives.

1.0.5.1.3 The Contractor shall take all necessary precautions in connection with the performance of the Works in order to ensure the safety and health of the personnel of the NPC, the Contractor as well as Third Parties, and to protect the Works, the property of the NPC and all Third Parties.

1.0.5.1.4 The Contractor shall prepare and HSE program and submit this to the NPC for review and acceptance within thirty (30) days after the Effective Date of Contract.

1.0.5.1.5 The HSE program shall indicate how the Contractor shall implement his HSE requirements, how to perform follow-up and a proposed level of reporting to the NPC. The Contractor has the overall responsibility to ensure that all Site activities are planned, organized, performed and documented according to the Contractor's program. Accordingly, the Contractor is responsible for coordinating the HSE activities for all Site personnel working on the Contract.

1.0.5.2 Reporting to the NPC

1.0.5.2.1 All situations not complying with approved procedures and other requirements shall immediately be reported to the NPC. All accidents shall be reported to the NPC.

1.0.5.3 Pollution Control

1.0.5.3.1 The Contractor shall perform the Works without discharge into the atmosphere, from any source whatever, smoke, dust or other air contaminants in violation of law.

1.0.5.4 Fossils and Articles of Value

1.0.5.4.1 All fossils, coins, precious or semi-precious stones, precious metals, articles of value or antiquity, and structures and other remains or things of geological or archaeological interest discovered on the Site of the Works shall be deemed to be the absolute property of the Government. The Contractor shall take appropriate precautions to prevent his workmen or any person from removing or damaging any such article or thing and shall immediately, upon discovery and carry out, at the expense of the Government, the NPC's orders as to the disposal of same.

1.0.6 DOCUMENTS TO BE PREPARED BY THE CONTRACTOR

1.0.6.1 General

1.0.6.1.1 The general documents, calculations, certifications, manuals, drawings, etc. relating to the manufacturing works, civil works, installation, testing and commissioning works which are to be prepared during detailed design by the Contractor are listed here below. The Contractor's attention is drawn to various sections of this Specification, where detailed contents of documentation are specified.

1.0.6.2 Outline Drawings

1.0.6.2.1 The Contractor shall, within sixty (60) calendar days after the Effective Date of Contract, submit outline drawings of the equipment to be furnished under this Contract, together with weights, external forces, anchoring details and sufficient overall dimensions to facilitate preparation of final designs of the structure foundations.

1.0.6.3 Diagrams

1.0.6.3.1 Schematic, circuit and wiring diagrams including list of materials, cable lists, etc. shall also be submitted by the Contractor for approval.

1.0.6.3.2 These diagrams shall show the internal and external connections of all apparatus, their designation, terminal numbers, color codes, etc. and shall be used for manufacturing, equipment installation and operation of the equipment.

1.0.6.4 Detailed Drawings, Designs and Specifications

1.0.6.4.1 Before proceeding with the manufacture of equipment, the Contractor shall submit corresponding detailed drawings, designs and detailed specifications (in typewritten hardbound form) which shall show all details of materials, manufacture, assembly, testing, erection, commissioning, operation and maintenance of the equipment in conformity with the Contract requirements.

1.0.6.4.2 The detailed drawings and specification shall include, but not necessarily be limited to the following:

(i) general assembly drawings;

(ii) assembly drawings, showing:

- sectional views
- details of mounting of the internal equipment,
- function of the assemblies,
- adjustment and operating ranges,
- concrete pedestals and foundation bolts and anchors'
- field tolerances,
- all field joints,
- methods of lubrication (if required)

(iii) detail manufacturing drawings showing:

- detail dimensions
- tolerances
- materials
- nameplate diagrams

(iv) engineering instructions and detailed specifications for:

- manufacturing
- fabrication
- painting, including final color scheme
- heat treatment
- welding
- surface treatment
- testing

1.0.6.5 Design Computation and Final Design Data

1.0.6.5.1 After the Contractor has completed the preliminary design of the equipment, he shall submit the final design data, design analysis and design computations (referred to as designs) along with all other specified designs and studies, all in typewritten and bookbound form, clearly laid out with all the design criteria and standards indicated for the NPC's review and approval.

1.0.6.6 Parts Bills

1.0.6.6.1 The Contractor shall submit with the first drawing issue, where applicable, corresponding parts bills. Reference to the respective detail or assembly drawing, materials used or catalog shall be made.

1.0.6.7 Catalogue Cuts, Illustrations, Etc.

1.0.6.7.1 Applicable requirements of this paragraph with reference to drawings shall apply equally to catalogue cuts, illustrations, printed specifications, design data, analysis and calculation, and manufacturer's descriptive literature and instructions for all equipment furnished

to demonstrate fully that all parts will conform with the requirements and intent of the Contract Documents.

1.0.6.8 Installation Manual

1.0.6.8.1 The Contractor shall provide the NPC with an Installation Manual covering installation procedure and instruction to facilitate smooth erection, assembly and testing on site of all equipment to be installed.

1.0.6.8.2 The instructions therein shall specify the exact procedures to be followed during installation, indicate data to be measured and recorded (adjustments, setting of limits, etc.), quantities, dimensions and tolerances to be checked, etc.

1.0.6.8.3 The manual shall include information on handling and slinging the major pieces of equipment, erection, tolerances, settings and adjustments and special precautions to be taken during installation.

1.0.6.8.4 The Contractor shall submit six (6) copies each of the Installation Manual for each equipment per substation per schedule to the NPC.

1.0.6.9 Commissioning Manual

1.0.6.9.1 The Contractor shall provide the NPC with a Commissioning Manual, which shall be similar in size and form to the Installation Manual and shall include procedures and instructions to be followed during the commissioning of all equipment to be installed.

1.0.6.9.2 The instructions therein shall specify the exact procedures to be followed during commissioning and shall indicate all data to be measured (and where appropriate, recorded in the manual itself) and all adjustments, setting of limits, etc., quantities, dimensions and tolerances to be checked.

1.0.6.9.3 The Contractor shall submit six (6) copies each of the Commissioning Manual for each equipment per substation per schedule to the NPC

1.0.6.10 Operation and Maintenance Manual

1.0.6.10.1 The Contractor shall provide the NPC with an Operation and Maintenance Manual similar in size and form with the other manuals and shall include procedures and instructions to be followed by the operating and maintenance staff necessary for reliable operation and maintenance of the equipment.

1.0.6.10.2 The manual shall contain at least the following documents and data as a minimum:

- General description of the equipment, operation in particular;
- Main technical characteristics;
- Connection to external system;
- Instructions for operating personnel including periodic tests, check-points, actions required following each individual alarm signal, etc.;
- Summary of important rules, standards, safety precautions and instructions to be followed during equipment operation and maintenance;
- Safety and warning signs to be placed in the plant/substations, etc.;
- Enclosures: Important principle diagrams.

1.0.6.10.3 Sections on "maintenance" shall be divided into two parts, namely:

a) Current (preventive) maintenance indicating inspection periods, routine cleaning and lubricating procedures (if required), safety checks, adjustments, etc.;

b) Repairs and overhauls describing the dismantling, removal and replacement of parts (with spare parts), trouble shooting guides, repair instructions, etc.

1.0.6.10.4 The Operation and Maintenance Manual supplemented by any additional drawings and project documents to be submitted to the NPC will be the only document to be generally used by the power plant/substation operating staff.

1.0.6.10.5 The Contractor shall submit six (6) copies each of the Operation and Maintenance Manual for each equipment per substation per schedule to the NPC. Likewise, four (4) sets of CDs containing these documents preferably in MS WORD Format shall be provided. Other format can be accepted provided software for this format is included in the CDs that will be furnished.

1.0.6.11 Final/As-Built Drawings

1.0.6.11.1 The Contractor shall furnish a complete set of an original reproducible copies of an approved type and four (4) sets of recordable CDs which can be loaded and handled on a personal computer each containing copies of all drawings as finally approved and built. Such CDs shall be suitable for CD ROM/WRITE drive of computer system. The Contractor, if required in Section E.1.1 of the Technical Data Sheets, shall supply the necessary hardware and software as a complement for the submission of Final/As-Built Drawings. Four (4) additional prints of same drawing with dark lines on a white background shall be furnished. For all approved drawings with no subsequent revisions, the reproducible copies earlier furnished may be considered part of this set. The NPC will not release the final payment and the performance security until the foregoing conditions have been fulfilled.

1.0.7 PRESENTATION OF DOCUMENTATION

1.0.7.1 Drawings and documents mentioned above under Paragraph 1.0.6 shall be submitted to the NPC for approval. The timing of such submission shall be in accordance with Paragraph 1.0.8.

1.0.7.2 All documents to be approved by the NPC shall meet the following requirements:

a. Metric units shall be used in all documents, correspondence, technical schedules and drawings.

b. Drawings, electrical diagrams, key charts, process diagrams, etc., shall be in A3 format and flow directions shall be from left to right or from top to bottom. The NPC's document number, document name and revision index must be readable when folded to A4. It is of vital importance that cross references between electrical diagrams are performed in a way that makes it possible to follow any signal from its source to its visualized position.

c. All other documentation shall be forwarded in A4 format with four (4) holes at intervals of 80-80-80 mm symmetrically around the center axis of the document. The NPC's document number, document name and revision index must be readable on all pages.

d. All drawings and copies shall be on white paper and with black print unless otherwise agreed upon.

e. All drawings shall be provided with clear space (approximately 80mm x 50mm) for the NPC's stamping of **"Approved"** or **"Approved With Corrections Indicated"** or **"Returned for Correction".**

"**Approved**"; this mark authorizes the Contractor to proceed with the Contract Work therein indicated.

"**Approved with Corrections Indicated**"; this mark authorizes the Contractor to proceed with the Contract Work therein indicated taking into account of the notes and/or comments by the Contractor and re-submit the drawings, specifications or designs for approval.

"**Returned for Correction**"; this mark requires the Contractor to make the corrections indicated and re-submit the drawings, specifications or designs for approval before commencing the Contract Work therein indicated.

f. For documentation submitted in binders, the binders shall have four (4) rings at intervals of 80-80-80mm symmetrically around the center axis. The maximum width of the binder shall be 75 mm. The binders shall have text at front and at spine.

1.0.7.3 Award of contract does not imply approval of drawings and data submitted by the Contractor with his tender.

1.0.7.4 Approval of the Contractor's drawings shall not be held to relieve the Contractor or any part of the Contractor's obligations to meet all the requirements of this specification nor of the responsibility for the correctness of the Contractor's drawings.

1.0.7.5 When revised drawings or drawings which have been returned to the Contractor marked "**Approved with Corrections Indicated**" or "**Returned for Correction**" are re-submitted for approval, the revision block shall be completed with the description and date of revision and the appropriate revision letter or numeral which shall be clearly indicated adjacent to the revision or modification which requires approval.

1.0.7.6 No revision affecting the design shall be made after a drawing has been "**Approved**" without re-submitting the drawings suitably revised for formal approval.

1.0.7.7 The NPC will complete the review and/or approval of the Contractor's drawings within twenty (20) calendar days after receipt at NPC office. If within the twenty (20) calendar days, Contractor has not received any reply from the NPC regarding the approval drawings, the Contractor may proceed with the design and manufacture of equipment or materials as if the drawings have been approved. The Contractor however, is referred to the provisions of Paragraph 1.0.7.4 regarding approval of Contractor's drawings.

1.0.8 PROCEDURE FOR DELIVERY OF DOCUMENTS

1.0.8.1 General

1.0.8.1.1 The Contractor shall submit the following information to the NPC. The number of copies to be supplied shall be as indicated below:

1.0.8.2 Within Thirty (30) Days after the Effective Date of Contract:

detailed time schedule showing the commencement and completion dates for the various activities and milestone specified in Paragraph 1.0.2.1.2

six (6) sets of:

- Drawing classification plan
- List of detailed drawings
- Quality Control and Assurance Program
- Detailed Contract Schedule

1.0.8.3 Within Forty Five (45) Days after the Effective Date of Contract:

six (6) sets of:

- Design and manufacturing schedules
- Delivery, erection and commissioning schedules
- Principal drawings, schemes, tables and electrical diagrams
- Type test reports and literature concerning the equipment if not submitted with the bid
- A program of performance, material and workshop tests to be carried out

1.0.8.4 Within Sixty (60) Days after the Effective Date of Contract:

six (6) sets of:

- Outline drawings of the equipment
- Loading of foundations for all items of equipment to be supplied and details of anchors and supports
- Principal electrical diagrams
- Schematic diagrams
- Drawings for structures
- Delivery of all drawings related to civil works

1.0.8.5 Before Beginning of Manufacturing

six (6) sets of:

- Detailed manufacturing drawings with all important dimensions, final assembly drawings, governing and control schemes, cabling and wiring diagrams and block and circuit diagrams intended to aid understanding and provide full information about the principles of operation
- Performance and stress calculations as the NPC may require

1.0.8.6 During Manufacture

six (6) sets of:

- Progress photographs of the shop work done. Photographs shall be approximately 20 x 25 cm in size, including a margin of 2.5 cm on one of the 25 cm sides for binding. Four (4) views will be required for each piece of equipment. Each photograph shall contain upon its face the date, the name of the manufacturer and the title of the view taken
- Notice of material tests and shop inspection

1.0.8.7 At Least Fifteen (15) Days Prior to Shipment

- Six (6) copies of Inspection report
- Five (5) copies of Test certificates or test reports together with certificate of inspections (additional two (2) complete set bound in books required).

1.0.8.8 At Least Thirty (30) Days Prior to Shipment

- Six (6) sets of packing lists for each consignment
- Six (6) sets of instructions for loading, unloading, handling and special precautions to be observed for storage at site
- Six (6) sets of Installation Manuals for each equipment to be supplied

1.0.8.9 Within Ten (10) Days After the Last Shipment of Equipment

- Six (6) sets of Commissioning Manual
- Six (6) sets of Operating and Maintenance Manual

1.0.8.10 Before Issuance of Certificate of Provisional Acceptance

- One (1) reproducible (rolled) and six (6) light copies of all drawings marked "**Final/As-Built Drawings**" and four (4) sets of recordable CDs each containing copies of all the drawings as finally approved and built.

1.0.9 QUALITY ASSURANCE REQUIREMENTS

1.0.9.1 General

1.0.9.1.1 The Contractor shall have a well-organized Quality Assurance Program (QAP) which shall comply with the requirements of ISO 9001 –"Model for Quality Assurance in Design/Development, Production, Installation and Servicing", or equivalent quality standard relevant for the Works to assure that items and services, including subcontracted items and services, comply with this specification.

1.0.9.1.2 Within thirty (30) days of the Effective Date of Contract, the Contractor shall submit six (6) copies of his complete quality control and assurance procedures, manuals for review and approval by the NPC. The manual shall include pro-forma check lists for all requirements of the Contractor's quality control and assurance program and those called for in this Specification.

1.0.9.2 Quality Assurance Program

1.0.9.2.1 The Contractor shall, for all work covered by the Contract:

a. Establish procedures for adequate planning and resourcing of all quality related activities including the preparation of quality plans.

b. Establish measures for the identification and control of items throughout all stages of the Contract. This shall include measures to maintain traceability as identified in agreed quality plans.

c. Arrange for the protection of the quality of the product to include delivery to the specified destination.

d. Control their measuring and test equipment in accordance with established procedures for measurements and calibration systems and ensure that such equipment that may be used by subcontractors to verify work is similarly controlled.

e. Ensure adequate quality systems exist for compliance with the requirements identified in Paragraph 1.0.9.1 to 1.0.9.10 inclusive.

1.0.9.2.2 Where any site installation and/or test and commissioning work is involved, the Contractor shall prepare contract-specific quality assurance procedures in agreement with the NPC prior to commencements of such works.

1.0.9.2.3 The Contractor shall be responsible for specifying the quality assurance requirements to his subcontractors, for approving subcontractors quality assurance program and for ensuring compliance with the requirements.

1.0.9.2.4 The Contractor shall ensure that all appropriate technical information is extracted from the Contract documents and specifications and passed on to the subcontractors.

1.0.9.2.5 The Contractor shall ensure that all computer systems and software to be utilized on the project is qualified for the application under consideration and such qualification is documented.

1.0.9.3 Quality Plan

1.0.9.3.1 The Contractor shall establish and implement quality plans detailing the specific activities, design reviews, operations, control procedures, inspections, testing, approvals and certification requirements applicable. All procedures, which support the quality plan shall be referenced and distributed to the NPC together with the quality plan. Quality plans shall be submitted to the NPC for review and approval.

1.0.9.3.2 Where inspection schedules are generated in support of a quality plan, these are also required by the NPC for review and approval. The format and content of schedules shall ensure that inspection operations are planned and performed in a systematic manner.

1.0.9.3.3 The Contractor shall keep the NPC informed of any changes in the quality plan during the Contract period.

1.0.9.3.4 The quality plan shall document how the Contractor shall apply his quality system in the execution of the Contract. For the quality plan description and definition, the Contractor is referred to ISO 8402 and ISO 9000-4. The quality plan shall meet the guidelines of ISO 10005.

1.0.9.3.5 The quality plan shall consist of a set of plans, for which other terms than quality plan may be used, e.g. inspection plan. The hierarchy of the quality plan shall be shown. The quality plan shall contain a master test plan.

1.0.9.3.6 The Interface Coordination plan shall be a part of the Quality Plan and reflect the interfaces in the project and to the Scope of Work of the Contract. The Interface Coordination plan shall be a tool in safeguarding the handling of interface issues as well as a documentation of the same. The plan shall be maintained on a continuous basis and shall contain all interfaces towards other contractors and/or the NPC, including target dates for exchange of information/documentation. The Contractor shall prepare the required documentation as input to other contractors in order to enable them to perform their scope of works.

1.0.9.3.7 Documents referred to in quality plans shall be available to the NPC for review, if required.

1.0.9.3.8 Specific quality plans shall be prepared for site work and submitted for review and approval by the NPC prior to commencement of such work.

1.0.9.3.9 The Contractor shall approve all quality plans, inspection and test schedules of their subcontractors and vendors.

1.0.9.3.10 The Contractor shall identify his verification requirements on the quality plans submitted to the NPC for review and approval and shall identify the following:

a. Stages subject to random surveillance.

b. Inspection that require to be carried out or witnessed, by the NPC or a third party following satisfactory verification and acceptance by the Contractor.

c. Hold points beyond which work cannot proceed before completion of all operations, verifications and related activities identified after the previous hold point on the quality plan.

1.0.9.4 Subcontractors and Suppliers

1.0.9.4.1 For each subcontractors, the Contractor shall identify the relevant quality standard ISO 9001, 9002 or 9003 to be selected in accordance withy guidelines given in ISO 9000-1 and ISO 9000-3. The Contractor shall asses subcontractor's quality system and their implementation to confirm adequate qualification standard.

1.0.9.4.2 The Contractor shall plan and carry out the Quality Surveillance (QS) of his subcontractors (ref. ISO 8402, Clause 3.11) at a level of detail sufficient to ensure fulfillment of the quality requirements of the Contract. The NPC shall have the right to participate as observer in such QS activities.

1.0.9.4.3 The Contractor shall submit his QS plans to the NPC for acceptance and keep the NPC informed of any change thereof.

1.0.9.5 Quality Audits

1.0.9.5.1 The Contractor shall plan and carry out quality audits in his own organization and in subcontractors organizations. The NPC shall review the Contractor's audit plans and coordinate his own audit plans with the Contractor's. The scope and frequency of the audits shall be adequate to confirm that the quality activities and results comply with the quality system and the planned arrangements.

1.0.9.5.2 NPC reserves the right to request, review and maintain for the duration of the contract a copy of the Contractor's Quality Manual.

1.0.9.5.3 During the course of the Contract, NPC reserves the right to carry out quality audits of the Contractor, subcontractors or their subcontractors. Monitoring will be by means of surveillance of activities at the work locations and where appropriate by formal audits. Representatives of the NPC shall be afforded unrestricted access, facilities and assistance at all reasonable times to carry out this quality audits.

1.0.9.6 Records

1.0.9.6.1 The Contractor shall generate records as required by the quality assurance system and quality plans. Records, including audit reports shall be made available for inspection by NPC.

1.0.9.6.2 All records shall be concisely compiled, indexed and cross referenced to the project contract number and the relevant subcontract numbers. They shall be clearly identifiable to the individual parts and assemblies to which they refer.

1.0.9.6.3 Those records required by the NPC, as defined in the contract specifications and quality plans shall be available at the time of delivery of the equipment. Such records shall include reports and certification in respect of pressure retaining components together with general traceability records for all items through certification and build documentation as a minimum. Six (6) copies of these records shall be supplied to NPC with the exception of radiographic films where the original set of films shall be supplied.

1.0.9.6.4 All records generated during the course of the Contract, including those generated as evidence of effective implementation of the quality assurance program of the Contractor and his subcontractors, shall be retained by the Contractor for a minimum period of five (5) years from the date of contract completion. These records shall be made available to NPC on request during the retention period.

1.0.9.7 Particular QA Requirements

1.0.9.7.1 <u>General</u>

1.0.9.7.1.1 As a supplemental document to the QA program, the Contractor shall submit for approval of the NPC, a separate document with detailed particular requirements and specific acceptance criteria of all equipment.

1.0.9.7.2 <u>At Shop</u>

1.0.9.7.2.1 Corresponding to each major and minor equipment, the following data are required for submission to and approval of the NPC:

a. Test and inspection procedure;
b. Guaranteed technical rated or design data;
c. List of holdpoints and/or routine tests;
d. Acceptance criteria and reference standards;
e. For of test results/data with comparison to the guaranteed data. All allowable tolerances with respect to dimensional control of assemblies and sub-assemblies at shop shall be clearly indicated in the manufacturer's drawings.

1.0.9.7.3 At Site

1.0.9.7.3.1 The dry tests at site shall be in accordance with the latest edition of ANSI or applicable IEC Standard. Verification tests after installation shall be thoroughly discussed with the requirements similar to the Paragraph 1.0.9.7.2.

1.0.9.7.3.2 The NPC or his duly authorized representative shall control said site tests, in collaboration with the Contractor's representatives.

1.0.9.8 Reporting and Corrective Action

1.0.9.8.1 The Contractor's quality assurance program shall provide for prompt detection and correction of all conditions adversely affecting quality, including failures, malfunctions, incidents, trends, deficiencies, deviations, non-conformances, and defective materials. The Contractor shall establish and maintain methods for verifying and determining the cause of an adverse condition and for initiating necessary improvement and corrections to preclude repetition. Quality trends shall be analyzed to furnish a basis for improvement in work performance. The Contractor's corrective action system shall extend to the performance of other participating contractors, sub-contractors, and Contractors, when necessary, and shall provide for the interchange of corrective action information. Identification of the adverse condition, its cause, and the corrective action taken shall be recorded and reported to appropriate levels of management.

1.0.9.8.2 The Contractor shall establish and implement procedures for reporting, verifying, analyzing, and correcting failures, including those that occur during development and qualification testing. The procedure shall provide assurance that the cause and mode of each failure are determined, that potential safety and availability implications are evaluated, and that corrective action is taken.

1.0.9.8.3 A failure report shall be prepared to identify the failed item and its origin or source of manufacture and shall describe the failure, the test status at time of failure, the probable cause and mode of failure, and the recommended corrective action.

1.0.9.9 Design Revision and Substitution of Material

1.0.9.9.1 Any revision affecting the design and manufacturing of the equipment as well as substitution of materials that is deemed necessary shall be notified by the Contractor to the NPC for the latter's review and approval.

1.0.9.10 Nonconformity Handling

1.0.9.10.1 For nonconformity handling, the requirements of ISO 9001, Clauses 4.13 and 4.14 shall apply.

1.0.9.10.2 The Contractor shall provide all information required to enable the NPC to evaluate the Contractor's nonconformity request.

1.0.9.10.3 Nonconformities which had been accepted by the NPC and decided to be "as is" shall be documented in the as-built documentation.

1.0.9.10.4 Nonconformities as mentioned above, which are introduced by subcontractors and their subcontractors and their subcontractors, shall also be recorded and handled by the Contractor.

1.0.9.10.5 Any request for the NPC's approval of a nonconformity shall be on a specific report form which shall fulfill the following requirement. The nonconformity report shall:

a. clearly state whether the nonconformity will be a permanent "as is" nonconformity or not;
b. give reference to violated requirements;
c. state whether it is violating authority requirements;
d. be justified with sufficient explanation and documentation for easy review and approval
e. clearly refer to affected area where applicable.

1.0.9.11 Contractor's Responsibility

1.0.9.11.1 Approval by NPC of the Contractor's quality assurance program, quality plans and inspection and test plans, or of those of his subcontractors will not relieve the Contractor of his obligation to provide goods and services which meet the requirements of the Contract.

1.0.10 TRANSPORT, PACKING, ETC.

1.0.10.1 General

1.0.10.1.1 No shipping or transport limitation shall be imposed by the NPC on the Contractor. The responsibility shall lie on the Contractor whether the dimensions of his supplied equipment and materials in crate or in box will be appropriate for loading, unloading and transported to the Site.

1.0.10.1.2 The Contractor must at his own expense, conduct an ocular route survey of all roads, bridges, overpasses, etc. from the Port of Entry to the Site and examine for himself the conditions of all roads and bridges.

1.0.10.1.3 The Contractor shall check the capacity and availability of loading and unloading facilities which will be utilized in connection with his transport operation, as well as its characteristics, taking appropriate measures to avoid damaging the same. All costs related to the reinforcement of roads, bridges and the like, if any, shall be borne by the Contractor.

1.0.10.1.4 The Contractor shall coordinate his own transport program and shall advise proper authorities of the transit of the heaviest items to be transported and shall comply with the instructions given by said authorities.

1.0.10.1.5 All damages caused to public roads, streets or public structures shall be compensated by the Contractor at his own expense.

1.0.10.2 Packing

1.0.10.2.1 Each crate, box or package must have a packing list and in addition to the usual and customary marks, the following identifying marks:

Republic of the Philippines
NATIONAL POWER CORPORATION
Diliman, Quezon City

Project :

Contract No. :

Destination :

Case No. :

Gross Weight :

Net Weight :

Dimension : L x W x H

In addition, each crate, box or package shall be color coded and marked with abbreviation code to aid the NPC in sorting materials for the various substations. The identifying marks and the color codes shall be as stated in the Technical Data Sheets of the equipment.

1.0.10.3 Transport Marking

1.0.10.3.1 The outside of all containers, cases, etc. shall be clearly marked with the total weight, point of maximum weight and correct position for the attachment of lifting hooks and cables and shall bear identification marks relating to the appropriate dispatch documents. Where appropriate, the cases or boxes shall bear special instructions such as **"top", "handle with care", "keep dry", etc.**

1.0.10.3.2 All parts of the Contracted Equipment and the Contractor's equipment shall be well-packed and protected against loss or damage during transport by sea and overland, and while in storage. Perishable material provided in spares and repair sets shall be provided in sealed containers with a shelf-life of at least ten (10) years. All packaging shall be performed in a such a way that overturning of the packages will not damage the equipment.

1.0.10.3.3 Instructions for handling shall be clearly marked on all parts, packages and crates.

1.0.10.3.4 All parts, packages and crates shall be adequately marked in order to enable identification. Each item contained in a package shall be clearly identified on the packaging list by its description and part number, package date, shelf-life and assembly drawing reference, and each item shall be marked or labeled to correspond with the packaging list.

1.0.10.3.5 The costs of all equipment necessary for the temporary fixing and supporting of the various parts of the Plant and the various packages to crane hooks, rail wagons, etc., during handling, transport and storage, and the cost of load distribution beams, etc., where they form part of the packages or crates, shall be included in the tender price.

1.0.10.3.6 The Contractor shall be entirely responsible for all packing and unpacking, and any loss or damage shall be compensated to the satisfaction of the NPC by the Contractor and, where not otherwise provided, at the Contractor's own expense.

1.0.10.4 Preparation for Shipping and Storage

1.0.10.4.1 Pre-Shipment Preparation

1.0.10.4.1.1 The Contractor shall prepare equipment for shipment to protect it from damage during shipment and subsequent storage not exceeding one year, unless specified otherwise in the Technical Data Sheets for each equipment under this specification.

1.0.10.4.1.2 Equipment shall be completely drained of all water and thoroughly dry prior to shipment. When such draining requires removal of plugs, drain valves, etc., the Contractor shall make sure that these parts are reinserted or reassembled prior to shipment.

1.0.10.4.1.3 All openings and machined surfaces shall be provided with protection to prevent damage, corrosion and entrance of foreign matter during shipment and storage.

1.0.10.4.1.4 Flanged connections shall be protected by a 12.5 mm or thicker plywood disc, or suitable alternate, bolted to the face of the flange.

1.0.10.4.1.5 Treaded or socket weld connections shall be protected with screwed or snap-in (snap-on) type, securely held, plastic protectors. Cast-iron plugs are not acceptable for protection unless part of the permanent assembly.

1.0.10.4.1.6 Wooden disks that cover the entire weld end area, and are secured by metal straps and fasteners shall protect butt weld connections.

1.0.10.4.1.7 Covers, straps or fasteners shall not be welded to equipment.

1.0.10.4.1.8 Equipment shall be adequately supported for shipment. All loose parts shall be crated or boxed for shipment and appropriately identified. If equipment is braced internally for shipment it shall be marked conspicuously, **"Remove internal braces before testing and operating"**.

1.0.10.4.1.9 The outside of all containers, cases, etc. shall be clearly marked with the total weight, point of maximum weight and correct position for the attachment of lifting hooks and cables and shall bear identification marks relating to the appropriate dispatch documents. Where appropriate, the cases or boxes shall bear special instructions such as **"top", "handle with care", "keep dry",** etc.

1.0.10.4.1.10 All large and heavy shipping units shall have suitable skids for moving. Crating shall also be adequate for lifting with slings. If location of slings is critical, these locations shall be marked accordingly.

1.0.10.4.1.11 For transformers, the following provisions shall also be considered:

a. Transformer designed for oil immersed operation shall be shipped oil-filled, unless otherwise specified. Provision shall be made for oil expansion caused by temperature changes during shipment. If transformers are shipped with gas, pressure gauge for transportation shall be provided and valves shall be sealed and effectively crated to prevent tampering or removal while in transit, and a means provided for allowing gas pressure to be measured in a simple way after uncrating, without requiring release of the gas. Valves shall be securely covered by a pipe cap or other tamperproof cap. If shipped gas filled, the Contractor's recommended oil filling procedure shall be submitted for NPC's approval.

b. If transformers are shipped filled with dry air, the dry air shall have a dewpoint of -50^0F or lower, otherwise, the same provisions as for gas-filled transformers shall be followed.

c. The transformer shall be shipped with NPC accepted three dimensional impact recorders with time period recording chart of at least three (3) months for transportation on the basis of returning back after the transformer arrive at the substation site. If it is missing or damaged, if the seal is broken or it has been disturbed in any way, a specific carrier's inspection report must be issued by the Contractor's carrier to relieve the NPC of responsibility for the recorder. Instructions for the recorder, and for special tests which may be required, are in the instruction letter enclosed in the recorder. The recorder and tape must be examined only in the presence of the Contractor or the Contractor's agent.

1.0.10.4.1.12 For the conductors, it shall be supplied on type of reels as specified in the Technical Data Sheets and shall be sturdy enough to withstand rough, but normal and customary, handling during loading, transport, unloading, field deployment and installation. The inside surfaces of the drum and flanges shall be smooth and without protrusions so that the conductor is not damaged during winding and unwinding. The cable shall be protected by plastic or other suitable material against dust and sprays (particularly salt spray). Steel-banded lagging is required on the outside of wooden flanges and between the flange I-beams of metal reels. Reels shall be marked consecutively from a production run.

1.0.10.4.1.13 Tubular bus conductors shall be packed in individual boxes. Tools shall be packed in individual boxes. Individual boxes may be shipped in larger shipping units such as containers or pallets.

1.0.10.4.1.14 All fittings, connectors, spacers and clamps shall be neatly packed in boxes or crates and shall be protected against dust and sprays (particularly salt sprays) by providing a hermetically sealed polyethylene sheet covering. Shipment without this covering will not be accepted.

1.0.10.4.1.15 All anchor bolts and accessories shall be packaged per unit structure such that a bundle shall contain the corresponding approved number of bolts and accessories.

1.0.10.4.2 Shipping and Transportation to Site

1.0.10.4.2.1 The Contractor shall arrange and pay for the transport of the equipment, materials, etc. to the site, as well as handling and storage within the site. The Contractor shall also be responsible for the transport, handling and storage of his equipment and tools that he will be using in the installation/erection, testing and commissioning of all equipment and materials under the Contract, as well as the return of these equipment and tools to the country of origin.

1.0.10.4.2.2 The Contractor shall be responsible for making sure that shipping is arranged on vessels having suitable equipment for loading and unloading of the equipment and materials, or that harbor has the corresponding facilities.

1.0.10.4.2.3 The NPC shall approve the transport arrangements. The Contractor shall, in good time, inform the NPC about each consignment by providing a list of contents, including the shipping date and the expected date of arrival.

1.0.10.4.2.4 It shall be deemed that all costs in connection with the transport, including storage, insurance, etc., detailed above and in Conditions of Contract, being the responsibility of the Contractor, have been included and allocated in his prices stated in the Schedule of Prices.

1.0.10.4.2.5 The Contractor shall arrange and carry out under his own responsibility and supervision, the local transport from the port of unloading to the Site.

1.0.10.4.2.6 The Contractor shall gather all information and arrange for all necessary provisions in order to obtain accurate information about unloading and local transport facilities, as well as prevailing local conditions, specifically the safe load bearing capacity of public road and bridges. The Contractor shall bear every and all expenses related herewith, which shall be included in the tender.

1.0.10.4.2.7 The Contractor shall use every reasonable means and care to prevent any of the roads and bridges on the route to the Site from being damaged by any traffic by the Contractor or any of his sub-contractors. He shall select routes, choose and use vehicles, restrict and distribute loads so that any such extra ordinary traffic that will inevitably arise from the moving of the Contractor's equipment and material to or from the Site shall be limited as far as reasonably possible, and so that no damage may be caused to roads and bridges.

1.0.10.4.2.8 If, during execution of the Work or at any time afterwards, the Contractor should receive any claim arising from the execution of the Works with respect to damage to roads or bridges, he shall immediately report this to the NPC and subsequently negotiate the settlement of any payment of all sums due with respect to all claims, proceedings, damages, costs, charges and expenses in related to the claim.

1.0.10.4.3 Inventory List

1.0.10.4.3.1 An inventory list approved by the NPC shall be furnished prior to shipment of materials and equipment, and shall consist of lists for:

a. Materials
b. Spare parts, tools and equipment
c. Test Equipment

The materials listed shall consist of an itemization of materials furnished at the factory site.

1.0.10.4.4 Storage

1.0.10.4.4.1 The storage will be in an environment similar to the installed location, i.e., indoor equipment will be stored indoors (without heating and ventilation), and outdoor equipment will be stored outdoors. Where required to protect against condensation and humidity, a desiccant shall be provided and its presence, with the need of periodic removal and dryout, shall be so marked. When electric space heaters are provided for that purpose, these should be wired to the outside of the equipment so that energizing immediately upon receipt is possible without disassembly of crates, etc. This also requires that no combustible materials be left in the inside of the equipment.

1.0.10.4.4.2 Items which maybe subjected to open storage for several months on site shall be suitably packed and protected from the weather.

1.0.10.4.4.3 The Contractor shall provide storage and handling instructions including descriptions for periodic inspection and/or storage maintenance to ascertain that no deterioration will occur during storage. One set of these instructions shall be fastened securely to the outside of the shipping unit.

1.0.10.4.4.4 The Contractor shall provide at NPC's request, the Contractor recommended instructions for long term storage.

1.0.10.4.4.5 When an equipment is specified for export shipment, the Contractor shall include packaging adequate for export shipment, and this packaging shall be such as to obtain approval and acceptance by transportation companies.

1.0.10.4.4. 6 All equipment shall be shipped from the factory completely assembled as far as practicable, subject to the limitations of length, height, depth, and weight, etc. described in the Special Conditions of Contract or in the Technical Data Sheets for each of the equipment under this Specification.

1.0.11 MISCELLANEOUS

1.0.11.1 Contractor's Supervision

1.0.11.1.1 The Contractor shall provide a competent (Engineer) Service Engineer, or technician during installation and perform the complete tests, commissioning and start-up of all equipment.

1.0.11.1.2 The Contractor shall send only service engineer, or technician who have adequate working knowledge of the English language.

1.0.11.1.3 The NPC reserves the right, if services for a longer period are needed, to ask for extension of the Contractor's supervisors until such time that the NPC's personnel have been fully trained in the operation, test and maintenance of the equipment supplied by the Contractor, at no cost to NPC.

1.0.11.1.4 The Contractor shall notify the NPC sixty (60) days in advance of the date when the service engineer or technician should commence the installation, tests and commissioning of the equipment at the site in order for the NPC to prepare his personnel in participating such activities.

1.0.11.1.5 The service engineer or technicians shall not be considered employee of the NPC for all legal intents and purposes and the Contractor shall be responsible for the payment to said service engineer or technician of all indemnities accruing of any labor accident which may occur in the course of the work and for which the Contractor maybe responsible either under the Philippine Laws or any foreign laws.

1.0.11.2 Training of NPC Personnel

1.0.11.2.1 General

1.0.11.2.1.1 If required in the Technical Data Sheets of the equipment, the Contractor shall provide overseas and local training courses for NPC personnel in English.

1.0.11.2.1.2 Training shall be geared towards the technical engineers and maintenance personnel of NPC through the transfer of technical knowledge.

1.0.11.2.1.3 Training overseas shall include classroom instruction courses conducted on the Contractors premises during manufacture of the equipment and hands-on training to enable NPC's personnel to manage, install, test, commission, maintain, operate and service the equipment on completion of the works in accordance with maintenance and operating procedures established by the Contractor. All expenses in the overseas training shall be borne by the Contractor including airfares, accommodation, transportation and allowances.

1.0.11.2.1.4 The training overseas shall not be more than one (1) month and shall commence at the latest, two (2) months before the date of the main shipment of the equipment to be supplied. NPC shall dispatch the required number of engineers specified in the Technical Data Sheets of the equipment where training is required to attend the training at the factory sites. They should be able to see and study the equipment to be supplied to NPC.

1.0.11.2.1.5 Local training shall also be conducted for ten (10) NPC personnel for not more than one (1) month. The Contractor shall provide similar training documentation and local meals to the NPC personnel. The NPC shall provide training room and any available test facilities.

1.0.11.2.1.6 Training selected from among NPC's maintenance staff will be qualified electrical and/or electronic personnel. Their experience will be of a broad and general technical nature, including general familiarity with electronic systems and testing facilities.

1.0.11.2.1.7 The cost of performing the training course shall be included in the Contract Price for the equipment.

1.0.11.2.2 Training Objectives

1.0.11.2.2.1 The training courses shall be designed to:

a. Enable maintenance staff to perform maintenance of the equipment by teaching principle of operation trouble-shooting methods and procedures leading to the identification and replacement of faulty piece of equipment, modules, units and components, with the objective that NPC personnel will become capable of carrying out repair and maintenance without outside assistance.

b. Enable maintenance staff to perform routine maintenance of the equipment by way of electrical and mechanical adjustments, lubrication and/or replacement of parts subject to wear or with a limited life.

c. Provide an understanding of the software and a working knowledge of the database for additions, modifications, and deletions and the practical use of diagnostic programs.

1.0.11.2.3 Course Content

1.0.11.2.3.1 The training course shall consist of formal courses given on the Contractor's premises including classroom training, instruction and explanation during shop tests and/or Factory Acceptance Tests and practical work sessions with the Contractor's specialists during the implementation of requirements of the Contract. Training shall be on the same hardware and software supplied under the contract.

1.0.11.2.4 Course Documentation

1.0.11.2.4.1 The Contractor shall submit a daily schedule for the entire training period and a syllabus for each course with a listing of course documentation, no later than thirty (30) days prior to the start of training.

1.0.11.2.4.2 Documentation shall be provided covering each course to a level of detail so that the text is self-explanatory and sufficient as future reference.

1.0.11.2.4.3 Prior to the start of a course, each trainee shall receive at least one (1) set of documentation covering that course. The Contractor shall submit to NPC one (1) set of course documentation per trainee no later than fifteen (15) days prior to start of each course.

1.0.11.3 Documentary Film

1.0.11.3.1 The Contractor, if required in the Bid Data Sheets of the General Requirements shall record and provide documentary film of the Scope of Works covering:

- footage on the various substations covered under this Project
- site preparation and mobilization
- processing and manufacturing of equipment to be used for the Project
- factory tests: type test, special test and routine test for the equipment that will be supplied
- equipment transport
- installation
- system testing

- commissioning of the system
- key personnel involved in the Project both on the NPC's side and the Contractor's side
- etc., which the Contractor may think would be necessary for inclusion on the documentary film.

1.0.11.3.2 The documentary film should last for a minimum of twenty (20) minutes and must be on a DVD type video disk on NTSC mode. Six (6) copies are to be provided by the Contractor to the NPC.

1.0.12 MEASUREMENT OF PAYMENT

1.0.12.1 Measurement of payment for all works shall be based on the bid price of each item shown in the Bill of Quantities. The cost thereof shall cover all works required and described in the pertinent provisions of the specifications and for the satisfactory completion of each work.

E.1.1: GENERAL TECHNICAL REQUIREMENTS

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E.1.1: GENERAL TECHNICAL REQUIREMENTS

1.1.0 SCOPE

1.1.0.1 General

1.1.0.1.1 This Section specifies the minimum set of requirements applicable to the materials and equipment included in the scope of works under this Project. Supplementary requirements of a special nature are contained in subsequent sections.

1.1.0.2 Scope of Works

The scope of work shall cover but not limited to the following:

Civil Works

1. Mobilization, demobilization, clean-up, provision of temporary office & housing and storage, and all miscellaneous works required for the implementation of the project;

2. Additional gravel surfacing to the existing gravel to required elevations in accordance with the details shown on the drawings;

3. Expansion of control room and office including cable trench and demolition and restoration for the affected structures;

4. Modification of concrete transformer pad;

5. Demolition and restoration of affected CHB perimeter fence for the installation of 20MVA transformer;

6. Repainting for the corroded metal clad switchgear.

7. All other works and services required to complete the project.

Electrical Works

1. Supply, delivery, installation, test and commissioning of new 20/20/5MVA three winding power transformer complete with all the required accessories, appurtenances, etc.;

2. Supply, installation and test of 1Cx300mm², XLPE 15kV Power cable (feeder supplying switchgear #1) including termination kits, terminal lugs, etc.;

3. Supply, installation and test of 1Cx125mm², XLPE 15kV Power cable (switchgear #1 feeders), termination kits, terminal lugs, etc.;

4. Dismantling & hauling of existing 10/10/10MVA three winding power transformer including its associated accessories, appurtenances, OLTC panel inside the control room, etc;

5. Dismantling, re-coiling & hauling of existing 1Cx500mm², XLPE 15kV Power cable (feeder supplying switchgear #2) including termination kits, terminal lugs, etc.;

6. Dismantling, re-terminate and test of existing bare & insulated XLPE power conductor/cable from existing 10MVA power transformer to the new 20MVA power transformer as shown in the Bid Drawing;

7. Dismantling, re-termination, test and commissioning of existing transformer protection system from existing power transformer to new 20MVA three winding power transformer including all associated protection accessories, panels, cables, etc.;

8. Supply, installation and test of additional grounding materials for the installation of new 20MVA power transformer, control house expansion, including connection to existing grounding grid;

9. Expansion of existing control house complete with all the required lighting & power system including kilowatt-hour meter, etc.;

10. Supply, laying, tagging, bundling, termination and test of new LV power, control and instrumentation cables; and

11. Supply, installation and test of lighting and power system for the proposed expansion of control room and construction of SPUG-Office building complete with all the required lighting fixtures, convenience outlets, panel boards, power cables, etc. including tapping to existing power supply; and

12. Supply and installation of embedded and/or exposed electrical metallic/non-metallic conduits, boxes, fittings and accessories for control cables.

Mechanical Works

1. Supply, installation and test of one (1) lot of domestic water supply system consisting of pipes, valves, pipe fittings, gaskets, flanges, bolts and nuts, pipe supports including the required excavation, backfilling and disinfection of embedded pipes and other incidentals to complete the domestic water supply piping system;

2. Supply, installation and test of one (1) unit of inverter-window type air conditioner of 10,000 kJ/hr minimum cooling capacity for proposed extension office, complete with its mounting accessories and controls;

3. Supply, installation and test of one (1) unit of wall mounted exhaust fan, 100 m^3/hr minimum capacity for comfort room, complete with its mounting accessories and control;

4. Supply and installation of one (1) unit of portable type fire extinguisher, clean agent (HCFC or Halotron I Type), 7.1 kg. (15.5 lbs), non-expiry, multi-shots, wall-hung type and UL/FM approved;

5. Relocation of one (1) unit of floor-mounted air-conditioning unit to the proposed expansion of control room and;

6. All other works and services required to complete the project.

In addition, the following shall be provided by the Contractor:

1. Removal/dismantling and hauling of all equipment and materials to be replaced to designated NPC plant stockyard/warehouse area;

2. Supply and delivery of spare parts and consumables as per manufacturer's recommendations and/or technical data sheets to ensure reliable operation of the equipment for at least two (2) years;

3. Supply and delivery of standard and special tools and appliances required for start-up testing, commissioning, operation and maintenance of the equipment;

4. Provision of services of highly qualified and competent engineers for the direct supervision during the test and commissioning of all supplied equipment;

5. Submission of drawings and documents i.e. Equipment Manufacturer's drawings, Operation and Maintenance Manuals, Calculation, etc;

6. Conduct inspection to verify and assess the extent of the related and incidental works needed to implement the project competently and efficiently.

1.1.0.3 Location of the Project

The contract to be bid is located at **NPC's Virac (Marinawa) Substation, Marinawa, Bato, Catanduanes**

1.1.0.4 Contract Period

The Contractor shall complete the works within **ONE HUNDRED EIGHTY (180) CALENDAR DAYS**. The contract period is inclusive of twenty (20) rainy/unworkable days considered unfavorable for the prosecution of work at the site. The number of calendar days shall be counted from the date of contract effectivity as specified in the Notice to Proceed.

1.1.1 WORKMANSHIP

1.1.1.1 Workmanship shall be of first-class quality and in accordance with the best modern practice for the manufacture, installation/erection, testing and commissioning of high grade equipment, notwithstanding any omissions from these specification and drawings.

1.1.1.2 All materials supplied under this specification shall be unused, of recent manufacture, free of defects or irregularities and the best available considering durability, strength and intended service suitability and best engineering practice.

1.1.1.3 All parts shall conform to the dimensions shown on, and shall be built in accordance with approved drawings. The surface finish of all parts and components shall be in conformity with the respective strength, fit and service requirements.

1.1.1.4 Like parts and spare parts shall be interchangeable whenever possible.

1.1.1.5 Machining of renewable parts shall be accurate and to specified dimensions so that replacement of those parts fabricated or made according to dimensions so indicated in the drawings could be readily installed.

1.1.2 MATERIALS

1.1.2.1 Requirements to Materials

1.1.2.1.1 All materials to be used under this Contract shall be new, the best of their respective kinds and free from defects and imperfections. All materials shall comply with the latest revisions or edition of the specified standards for each equipment specification unless otherwise specified or permitted by the NPC.

1.1.2.1.2 When other standards are used, Contractor shall indicate the equivalence between the materials used and the corresponding materials following the specified standards in the equipment specification and shall obtain the approval of the NPC before starting the manufacture of the equipment and materials.

1.1.2.1.3 Materials and finishes selected for equipment shall be suitable for the purpose intended and for the humid tropical conditions under which the equipment is to operate. The use of other materials maybe permitted where the equipment is hermetically sealed.

1.1.2.1.4 Iron and steel where possible, shall be avoided in instruments and in electrical relays. Instrument screws (except those forming part of magnetic circuit) shall also be brass or bronze. Steel screws, when used, shall be zinc or chromium plated, or when plating is not possible owing to tolerance limitations, shall be of corrosion-resisting steel. Springs shall be of a non-rusting material, such as phosphor-bronze or nickel silver.

1.1.2.1.5 The names of manufacturers of equipment and articles contemplated for incorporation in the work together with performance capacities and other significant information pertaining to the equipment, shall be furnished for approval. Equipment and articles installed or used without such approval shall be at the risk of subsequent rejections.

1.1.2.2 Test of Material

1.1.2.2.1 Materials, parts and assemblies thereof entering into the work shall be tested, unless otherwise directed, according to the best commercial method for particular type and class of work. When the Contractor desires to stock material not manufactured specifically for the equipment furnished, satisfactory evidence that such material conforms to the requirements herein stated shall be furnished, in which case tests on these materials may be waived. Certified mill tests reports of materials will be acceptable.

1.1.2.2.2 Certified copies of test reports shall be furnished in triplicate as soon as possible after the tests are made and shall be in the manufacturer's possession prior to incorporating that

material in the work. The reports shall be in such form as to enable determining compliance with the applicable specification for the material tested. When requested, tests shall be made in the presence of a duly authorized inspector.

1.1.3 CODES AND STANDARDS

1.1.3.1 Prescribed Standards

1.1.3.1.1 Unless specified otherwise in the various sections of this technical specifications for equipment, the design, materials, manufacture and testing of all works under this Contract shall comply with the latest revision or edition of the various standards specified for each equipment section of the specification.

1.1.3.1.2 The latest edition of each standard shall mean the latest edition available at the date of Contract signing.

1.1.3.1.3 In addition to the codes and standards mentioned in the technical specification for each equipment, the Contractor shall comply with all National and local laws, codes, regulations, statutes and ordinances.

1.1.3.1.4 Equipment or materials meeting other internationally accepted standards, which ensure an equal or higher quality than the standards mentioned, will also be accepted.

1.1.3.1.5 In the event of any apparent conflict among standards, codes or this specification, the Contractor shall refer the conflict to NPC for written resolution before start of fabrication. Final decision regarding the acceptance of proposed standards is the prerogative of the NPC.

1.1.3.1.6 No deviation from the accepted standards shall be made subsequent to the Contract without the written approval of the NPC.

1.1.3.1.7 Standards listed in individual technical specification are used mainly for NPC's references. Other internationally known standards however, shall also apply, provided such standards are equivalent in all respect to the standard prescribed and to the specific requirements described in the individual equipment specification. Contractor shall submit copies of such standards for NPC's review and approval.

1.1.3.2 Designation of Trade Name or Catalog Name and Number

1.1.3.2.1 For convenience in designation in the Specifications, certain equipment, articles, materials, or processes are designated by trade name or catalog name and number. Such designations shall be deemed to be followed by the words "or equivalent' whether such words are shown or not, and the Contractor may offer any material or process which shall be equal in every respect to that so indicated or specified. The burden of proof of acceptability to the NPC, as to the comparative quality and suitability of alternative shall be upon the Contractor. If the Contractor's request is not approved, the Contractor shall not ask or be permitted to use the same alternative materials or equipment in modified form.

1.1.4 INTERCHANGEABILITY AND STANDARDIZATION OF SMALL EQUIPMENT

1.1.4.1 All like parts shall be fully interchangeable with no requirement for alteration or adjustment.

1.1.4.2 The Contractor shall be responsible for the standardization of all small equipment, materials and devices he would supply. He shall arrange and perform the necessary coordination work with his manufacturers for the purposes of such standardization.

1.1.4.3 All equipment, parts and elements of mass production shall be standardized. Such items of equipment, parts and elements shall include, but shall not be limited to, the following;

- Motors
- Pumps
- Flanges
- Valves
- Bolts
- Gauges and detectors
- Electrical instruments and measuring devices
- Terminals and terminal boxes
- Primary, secondary and auxiliary relays
- Contactors, fuses and switches
- Lamps, bulbs, sockets, plugs, push button, etc.
- Lubricants
- etc.

1.1.5 TESTS AND INSPECTION

1.1.5.1 General

1.1.5.1.1. The Contractor shall provide a test specification covering all tests on Contractor's premises. Successful completion, as deemed by the NPC, of Inspection and Tests on Contractor's premises shall be a prerequisite to shipment of all materials, equipment, software or system(s). Following successful completion of inspection and tests on his premises, the Contractor shall obtain the approval to proceed with the delivery of the equipment, materials, software or system(s) from the NPC in accordance with the Technical Specification for the equipment.

1.1.5.1.2. The objective of the test specification shall be to set forth the means, manner and circumstances in which to verify compliance with the Contract requirements including all functional and operation performance claims for the material, components, equipment, software or system made by the Contractor and/or the original equipment manufacturer.

1.1.5.1.3. The test specification shall include a program for Factory Acceptance Test (FAT) and detail the following:

a. Requirements to be tested;
b. Step-by-step method of testing;
c. Expected results of tests

1.1.5.1.4 Approval of the test specification/procedure will not prejudice the NPC's right to order additional tests, should the NPC deem, following approval but before his acceptance of the material, equipment, software of system(s) for shipment, that certain conditions or combination of conditions were not foreseen in the test specification, in order to demonstrate that performance requirements of this Specification have been met.

1.1.5.1.5 Tests shall only be conducted with the aid and in accordance with test specification(s) and standards clearly identified as approved for use by the NPC, and, where applicable, employ test instruments of suitable quality calibrated to manufacturer's recommendations by a reputable agency within the previous six (6) months.

1.1.5.2 Inspection on Contractor's Premises

1.1.5.2.1 The NPC reserves the right to inspect all shop and assembly work associated with the Works, verify quantities consigned to stores and inspect quality control and assurance records as well as shop and purchase order records. When scheduled, and as often as the NPC deems appropriate, progress will be monitored with respect to Key Dates in the Contract Schedule and the sequence of events and activities on the Contractor's Detail Contract Schedule as referred to Paragraph 1.0.2.

1.1.5.2.2 The Contractor shall demonstrate and furnish evidence that general progress is being maintained so that no activities are in danger of becoming the critical path and that specific progress of those activities on the critical path meet all target dates set by the Contractor as well as Key Dates in the Detail Contract Schedule.

1.1.5.2.3 The Contractor shall furnish the NPC, a list of Contractors and the components, materials, equipment or software to be furnished by them for use in the Works, in sufficient time to permit inspection and testing of all components, materials, equipment and software. Purchase Orders shall clearly indicate level of inspection to which purchased items will be subject.

1.1.5.2.4 All shop orders or instructions to production and manufacturing departments shall quote the pertinent requirements of the Specification and shall bear a suitable notation advising quality control inspection requirements. A system for advising the quality control department of same shall exist. If so requested by the NPC, the Contractor shall furnish triplicate copies of the designated internal orders and instructions.

1.1.5.3 Tests on Contractor's Premises

1.1.5.3.1 Routine Tests

1.1.5.3.1.1 The Contractor shall perform routine tests in accordance with requirements of the Specification and the Contractor's test specification approved by the NPC. The Contractor shall give the NPC access to Works to determine or assess compliance with the provisions of this Specification or to witness Contractor's routine shop tests. The Contractor shall submit results of routine tests within fifteen (15) days after performance of the tests.

1.1.5.3.2 Type Tests

1.1.5.3.2.1 The Contractor shall carry out all type tests called for in this Specification and such tests in the Standard in accordance with criteria and to the extent specified in the Specification and on custom manufactured items as called for by the NPC to obtain required performance data.

1.1.5.3.2.2 Upon submission of relevant test certificates from an independent testing agency approved by the NPC, and proof that the equipment to be tested is identical to that covered by the test certificates, the NPC will waive the requirements for corresponding type tests called for in this Specification and/or specified in the Standards.

1.1.5.3.3 Factory Acceptance Tests

1.1.5.3.3.1 Prior to shipping and final inspection, tests hereinafter referred to as Factory Acceptance Tests (FAT) shall be conducted by the Contractor at his plant and will be witnessed by the NPC.

1.1.5.3.3.2 The Contractor shall carry out tests, as may be required by the specified Standards and the Quality Control and Assurance Program, as well as the entire test program, approved by the NPC, prior to the witnessed FAT, remove all faults found and correct all failures so that to the best of his knowledge, no functional or procedural errors will occur during the witness FAT.

1.1.5.3.3.3 At the commencement of the witness FAT, all equipment shall be brought together in one place, integrated and the configuration/set-up at the factory site shall be identical to that to be installed at the site and any equipment and software necessary for the proper operation of the equipment shall have reached its final form, not to be changed during the FAT and until commencement of commissioning at site.

1.1.5.3.3.4 The Contractor shall immediately advise the NPC should failures occur, take remedial action subject to the NPC's approval and proceed with the FAT as and when directed by the NPC. It shall be the NPC's prerogative to order a repeat of all such tests that he deems may have been affected by the failure.

1.1.5.3.3.5 The Contractor shall ensure that during the test, all hard copy from output devices is retained and that no outside parties interfere in any way with testing, equipment or test instruments, fixtures and jigs for the entire duration of the FAT. Only Contractor's personnel who are needed on the testing of the equipment shall be allowed in the test area. The Contractor shall appoint a chief-tester who shall be responsible for conducting the test, ensuring at all times that the test instruments, fixtures, jigs and extender cards, and those of the Contractor's personnel who in any way may contribute to the test, including testers, specialists and maintenance personnel are available prior to scheduled commencement of each test or as and when instructed by the NPC.

1.1.5.3.3.6 The chief-tester shall also be responsible that an accurate record of tests are kept and each individual test is duly initialed and dated by the tester and marked either passed or failed with annotations of antecedents and observations concerning the test. For each day of testing, the chief-tester shall submit to the NPC the proposed disposition of each criterion that failed during the previous day of testing, prior to commencement of the tests scheduled for that day. Tests witnessed by the NPC will be initialed accordingly by him on the test record. The test record and dispositions, and any other pertinent supporting data and documents shall form part of a test report to be submitted in accordance with the specification.

1.1.5.3.3.7 Material, equipment, software or system(s) shall be required to pass one complete run of functional tests with satisfactory results and shall have all faults and failures corrected, if any. At completion of all tests, as well as at any time during the test at the NPC's discretion, test results, except for the parts comprising dynamic data, shall be compared with the reference copy. If no differences are detected and all tests have demonstrated compliance with the requirements of this Specification, then the FAT will be deemed successful.

1.1.5.3.4 Tests Failures

1.1.5.3.4.1 If any equipment fails to pass any test, the NPC may, at his own judgment, direct the Contractor to make any necessary corrections or alterations to it for minor defects or to replace it forthwith for major defects. Any and all expenses that might result by the supply and installations of new parts or by modification of existing parts and any and all expenses resulting in additional tests made necessary by failure of equipment to meet the guarantees and other requirements of the specification shall be borne by the Contractor. The costs of witnessing the Factory Acceptance Tests by the NPC or his representative(s) as a result of re-test to be conducted on the equipment shall also be borne by the Contractor.

1.1.5.4 Field Test

1.1.5.4.1 Field tests and acceptance tests shall be performed by the Contractor and witnessed by NPC's representative to determine whether requirements of the specification have been fulfilled. The Contractor shall provide instructions and acceptance criteria for field testing for NPC's review and approval prior to conduct of such tests and commissioning the equipment. No field tests shall be performed unless approved by the NPC.

1.1.5.5 Test Reports/Certificates

1.1.5.5.1 Six (6) certified copies of the reports of all NPC's specified tests and other manufacturer standard tests shall be furnished to the NPC immediately within a maximum of fifteen (15) days following the completion of the tests. For equipment which had the required type test already, the type test certificates shall be submitted by the Contractor together with his proposal.

1.1.5.5.2 For the routine tests, acceptance tests and field tests, the test certificates shall include, in addition to the test results, the following information:

a. Date for the test certificate
b. Equipment data
c. NPC's reference number
d. The equipment serial number

1.1.5.5.3 Certified test data submitted to NPC shall also include copies of oscillographic records made in conjunction with the tests, and certification that all equipment furnished are suitable, when energized at continuous voltage, and for manual washing using a single-stream high pressure nozzle.

1.1.5.5.4 The Contractor shall bear the cost of furnishing these records and reports.

1.1.5.6 Waiver of Factory Acceptance Tests Witnessing / Inspection by NPC

1.1.5.6.1 Where Factory Acceptance Tests (FAT) to be witnessed by NPC's representative(s) have been required in the Technical Data Sheets of a particular equipment, costs of these tests witnessing shall be deemed included in the price for the equipment pursuant to Paragraph 1.1.5.1.6.

1.1.5.6.2 If however, the NPC opted not to witness the Factory Acceptance Tests, NPC will issue a Certificate of Waiver of Tests Witnessing/Inspection for the equipment and materials. In such case, the Contractor shall proceed with the Factory Tests in accordance with the requirement of the specification and the manufacturer's test specification as approved by the NPC.

1.1.5.6.3 Where Factory Tests are not required to be witnessed by NPC's representative(s) as indicated in the Technical Data Sheets of the equipment, a Certificate of Waiver of Tests Witnessing/ Inspection will be issued also by the NPC. In this case, no claim whatsoever can be made by the NPC on the Contractor as a result of waiving the Factory Acceptance Tests.

1.1.6 ELECTRIC WELDING

1.1.6.1 Welding Procedure

1.1.6.1.1 All welding shall be performed in accordance with a procedure which shall be in accordance with standards equal to those required by the "Standard Qualification Procedure" of the American Welding Society.

1.1.6.2 Acceptance of Welded Structures

1.1.6.2.1 The acceptance of the welded work shall depend upon correct dimensions and alignment and absence of distortion in the structure, upon satisfactory results from the examination and testing of the joints in accordance with the instructions given on the drawings and the soundness of the welds and upon general good workmanship.

1.1.6.3 Cleaning

1.1.6.3.1 All excess weld materials, slag, splatter and flux residues shall be removed from the steel work.

1.1.7 TROPICAL SERVICEABILITY

1.1.7.1 General

1.1.7.1.1 In choosing materials and their finishes, due regard is to be given to the humid tropical conditions under which equipment is to work. Some relaxation of the following provisions may be permitted only when equipment is hermetically sealed but it is preferred that tropical grade materials should be used wherever possible.

1.1.7.1.2 Cubicles used for switchgear and control cabinets in outdoor plant shall be vermin-proof and fungus-proof.

1.1.7.1.3 Totally enclosed motors and enclosures containing electrical control and switching equipment and instrument for outdoor installations shall be equipped with temperature controlled electrical heaters. The construction of the enclosures and installation of heaters shall be as to ensure effective circulation of air while ensuring that no damage to equipment occurs due to overheating.

1.1.7.1.4 The Contractor shall supply the NPC with detailed descriptions of all design characteristics necessary to fulfill the requirements in connection with the tropical conditions under which the equipment will be operated.

1.1.7.2 Metals

1.1.7.2.1 Iron and steel are in general to be galvanized or painted as appropriate. Small iron and steel plate (other than SUS 316 stainless steel) of all instruments and electrical equipment, the cores of electromagnets and the metal parts or relays and mechanisms are to be treated in an approved manner to prevent rusting. Cores or other components which are laminated, or which cannot be rustproofed, shall have all the expected parts thoroughly cleaned and heavily enameled, lacquered or compounded. Where it is necessary to use dissimilar metals in contact, these should, if possible, be so selected that the potential difference between them in the electrochemical series is not greater than 0.5 volt. If this is not possible, the contact surfaces of one or both of the metals are to be electroplated or otherwise finished in such a manner that the potential difference from each other by an approved insulating material or a coating of approved insulating varnish.

1.1.7.3 Screws, Nuts, Springs, Pivots, etc.

1.1.7.3.1 The use of iron and steel is to be avoided in instruments and electrical relays wherever possible. Steel screws, when used, are to be zinc or chromium plated or, when plating is not possible owing to tolerance limitations, are to be of corrosion-resisting steel. All wood screws are to be of dull nickel plate brass or other approved finish. Instrument screws (except those forming part of a magnetic circuit) are to be brass or bronze. Springs are to be of non-rusting materials, e.g., phosphor bronze or nickel silver, as far as possible. Pivots and other part for which non-ferrous material is unsuitable are to be of an approved rustproof steel where possible.

1.1.7.4 Fabric, Cork, Paper, etc.

1.1.7.4.1 Fabrics, cork, paper and similar materials, which are subsequently to be protected by impregnation, are to be adequately treated with an approved fungicide. Sleeving and fabrics treated with linseed oil or linseed oil varnishes are not to be used.

1.1.7.5 Wood

1.1.7.5.1 The use of wood in equipment is to be avoided as far as possible. When used, woodwork shall be of thoroughly seasoned teak or approved wood which is resistant to fungal decay and shall be free from shakes and warps, sap and wane, knots, faults and other blemishes. All woodwork is to be suitably treated to protect it against the absorption of moisture, the growth of fungus and termite attack, unless it is naturally resistant to these causes of deterioration. All joints in woodwork are to be dovetailed or tongued and grooved as far as possible. Metal fittings where used are to be of non-ferrous material.

1.1.7.6 Adhesives

1.1.7.6.1 Adhesives are to be specially selected to ensure the use of types which are impervious and resistant to attack of mildew and insects. Synthetic resin cement only shall be used for joining wood. Case-in cement shall not be used.

1.1.8 ENVIRONMENTAL REQUIREMENT AND OPERATING ENVIRONMENTAL CONDITIONS

1.1.8.1 General

1.1.8.1.1 All equipment shall conform with the environmental requirements and conditions applying to the location where it is to be used. Additional heating by equipment inside buildings must be taken into account.

1.1.8.1.2 All equipment and materials to be furnished shall meet the performance and rating requirements of this specification and all Contractor's guarantees shall be based on operation within the environment specified in the Technical Data Sheets of the equipment. This also applies during storage and if susceptible to moisture absorption or fungus attack, the equipment and materials shall be treated with fungicidal varnish and otherwise be adequately tropicalized as specified in Paragraph 1.1.7.

1.1.8.1.3 Special measures shall be taken such as the use of chemically inert parts and proper surface preparation and paint application in accordance with this Specification for equipment installed at Site(s) with a corrosive atmosphere, to protect exposed metal parts and other materials susceptible to chemical reaction.

1.1.8.1.4 Materials susceptible to deterioration from climatic conditions or subject to the formation of fungus or any other form of parasitic life shall preferably not be used, but if used and cannot be avoided, these must be permanently protected.

1.1.8.1.5 For all outdoor equipment, the operation of the equipment must not be influenced by dew, fog, rain, wind, sun radiation, quick changes of temperature, dust, smoke, salts, aggressive gases, and steams. Outdoor installations shall be protected against solar radiation by means of adequate covers, where required, with non- deteriorating material to be provided by the Contractor.

1.1.9 SEISMIC REQUIREMENTS

1.1.9.1 Equipment and equipment supports shall be designed to withstand and maintain their structural integrity when exposed to seismic loading/seismic factor specified in Section 1.1 of the Technical Data Sheets. It shall be designed to resist a lateral seismic force and remain in place in accordance with the requirements of the latest issue of Uniform Building Code (UBC), Section 2312g.

1.1.9.2 The Contractor shall demonstrate the equipment's ability to withstand and maintain its structural integrity when subjected to the forces resulting from the seismic conditions specified herein. This can be accomplished in one or a combination of the following methods:

a. Predict the equipment's performance and response to a seismic force by mathematical static analysis;

b. Test the equipment under simulated seismic conditions (static or dynamic testing); or
c. Utilize previous seismic qualification of the equipment and demonstrate applicability under the seismic conditions specified herein.

1.1.9.3 The seismic loading on the equipment and its supports shall be obtained by multiplying the weight of components by the horizontal seismic acceleration coefficient (H). The force shall be assumed to act in any lateral direction.

Where: $H = 0.5 \times Z \times I$

Z = Uniform Building Code coefficient corresponding to the zone where the equipment is located
I = Importance Factor

1.1.9.4 Equipment and supports shall be designed for lateral forces in accordance with the following formula derived from the UBC:

$Fp = HWp$

Where:

Fp = lateral force on the equipment
Wp = the total weight of the equipment supplied by the Supplier
H = Horizontal seismic acceleration coefficient given in the above formula

1.1.9.5 Support design shall not include friction in resisting the lateral shear load.

1.1.9.6 The maximum stresses, under seismic loading combined with all other load effects, shall be within the normal allowable material working stress limits as set forth in the appropriate design standards and codes listed in this specification.

1.1.9.7 Deformations resulting from the combined influence of normal operating loads and seismic loads shall be investigated to verify that they will not impair structural integrity.

1.1.9.8 The Contractor shall submit a certification stating that the equipment can resist the forces resulting from the seismic conditions specified herein and remain in place. The Contractor shall submit the following data and documents for NPC's information:

a. Outline arrangement drawing showing all pertinent dimensions and support locations
b. Analytical method and procedures in a step-by-step form which is readily auditable by persons knowledgeable in such analysis
c. Results of analysis and conclusions

1.1.10 CLEANLINESS

1.1.10.1 At time of shipment, the equipment shall be clean inside and outside.

1.1.10.2 All waste such as metal chips or filings, welding stubs, dirt, rags, debris and any other foreign material shall be removed from the interior of each component. All mill scale, rust, oil, grease, chalk, crayon or paint marks and other deleterious materials shall be removed from all interior or exterior surfaces.

1.1.10.3 Solvent cleaning, if required, shall be performed in accordance with SSPC-SP1.

1.1.10.4 Heavy cleaning, if required, shall be performed in accordance with SSPC-SP3.

1.1.10.5 Cleaning of stainless steel surfaces shall be performed with solvents, cloths and abrasive that do not contain halide. Only stainless steel, clean, iron-free, hand or power tools and aluminum oxide abrasive shall be used on stainless steel components. Materials used to clean carbon steel or cast iron shall not be used to clean stainless steel surfaces.

1.1.11 SURFACE TREATMENT AND CORROSION PROTECTION

1.1.11.1 General

1.1.11.1.1 Equipment and all steel parts shall be painted, hot-dip galvanized or treated with protective coatings to prevent corrosion and provide a smart and pleasing appearance. This work shall comprise the surface treatment, priming and application of paint or metallic coatings in the workshop and at the site, including all paint repair works that may be necessary. Corrosion protection shall include the steel surfaces of structures cast into concrete.

1.1.11.1.2 The works of corrosion protection shall include all equipment and installations for sand blasting and paintings.

1.1.11.1.3 The Contractor shall furnish, with his proposal, a complete description of the corrosion protection he intends to provide. After purchase order, the Contractor shall submit applicable cleaning and coating procedures and specific description of coating material to be used.

1.1.11.1.4 Where possible, equipment shall be designed such that all surfaces can be finish-coated or recoated after erection at the site.

1.1.11.2 Requirements to the Finished Coating

1.1.11.2.1 All finished surfaces shall be level and free of tears, burrs, clots and impurities. The coat of paint shall be of even thickness, also in corners and on edges. Moreover, all finished surfaces shall be uniform in respect of color and gloss.

1.1.11.2.2 The paint film, under visual examination, must in any case present the appearance of an accurate application and be free of lesions, porosity, cracks or bubbles.

1.1.11.2.3 Any damage during transport, mounting, welding, etc. shall be repaired by Contractor. Repair methods shall be submitted for approval of the NPC. This also applies to damages to components supplied by a sub-contractor.

1.1.11.3 Guarantees

1.1.11.3.1 The guarantee period of the paint work shall be two (2) years. During this period, it will be the responsibility of the Contractor to repair or replace without charge all paintwork showing defects (such as discoloration, peeling, wrinkles, bubbles, flakes or rust, etc.) where it may be proven that the deterioration arises from:

a. Poor quality paint;
b. Insufficient cleaning of the surface before painting;
c. Incorrect choice of paint for the service required; and

d. Incorrect application of paint itself to the surface.

1.1.11.3.2 In such cases, the Contractor shall take charge of restoration of all parts which have shown defects.

1.1.11.3.3 For the guarantee against corrosion penetration, the NPC requires a ten-year guarantee period. The rust penetration shall be measured according to ISO 4628/3-1982. After ten years, the rust penetration shall not exceed Ri 2. Ri 3 penetration shall entitle the NPC to repair the surface at the expense of the Contractor.

1.1.11.3.4 The guarantee shall commence on the day of the issuance of the Certificate of Provisional Acceptance.

1.1.11.4 Reference Standard

1.1.11.4.1 Except otherwise specified elsewhere in the specification, the surface treatment and corrosion protection for all metal parts shall be in conformity with the latest revision of the standards listed below:

ASTM 123	Zinc (hot-dip galvanized) coating on Iron and Steel products
DIN 55928	Protective painting of steel structure instructions
DIN 55945	Painting Materials – Notions
DIN 18363	Paint work – Buildings
DIN 18364	Surface Protection Work for Steel
DIN 53210	Determination of Rust Degree
DIN 55151	Determination of Adhesion
ISO 4628/3	Determination of Rust Penetration

Other internationally known standards however, shall also apply provided such standards are equivalent in all respect with the reference standards prescribed above. The Contractor shall submit copies of such standards for NPC's review and approval.

1.1.12 EQUIPMENT DESIGNATION (EQUIPMENT MARKING)

1.1.12.1 Identification System

1.1.12.1.1 All equipment and all component parts including cables, control wiring and terminals shall be designated with an alphanumeric code allowing clear identification of the equipment and components during design, installation and operation of the plant/substation. Equipment, cables, control wiring and terminals shall be systematically marked, both on the drawings and documents and on the equipment, cables, wires and terminals themselves.

1.1.12.1.2 Equipment designation codes shall be indicated on all planning documents including bills of materials, lists of spare parts, etc. The codes will later be used for easy identification of stored equipment parts and materials and shall be suitable for use with a computer supported registration system.

1.1.12.1.3 Tender drawings are in some cases already marked with designated codes; the system shall be expanded to include detailed diagrams, cable lists, spare parts list, etc. approved by the NPC.

1.1.12.1.4 Wherever applicable, labels/plates bearing the E.D.S. code shall be attached to equipment in the Contractor's works.

1.1.12.1.5 The material and fastening methods proposed for E.D.S. labels/plates are subject to the approval of the NPC.

1.1.12.2 Labels and Plates

1.1.12.2.1 A stainless steel nameplate or equivalent anti corrosive nameplate with clearly legible writing shall be permanently attached to each assembled piece of equipment at an easily visible place. It shall provide all necessary information pertaining to the equipment, but as a minimum, the following must be included: Manufacturer's name, type of equipment, serial number, year of manufacture, project identification number, weight, E.D.S. code and other relevant information in compliance with applicable standards. Any special maintenance instructions shall also be shown at this or other suitable location.

1.1.12.2.2 For other major components i.e., pumps, motors, etc., the following shall be added: Rated hp, speed, total head, capacity, direction of rotation, and any other pertinent information.

1.1.12.2.3 If it is not practical to include NPC's equipment identification, or tag number on the equipment nameplate, then a separate durable stainless steel tag with NPC's identification number shall be provided and securely attached to the equipment.

1.1.12.2.4 Labels shall also be provided for equipment and devices mounted on control boards, relay cabinets, desks and other places as required for proper identification, as well as for operational, functional and safety reasons. The labeling, size of label-plates and their location shall be subject to approval by the NPC. A sample label-plate (with indication of material used) with lettering shall be submitted for this purpose.

1.1.12.2.5 Each equipment wherever necessary, shall be provided with cautionary and warning plates and signs in accordance with the prescribed ANSI/IEEE or equivalent IEC Standards for the particular equipment. Nameplates, labels and warning plates shall be in English.

1.1.13 SPARE PARTS AND SPECIAL TOOLS

1.1.13.1 A list of mandatory spare parts and special tools to be supplied by the Contractor is specified in the Technical Data Sheets for each of the equipment under this specification. If in case any of the mandatory spare parts or tools are not applicable to his supplied equipment, the Contractor is required to provide an alternative spare parts and tools that are applicable to his supplied equipment with the same quantities as required. The NPC has the option to choose in the list of the recommended spare parts and tools given by the Contractor the replacement for the mandatory spare parts and tools, which the Contractor failed to offer or provide an alternative replacement.

1.1.13.2 In addition to the above, the Contractor shall also include with his Proposal, a list of recommended spare parts and special tools which he considers necessary for the safe and reliable operation and maintenance of the equipment. The Contractor shall indicate the expected life of the parts requiring replacements and the minimum recommended inventory of the spare parts for installation, start-up, continuous operation and maintenance. Contractor shall state whether the recommended spare parts is a stock item or a special item, and shall furnish

name and location of the nearest Contractor, and approximate lead time required for delivery. The NPC has the option to consider or not to consider the recommended spare parts and tools as given by the Contractor with the corresponding price.

1.1.13.3 All spare parts shall be readily interchangeable with the ones which they are to replace. They shall be of the same material, of identical size and manufacture and shall have the same properties as the corresponding parts of the installed equipment. Specified conditions relating to tests, treatment of surfaces and painting, etc. of the installed equipment shall also apply to spare parts.

1.1.13.4 All spare parts shall be properly packed (and where necessary treated) in such a manner as to allow prolonged storage at the Site, considering the ambient conditions prevailing there. In due time, the Contractor shall inform the NPC of the eventual precautions to be taken for the proper storage of the spare parts.

1.1.13.5 The Contractor shall provide a spare parts list containing at least the following information:

- Name and address of manufacturer and other identification no.
- Item description including EDS-code, drawing no., material designation, units to be ordered.
- List of items (designated by EDS-code) for which the respective spare parts can be used.
- Item price.

1.1.14 GENERAL ELECTRICAL REQUIREMENTS

1.1.14.1 General

1.1.14.1.1 The supply of the electrical equipment for high and low voltage installation shall be complete to the extent required to put the substation(s)/power plant(s) in satisfactory operating conditions, with all the requirement completely connected and interconnected with operating switches, interlocks, signalization, alarms and metering instruments.

1.1.14.1.2 The Contractor must supply all minor items (such as auxiliary relays, terminal blocks, accessories, etc.) which are necessary although not expressly described in the Technical Specifications, in order to guarantee the trouble free operation and ease in the maintenance of the supplied substations/switchyard (or parts of substations/switchyard) with particular reference to the provisions to be taken in order to avoid dangerous or wrong operations.

1.1.14.1.3 The electrical equipment shall be designed in such a way as to bear without damage and permanent deformation the consequences of over-voltage of internal or atmospheric origin and short circuit calculations shall be provided, giving full evidence, that each electrical component can withstand the maximum stresses under fault conditions, e.g., upon failure of the corresponding main protection device and time-delayed fault clearing by the back-up protection device.

1.1.14.1.4 Outdoor installations shall be protected against solar radiation by means of adequate covers, where required, with non-deteriorating material to be supplied by the Contractor.

1.1.14.1.5 The Contractor shall ensure, that all equipment supplied is insensitive to any signals emitted by wireless communication equipment.

1.1.14.1.6 All the metallic frames of the electrical equipment shall be securely connected to the general earthing system in compliance with accepted Standards.

1.1.14.2 Insulation Levels

1.1.14.2.1 The insulation levels for different system voltages shall be as indicated on the particular Technical Data Sheets of the equipment.

1.1.14.3 Minimum Clearances

1.1.14.3.1 The center-line spacing and clearances above ground level of the conductors shall be as shown on the bid drawings, or in the absence of such information, shall match the ANSI Standards.

1.1.14.3.2 Clearances of energized metal parts are summarized in the following table for the different systems:

Nominal System Voltage	*d1 (mm)*	*d2 (mm)*	*D (mm)*	*H (mm)*
13.8	300	350	900	3500
34.5	500	610	1500	3600
69	**800**	**900**	**2000**	**3750**
115	1100	1360	2500	4000
138	1300	1800	3000	4000
230	1850	3200	4000	5000
500	3250	5200	8000	9000

where: d_1 = minimum clearance between live metal parts and ground
d_2 = minimum clearance between live metal parts of two phases
D = practical distance between phase center lines
H = minimum height of live conductors above ground.

However, the upper edge of an earthed insulator support must, for all voltage series, beat a height of at least 2300 mm above the ground level.

1.1.14.4 Creepage Distances

1.1.14.4.1 Creepage distance of bushing of equipment, string of insulators, station post insulators and rigid support insulators shall comply with the requirements stipulated in the Technical Data Sheets of the equipment.

1.1.14.5 Levels of Equivalent Salt Deposit Density (mg/cm^2)

1.1.14.5.1 The level of equivalent salt deposit density shall be as stated in the Technical Data Sheets of the equipment.

1.1.14.6 Auxiliary Services Voltages

1.1.14.6.1 The auxiliary equipment shall be designed for the conditions of voltage and frequency mentioned in the Technical Data Sheets of the equipment.

1.1.14.7 Color Standard

1.1.14.7.1 Each equipment shall be painted in accordance with the Standard specified below.

Equipment	*Color*
Outdoor equipment	RAL 7035
Indoor Equipment (including Inside cubicle)	RAL 7032

1.1.14.8 Color and Code of Phase Indication

1.1.14.8.1 Color and code of phase indication shall be as follows:

Phase	Color	Code
First phase	Red	A
Second phase	Yellow	B
Third phase	Blue	C

1.1.14.9 Equipment Number Plates

1.1.14.9.1 The Contractor shall furnish outdoor equipment number plates as required by the NPC. Equipment numbers are shown in the Bid Drawings "ONE LINE DIAGRAM" of each substation/switchyard. The equipment number plates shall be clearly visible to a man standing on the ground even at a distance and shall be made of weather resistant materials. This is in addition to the equipment marking to be supplied by the Contractor as mentioned in Paragraph 1.1.12.2.

1.1.14.10 Phase Indication Plates

1.1.14.10.1 Phase indication plates shall be provided on the substation steel structures to indicate the phases of bus, incoming lines and transformer feeders.

1.1.14.10.2 Color and codes of phase indication plates shall be as follows:

Phase	Color	Code
A - Phase	Red	A
B - Phase	Yellow	B
C - Phase	Blue	C

1.1.14.10.3 The color and code letters shall be luminous and shall be placed at easily recognizable position. The plates shall be made of weather resistant materials.

1.1.15 PROTECTION SYSTEM REQUIREMENTS

1.1.15.1 General

1.1.15.1.1 The supply of the electrical equipment for high and low voltage installation shall be complete to the extent required to put the substation(s)/power plant(s) in satisfactory operating conditions, with all the requirement completely connected and interconnected with operating switches, interlocks, signalization, alarms and metering instruments.

1.1.15.1.2 The Contractor must supply all minor items (such as auxiliary relays, terminal blocks, accessories, etc.) which are necessary although not expressly described in the Technical Specification, in order to guarantee the trouble free operation and ease in the maintenance of the supplied substations/switchyard (or parts of substations/switchyard) with particular reference to the provisions to be taken in order to avoid dangerous or wrong operations.

1.1.15.1.3 The electrical equipment shall be designed in such a way as to bear without damage and permanent deformation the consequences of over-voltage of internal or atmospheric origin and of the short circuit currents within the limits stated in the Technical Specification.

1.1.15.1.4 All the metallic frames of the electrical equipment shall be securely connected to the general earthing system in compliance with accepted Standards.

1.1.15.2 Protection Design Criteria

1.1.15.2.1 The functional requirements of this specification relating to protective relaying shall apply to all equipment on which the protective function is dependent. They shall thus also apply to parts which are not directly related to the protective relays, such as functions in the auxiliary power distribution, interface cubicles, etc., included in the relay protection function.

1.1.15.2.2 Strict demands shall be made on selectivity in isolation. To improve security, protection systems should be designed to isolate only the faulted portion of the network. For faults external to the protection zone, the protection system should be designed either not to operate, or to operate selectively with other systems, including breaker failure.

1.1.15.2.3 All primary faults which are of such magnitude that they jeopardize operation of the grid, which represent a risk to personnel, or which could cause appreciable material damage to plant or to the whole system, shall be isolated or relived of stresses in a controlled way even in the event of a single failure in the relay protection equipment, its supply of measuring quantities, auxiliary voltage, etc., or primary breakers.

1.1.15.2.4 When required, every fault condition shall be detected by at least two fast primary protection systems with different measuring principle.

1.1.15.2.5 Primary and back-up protection, including the auxiliary supply, shall be physically and electrically separated to allow maintenance on one protection without affecting the function of the other.

1.1.15.2.6 To improve dependability, the two protection sets shall be divided into two electrically and mechanically separated parts by means of:

- separated DC power supply
- separated boards

- separate current transformer cores
- separate voltage circuits
- separated tripping devices
- separated cables
- separated relay protection channels (only for lines)

1.1.15.2.7 To improve dependability, each primary protection shall have separate tripping paths to the circuit breaker, that is one primary protection set to actuate trip coil number 1 only and the other protection set to actuate trip coil number 2 only. Cross-tripping is not allowed.

1.1.15.2.8 Each protective relay shall be equipped to indicate the trip on the respective alarm relay rack.

1.1.15.2.9 The protection system shall be arranged for complete subdivision in two parts (relay set 1 and 2). Protective relays belonging to relay set 1 and 2 must not be fitted in a common panel unless otherwise indicated in the Technical Data Sheets of the respective Sections. Communication between the two subdivisions shall be transferred via barrier relays.

1.1.15.2.10 Each feeder shall have a separate protective zone. Each feeder protective relay shall trip only the breaker or breakers associated with that feeder. Selective tripping of all circuit breakers within the protected zone shall be guaranteed.

1.1.15.2.11 All protective relays shall be microprocessor based, numerical design if required, modularized plug-in type and placed in standard 19-inch racks (Other relays, where instructed, shall be mounted on the rear panel of a duplex control switchboard. All accessories necessary for this type of mounting shall be provided with the relays). If required to be coupled to substation control system through a microprocessor-based substation control and protection system, all relays shall be numerical in nature with serial communication facilities.

1.1.15.2.12 The fault detection and maintenance shall be easy. Suitable facilities shall be provided on each measuring relay or system to disconnect the trip outputs, and to subsequently short and disconnect the current transformers. These shall also disconnect any voltage transformer, alarm or critical d.c. circuit, without affecting any other devices. Removal of any relay or system component directly connected to any CT circuit shall short out the relevant CT connection.

1.1.15.2.13 All relays shall be wired and preferably automatically tested at the factory. Plug-in elements shall have reliable devices for fixing them in the service position.

1.1.15.2.14 Breaker failure protection, if required, should be provided to detect stuck breaker condition and initiate tripping of breakers adjacent to stuck breaker, including line remote breaker to improve dependability. DC supplies to the breaker failure protection should be separate from the breaker trip coils dc supplies and from other protection system dc supplies. Generally, only one breaker failure protection system is provided.

1.1.15.2.15 Protection systems should not operate for stable power swings. Also, protection systems should not impose limitations under normal or short-time contingency circumstances.

1.1.15.2.16 To shorten overall operating times, protection schemes should utilize, where required, differential relaying, communication based relaying and instantaneous overcurrent relaying to the maximum possible extent, with due regard to selectivity.

1.1.15.2.17 To improve dependability and security, critical features associated with protection systems and circuit breaker operation should be monitored and annunciated. These features include integrity of power supplies, signal levels, integrity of trip circuits and relay operations.

1.1.15.2.18 If required, sequence of event recorders and oscillographs should be provided to permit analysis of protection system performance during network disturbances.

1.1.15.3 Relay-Setting

1.1.15.3.1 Recommended relay settings shall be issued by the Contractor after being supplied with needed basic data from the NPC.

1.1.15.4 Inter-Tripping

4.1.15.4.1 Breakers in adjacent stations have to be opened when the breaker fails to isolate a primary fault. This tripping of breakers in adjacent stations shall be achieved by direct inter-tripping activated from the breaker failure protection.

1.1.15.5 Relay Indications

4.1.15.5.1 All relay protection shall be provided with resettable visual indicating devices for trip functions in the individual protective relay or group of relays for all protection belonging to a primary object. These indications shall be clearly visible without the need for opening doors, or the like, on the relay cubicles or other enclosures. Indication devices shall be provided for every relay protection. Start indications from time delayed protective relays are required. The faulty phases shall be indicated when the measuring principle in the protection makes this possible. Multi-stage protection shall be designed so that the indications will clearly show the stage which has initiated tripping. Tripping indication shall always be provided, regardless of the duration of the tripping signal.

1.1.15.5.2 The following colors shall be made available for visual indications:

- yellow : start indication
- red : trip indication
- green : auxiliary power

1.1.15.5.3 In addition to the above visual tripping indications, corresponding potential-free contacts shall be available for Sequence of Events (SOE) and alarm panel, and these contacts shall close when visual indication is obtained.

1.1.15.6 Tripping Circuit

1.1.15.6.1 The tripping circuit for the relay protection belonging to relay set 1 and 2 shall be separated both electrically and mechanically. This implies that they must not include common switching devices, connectors, terminal blocks, cables, auxiliary relays, etc. Breakers shall have electrically and mechanically separate tripping coils for relay set 1 and 2. The function must not be jeopardized if both coils receive a trip impulse simultaneously, or if one coil is short-circuited.

1.1.15.6.2 The design in relay set 1 and 2 shall conform with the following stipulations:

- High functional security and speed are necessary in the tripping circuit, and the system design shall thus be such that a minimum of series-coupled elements will be required.

- The tripping circuits shall be supervised both when the breaker is open and closed. The supervision shall include the DC supply, tripping coil, cables (DC supply cable and tripping cable to the breaker). The auxiliary contact for the coil shall also be included in the supervision when the circuit breaker is closed. The alarm shall be time-delayed to prevent it operating during momentary dips in the DC supply. The alarm shall also be inhibited when the circuit breaker auxiliary switch interrupts the trip coil circuit, on circuit breaker opening.

- Each protection dedicated to one unique object shall have its own tripping equipment. Furthermore, each breaker shall have its own tripping circuit for those protection that are common for more than one object, i.e. Breaker Failure Protection.

- There shall be separate equipment for set 1 and set 2.

- The tripping equipment shall have auxiliary relays, which must have an operating time not in excess of 5 ms. These tripping relays shall also be capable of breaking the circuit to the solenoid, even if the auxiliary contact in the breaker should fail to open.

- Trip relays must be immune to operation with wiring capacitive discharge currents in the event of a DC system earth fault.

- Specified lockout relays shall be of mechanically latched type with manual reset.

- The DC circuit used to actuate the tripping relays shall be separate from the DC circuit for the tripping coils.

1.1.15.7 Auxiliary Relays

1.1.15.7.1 General

1.1.15.7.1.1 Auxiliary relays shall be vibration proof and shock-proof. They shall be rated for operation at 125 V dc unless otherwise noted. Both the moving and stationary contacts shall be of silver plated. Each one will close and carry 5 A continuously, or will carry 30 A for one minute.

1.1.15.7.2 Manual Reset Auxiliary Relay

1.1.15.7.2.1 Manual reset auxiliary relay shall be electrically and manually reset, high speed, multi-contact type. The voltage rating of the relay coil shall be such that, with the suitable series cut-off contact furnished, the operating time shall be approximately one cycle. The relays shall have interlocking contacts in the closing circuit of circuit breakers they operate.

1.1.15.7.3 Self-Reset Auxiliary Relay

1.1.15.7.3.1 Self-reset auxiliary relays shall have a dc operating coils corresponding to the DC source specified in the Technical Data Sheets of the equipment and at least three (3) electrically independent, potential-free, normally open contacts.

1.1.15.7.3.2 They shall be suitable for continuous duty and shall have an operating time of about two (2) cycles. The Contractor shall provide at least two (2) spare "a" and/or "b" contacts.

1.1.15.8 Operating and Service Conditions

1.1.15.8.1 The protective and auxiliary relays shall be installed and operated under the following conditions and ratings unless otherwise indicated in the Technical Data Sheets of each protective relay equipment:

Momentary current	:	40 times rated current coil (2 sec) current (5A)
Continuous voltage	:	1.2 times of rated potential coil voltage (115V)
Continuous current	:	2.0 times of rated current coil current (5A)
Make and carry ratings	:	30 amperes for tripping contacts for at least 2000 operation in a prescribed duty (ANSI C37.90-1978)
Insulation	:	2 kV, 60 Hz for 1-minute
Surge withstand capability	:	ANSI C37.90/IEC 60255
Rated frequency	:	60 Hz
1 MHz burst disturbance	:	IEC Publication 60255-22-1 with severity Class III
Electrostatic discharge	:	IEC Publication 60255-22-2 with severity Class III
Radiated electromagnetic field disturbance	:	IEC Publication 60255-22-3 with severity Class III.

The test shall be carried out by using Test Method A and by sweeping through the entire frequency range 27 MHz to 500 MHz

Fast Transient disturbance	:	IEC Publication 60255-22-4 with severity level IV

1.1.15.8.2 The Contractor shall also guarantee that all equipment furnished under the scope of this specification shall meet the performance and rating requirements of this specification while operating within the environmental conditions specified in item A.4, Section E.1.1 of the Technical Data Sheets.

1.1.15.9 Enclosure and Environmental Requirements

1.1.15.9.1 The protective relays shall be enclosed in a free-standing control cubicle with a front hinged-frame suitable for easy installation of functional units, designed for front access.

1.1.15.9.2 The installation dimensions for rack mounted equipment should conform to the 19-inch standard.

1.1.15.9.3 The enclosure shall be designed to have proper ventilation preventing the occurrence over-heating. The ventilation shall be such that rodents and insects entry inside the panel are prevented.

1.1.15.9.4 The degree of protection of relay cases or cubicles shall be minimum IP50. Relays shall be tropicalized and shall have enhanced corrosion protection.

1.1.15.9.5 The enclosure should be provided with a key-lockable full transparent hard plastic protective door mounted on the front of the hinged frame. Equivalent means to protect the individual relays can be provided.

1.1.15.9.6 The enclosure shall be provided with enough space for mounting other ancillary equipment as specified. Unused spaces shall be covered with plates. The rear of the cubicle shall be closed suitable for back to back or back to wall mounting. The inside rear plane shall be provided with a fixed mounting plane for terminal blocks and other accessories.

1.1.15.10 Panel/Cubicle Wiring

1.1.15.10.1 Wires shall be 600 V, stranded copper conductor with thermo plastic insulation and shall comply with the requirements of ICEA Standard No. S-61-402. Minimum size shall be 2.0 sq. mm. or larger for control circuit except annunciator wire which shall be 1.2 sq. mm. or larger. Minimum test voltage shall be 2000 V.

1.1.15.10.2 All cubicle wiring shall be neatly run and securely fixed in such a manner that, wherever practicable wiring can be easily checked against diagrams.

1.1.15.10.3 The wiring between sub-components of a single systems hall be of adequate dimensions. Point to point wiring to fixed terminals shall be used for CT and trip circuits, however, other circuits maybe plug and socket assemblies of adequate design. Wires shall not be spliced or joined between terminal points.

1.1.15.10.4 Soldered or wire wrapped connections shall only be inside electronic systems. Any wire wrapping shall be in accordance with IEC Publication 60352.

1.1.15.10.5 Where provisions are made for the addition of equipment not required initially, means shall be provided for supporting and terminating wiring during the interim period.

1.1.15.10.6 All panel wires shall be identified at both ends with numbered ferrules according to the wiring diagrams. On rack mounted equipment using wrap or soldered connections within the rack and for all telecommunication circuits, color coded details wiring will be acceptable. Include color code details in drawings, where used. Numbered ferrules shall be fitted to all multi-core cable tails.

1.1.15.10.7 Ferrules shall be of insulating materials with glossy finish to prevent adhesion of dirt. They shall not be affected by moisture or oil and shall be clearly and permanently marked. Temporary marking shall not be used.

1.1.15.10.8 All power circuits, control and protection wiring and low level signal wiring shall be physically separated. Separate raceways shall be provided for power cables and the working voltage of each power circuit shall be marked on the associated terminal boards.

1.1.15.10.9 As far as reasonably possible, all outgoing wiring should be grouped by function (CT, VT, Trip, Alarm, etc.) with those going to a common destination allocated to adjacent terminal blocks. Terminal block configuration shall be submitted for approval. Labels shall be provided on the fixed portion of the terminal boards showing the function of the group.

1.1.15.10.10 Connections for indicating instruments and for the telecommunication circuits from transducers or modem outputs shall use individually shielded wire pairs. One (1) extra terminal per pair of terminals, shall be provided to connect this shield to ground.

1.1.15.10.11 If wiring is provided between swinging panels, bundled conductors shall be used on the hinged doors or panels with extra/flexible wire, so arranged that a twisting rather than a bending motion, is imparted to the moving bundled conductors. Each bundle shall be anchored such that the moving bundled length is the maximum available without loops.

1.1.15.10.12 Wiring shall be arranged to give easy access to the terminal or relays and other apparatus.

1.1.15.11 Cubicle Construction

1.1.15.11.1 The cubicle shall be of the type specified in Technical Data Sheets of the individual protection equipment. It shall be of reliable construction, of rugged design and modularized.

1.1.15.11.2 The cubicle shall be made of smooth sheet steel panels with angle or channel frame and with edges bent to 6.0 mm radius, seam-welded at corners and ground smooth. The panels shall be bolted at the bottom to suitable steel channel sills to be furnished as part of this supply. Suitable grounding and anchor bolt holes shall be provided in the channel sills. Butt joints on outside surfaces shall not be permitted. Outside panels shall not be drilled or welded for attaching wires, resistors or other devices where such holes or fastening will be visible from the front of the panel. All screws and bolts used for assembling members and panels and for mounting wire cleats and devices shall be provided with lock washers or other locking devices. Vertical edges of panels shall be formed and bolted together in such a manner that no part of edges are exposed to view. The panels shall not deviate more than 1.6 mm from the true plane. To prevent warping of panels, all heavy devices shall be adequately supported by means of rear mounted brackets or straps.

1.1.15.11.3 The cubicles shall be constructed from a minimum of 2.0 mm sheet steel with edges formed into a rectangular pattern or welded to steel shapes so that each section is rigid and self supporting and enclosed.

1.1.15.11.4 The panels, trim, doors and frames shall match and shall present a neat appearance when assembled. Electrical clearance shall be provided without cutting away the adjacent steel framework. Vents or louvers shall be provided, where required, to give adequate ventilation. All ventilation openings and all opening in the floor shall be provided with screens to prevent entrance of insects and rodents. Thermostatically controlled heaters with switches shall be furnished for prevention of condensation. Heaters shall be suitable for auxiliary power supply specified in the Technical Data Sheets of the telecommunication equipment.

1.1.15.11.5 The design of the cubicle and arrangement of devices shall be such that adequate space is provided for inspection and maintenance of wiring, terminals and equipment. Equipment inside the panels shall be so mounted that the studs of the equipment mounted on the panels will be accessible without removing any device. American Standard device number shall be used and marked on the rear of the panels near the corresponding device. The device numbers shall be marked legibly with permanent marking fluid that will form a contrast with the panel finish.

1.1.15.11.6 The dimensions of a cubicle shall be as follows unless otherwise specified in bid drawings and/or the Technical Data Sheets:

a)	Depth	700	mm (maximum)
b)	Width	750	mm (maximum)

c) Height 2200 mm (maximum)

1.1.15.12 Facilities for Relay Testing and Maintenance

1.1.15.12.1 The design of the protection system shall allow easy maintenance of its functions. It shall be possible to check the operating levels and each of the functions separately. The whole functional unit shall also be able to be tested. All tests shall be performed from the front panel. Provisions for push button functional test of the relay shall also be preferably available.

1.1.15.12.2 An independent test facility for each individual protective relay, although several relays may be connected together in a common cubicle, shall be provided. While one relay is being tested the other relays shall remain in operation.

1.1.15.12.3 The test facilities shall include a permanently mounted test block and shall be paired with a test plug. Switching and isolation of inputs/outputs by means of electrically-operated auxiliary relays is not acceptable. The test facilities may be supplemented by a manually-operated switch, if necessary to comply with all provisions stated below. Details of the test facilities shall be submitted for approval before being used.

1.1.15.12.4 The following shall be accomplished automatically and in a safe sequence, to prevent spurious tripping and ensure safety of personnel, when the test position is selected or when the test plug is inserted into the test block:

a) Isolate the tripping circuits, teleprotection signalling circuits, breaker fail and other circuits which could affect the tripping functions.

b) Isolate the relay under test from the CT circuit while maintaining the CT through connection to other relays or instruments in the series-connected chain without opening the circuit at any instant. This process shall not require the test technician to connect external shorting wires before inserting the plug.

c) Isolate the relay from the VT circuit

d) Isolate DC auxiliary supply (optional)

1.1.15.12.5 A separate single-finger test plug which can be inserted into the test block, to connect a test instrument, to allow measurement of current or voltage magnitudes and phase angles shall also be provided.

1.1.15.12.6 The test plug shall be designed to provide protection to personnel should an open-circuit develop on the external circuit to the test instrument, by shorting the test finger when the voltage across the open CT circuit exceeds a dangerous level not more than 200V.

1.1.15.12.7 Means of allowing secondary injection of test currents and voltages using standard 4-mm banana plugs should be provided on the test facilities.

1.1.15.12.8 Provide monitoring points on the test block/plug to monitor status of test points such as relay starts, phase selection, trips for each phase, and other critical functions by means of contacts to be connected to the test equipment.

1.1.15.12.9 Provide, for each cubicle, a set of test cables with a length of at least 2.5 m, to connect the relay under test to the test equipment. It shall include all the wires to monitor all the circuits and inject currents and voltages as indicated in Paragraphs 1.1.15.12.5 and 1.1.15.12.6.

1.1.15.12.10 Provide diagnostic and extender cards as well as suitable test probes to match internal test points of the relays to facilitate testing and trouble-shooting.

1.1.15.12.11 It shall also be possible to close the cubicle door, even when a block plug is used for disabling operation or tripping of the relay.

1.1.15.13 Current Circuit

1.1.15.13.1 The relay protection shall be designed for a rated current, which corresponds to the secondary rated current of the current transformers. The relay protection shall be dimensioned on current transformers with data in accordance with the apparatus specifications in this documents.

1.1.15.13.2 The current circuit shall be earthed in the junction box nearest the current transformer in the switchgear. In the case of summation of currents by direct galvanic connection, the circuit may only be earthed at one point and in the junction box nearest the current transformers.

1.1.15.13.3 In the first junction box in the substation yard, provisions shall be made for short-circuiting the current circuit in a simple manner. This can be arranged with a suitable design of the terminal block.

1.1.15.13.4 Separate current transformer cores shall be used for relay set 1 and 2.

1.1.15.14 Voltage Circuit

1.1.15.14.1 The relay protection shall be dimensioned on the basis of capacitive voltage transformers with data in accordance with the apparatus specification in this document.

1.1.15.14.2 The secondary windings of the voltage transformers in the various phases shall be interconnected and earthed in the junction box nearest the voltage transformers. The interconnecting and earthing shall be carried out in such a manner that a correct reflection of the primary voltage will be obtained. No earthing, in addition to the above, may be employed in the galvanic connection parts of the voltage circuits.

1.1.15.14.3 The voltage circuit shall be divided into separate groups for relay set 1 and 2. A group for the protective relays must not be used for any other purpose. All subdivisions into groups shall be carried out in the junction box nearest the voltage transformer, where the various groups shall also be individually protected against short circuits with miniature circuit breakers.

1.1.15.14.4 The following general functional requirements shall be fulfilled:

For Miniature circuit breakers:

The miniature circuit breakers shall be placed in the junction box nearest the CVT.

The miniature circuit breaker shall be provided with electromagnetic and thermal protection elements.

The miniature circuit breaker shall have potential free contacts for blocking purpose and signalling.

1.1.15.15 Relay Panel Accessories

1.1.15.15.1 Terminal Blocks

1.1.16.15.1.1 Terminal blocks shall be mounted so as to give easy access to wires terminations and ferrules and shall give a clear view of the arrangement of cable tails. The AC, DC current and voltage transformer inputs shall be separately grouped and adequately protected. Each wire shall be connected to an individual terminal which shall have a clearly lettered marking strip corresponding to the wiring diagram. To allow for extensions and alterations, approximately 25% extra terminals should be provided per terminal block.

1.1.15.15.1.2 Terminal blocks for control wiring shall be rated not less than 30 A, 600V with barriers of the type approved by the NPC.

1.1.15.15.1.3 Isolation-type terminal blocks shall be provided for the auto-reclosing scheme isolation for all external alarms on each panel. Isolation-type terminal blocks for the sequence of events and transient fault recorder terminals shall also be provided. Shorting type of terminal blocks for current circuit isolation to transient fault recorder shall be provided.

1.1.15.15.1.4 Terminal blocks shall not have more than twelve positions per block, shall be rated 600 volts, 30 amperes, shall be one piece type and shall have vinyl marking strips. They shall have terminal screws on both sides; box clamps or saddle clamp terminals are not acceptable. No live metal shall be exposed at the back of the terminal blocks.

1.1.15.15.1.5 Every terminal point shall have individual and complete identification identical to those on the wiring diagrams and shall be acceptable to NPC. Terminals for NPC's external connections shall be arranged for consecutive connections of conductors within one cable. Only one external wire will be connected to each outgoing terminal point. Wires (usually three to five, including ground isolating jumpers) for a given current transformer or voltage transformer circuit shall be connected to a single terminal block; they shall not split between two blocks.

1.1.15.15.2 Nameplates

1.1.15.15.2.1 Each piece of equipment mounted on or inside the panels shall be provided with a nameplate. Nameplate shall be made or laminated black surface, white core micarta or sheet plastic with lettering engraved on the black surface exposing the white core. Single phase items shall be identified by nameplates as to the particular phase in which they are connected. Nameplate size shall be approximately 25 by 75 mm or 50 by 150 mm. The nameplates shall be fastened to the panels with black finished round-head screws. Nameplate design shall be submitted for approval to the NPC, together with samples of engraved nameplates.

1.1.15.15.3 Ground Bus

1.1.15.15.3.1 A ground bus of copper bar not less than 60 sq. mm. shall be bolted to the frame of each of the panel in such a way as to make a good electrical contact. For the relay panels, a ground bus shall be provided along the front of the panel and shall be connected at each panel end to the next panel in the lineup.

1.1.15.15.3.2 The ground bus shall have drilling at each end to permit interconnections with the ground buses in adjacent units. The necessary copper bar jumpers, bolts, nuts and washers for making interconnection shall be furnished.

1.1.15.15.3.3 The ground buses in the relay panels at the left and right ends of the lineup shall be provided with a solder bus clamp type pressure connector for terminating 60 mm^2 of stranded copper ground conductor.

1.1.15.15.4 Interior Lighting and Convenience Outlets

1.1.15.15.4.1 A switch controlled fluorescent lamp shall be installed at the top of each panel for internal illumination. The switch shall be located at a convenient height inside the unit. A duplex convenience outlet with a rating specified in the Technical Data Sheets of the equipment shall be furnished and installed in each panel at a convenient location.

1.1.15.15.4.2 The lamp switch and convenience outlet shall be located near the latch side of the door in single door panels and near the hinge side of a door in double door units. The lamp and convenience outlet shall be wired to terminal block points for connection to a power source specified in the Technical Data Sheets for the equipment.

1.1.16 MISCELLANEOUS

1.1.16.1 Communication

1.1.16.1 For each Local Control Panel in the switchyard (control cubicle of circuit breaker, transformer control cubicle, BCU building (if BCU is required outside of the Control Room) and marshalling kiosk), a telephone connection to the Control Room shall be provided to enable reliable communication with a mobile telephone set at any time.

1.1.16.2 Provisions for Erection and Installation

1.1.16.2.1 All parts of the equipment to be assembled on site must be connected by means of screws and bolts/nuts, welding is not acceptable except for accessories and where expressly stated.

1.1.16.2.2 It must be possible, except in particular cases, to introduce and draw out all the indoor equipment through the doors or opposite opening.

E.1.2: POWER TRANSFORMER

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E.1.2: POWER TRANSFORMER

1.2.0 SCOPE

1.2.0.1 General

1.2.0.1.1 This specification covers the technical and associated requirements for power transformers and accessories for use in electric generating station and/or substation. The requirements of the project are indicated in Paragraph A, Section E.1.1 of the Technical Data Sheets, and the equipment details are in the Technical Data Sheets of Section E.1.2 of the same volume of the Specification.

1.2.0.1.2 It is not NPC's intent to specify all technical requirements nor to set forth those requirements adequately covered by applicable codes and standards. The Contractor shall furnish high quality power transformers meeting the requirements of these specification and industry standards.

1.2.0.1.3 The Contractor shall bear full responsibility that the equipment has been designed and fabricated in accordance with all codes, standards, and applicable governmental regulations and performs under the conditions and to the standards specified herein.

1.2.0.1.4 No departure shall be made from these specification and standards unless waived or modified in writing by NPC. The Contractor shall obtain from its subcontractors a statement as to compliance with this specification without exception and/or if there are any exceptions, these shall be described in detail and included in Contractor's proposal. The Contractor shall add a statement that no other exemptions are taken to this specification.

1.2.0.2 Works to be Provided by the Contractor

1.2.0.2.1 The Contractor shall provide the equipment, accessories and services delineated in Paragraph A.2, Section E.1.1 of the Technical Data Sheets.

1.2.0.3 Works to be Provided by NPC

1.2.0.3.1 NPC shall provide the materials and services listed in Paragraph A.2, Section E.1.1 of the Technical Data Sheets.

1.2.1 CODES AND STANDARDS

1.2.1.1 General

1.2.1.1.1 The equipment furnished shall be in accordance with, but not limited to, the latest issues of the following codes and standards, including all addenda, in effect at time of purchase order unless otherwise stated in this specification:

ANSI/IEEE American National Standards Institute and/or Institute of Electrical & Electronic Engineers

B1.1.a	Metric Translation, Optional Supplement to Unified Screw Threads
B2.1	Pipe Threads (Except Dryseal)

B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800
B16.10	Face-to-face and End-to-End Dimensions of Ferrous Valves
B57.1	Compressed Gas Cylinder Valve Outlet and Inlet Connections
C57.12.00	General Requirements for Liquid-Immersed Distribution, Power and Regulating Transformers
C57.12.10	Requirements for Transformers, 230,000 volts and below; 833/958 through 8,333/10,417 kVA, single-phase, 750/862. Through 60,000/80,000/100,000 kVA, three-phase.
C57.19.00	Standard General Requirements and Test Procedure for Outdoor Power Apparatus Bushings
C57.19.01	Standard Performance Characteristics and Dimensions for Outdoor Apparatus Bushings
C57.19.101	Trial-Use Guide for Loading Power Apparatus Bushings
C57.12.70	Terminal Markings and Connections for Distribution and Power Transformers
C57.12.80	Terminology (IEC76), including Supplement C57.12.80a.
C57.12.90	Test Code for Distribution, Power and Regulating Transformers, including Supplement C57.12.90a.
C57.13	Standard Requirements for Instrument Transformers.
C57.92	Guide for Loading Oil-Immersed Distribution and Power Transformers
C57.98	Guide for Transformer Impulse Tests
C57.106	Guide for Acceptance and Maintenance of Insulating Oil in Equipment
C57.109	Guide for Transformer Through-Fault-Current Duration
C57.110	Recommended Practice for Establishing Transformer Capability When Supplying Nonsinusoidal Load Currents
C57.115	(redesignation of IEEE Std 756, Trial Use May 1984), Guide for Loading Material-Oil Immersed Power Transformers Rated in Excess of 100 MVA (65^0C Winding Rise)
C62.11	Guide for Metal Oxide Surge Arresters for Alternating-Current Power Circuits
C80.1	Specification for Rigid Steel Conduit, Zinc Coated
Z55.1	Gray Finishes for Industrial Apparatus and Equipment (No. 24 Dark Gray and No. 61 Light Gray)
IEEE Std.80	Guide for Safety in AC Substation Grounding
IEEE Std. 979	Guide for Substation Fire Protection
IEEE Std. 980	Guide for Containment and Control of Oil Spills in Substations

ASTM **American Society for Testing and Materials**

A344	Electrical and Mechanical Properties of Magnetic Materials
A153	Zinc coating (hot dip) on iron and steel hardware
B432	Copper and Copper Alloy Clad Steel Plate

NEMA **National Electrical Manufacturers Association**

107	Methods of Measurement of Radio Influence Voltage of High-Voltage Apparatus

ICS **General Standards for Industrial Control and Systems**

MG-1	Motors and Generators
MG-2	Safety Standard for Construction & Guide for Selection, Installation and Use of Electric Motors and Generators

SSPC **Steel Structure Painting Council**

SP1	Solvent Cleaning
SP3	Power Tool Cleaning
PA1	Shop, Filed and Maintenance Painting
PA2	Measurement of Dry Paint Thickness with Magnetic Gages

UL **Underwriters Laboratories, Inc. (all parts apply)**

44	Rubber-Insulated Wires and Cables

IEC **International Electro-Technical Commission**

60044	Instrument Transformer
60071	Insulation Coordination
60076	Power Transformers, Parts 1-5
60060	High Voltage Test Technique
60137	Bushings for Alternating Voltages Above 1000V
60214	On-Load Tap Changer
60270	Partial Discharge Measurements
60296	Specification for unused mineral insulating oil for transformer and switchgear
60354	Loading Guide for Oil-immersed Power Transformers
60542	Application guide for on-load tap-changers
60551	Determination of Transformer and Reactor Sound Levels
60599	Interpretation of the analysis of gases in transformers and other oil-filled electrical equipment in service
60606	Application guide for Power Transformers
60616	Terminals and tapping markings for power transformers
60722	Guide to the lightning and switching impulse testings of power transformers and reactors
60947	Low Voltage Switchgear and Control Gear

NFPA **National Fire Protection Association**

ISO **International Standards Organization**

9001	Quality System Model for Quality Assurance in Design/Development, Manufacture and Testing
9002	Quality System Model for Quality Assurance in Production, Installation & Servicing

1.2.1.1.2 These codes and standards set forth the minimum requirements which may be exceeded by the Contractor, if, in the Contractor's judgment and with NPC's acceptance, superior or more economical designs or materials are available for successful and continuous operation of the Contractor's equipment as required by this specification.

1.2.2 TECHNICAL REQUIREMENTS

1.2.2.1 Description of Services

1.2.2.1.1 The power transformer(s) covered by this specification is (are) for use in a generating station and/or a substation. The application details are stated in the Technical Data Sheets of Section E.1.2.

1.2.2.1.2 Depending on the requirement stated in the Technical Data Sheets of Section E.1.2, the transformer shall be provided either with an automatic fire detection and extinguishing system (Deluge System) according to NFPA requirements to extinguish accidental transformer fire and to prevent occurrence of fire on the adjacent transformer in case of fire from the other, or an equivalent Transformer Explosion and Fire Prevention System utilizing nitrogen gas as a preventive measure in avoiding transformer explosion and ensuring non-occurrence of fire on the transformer and the adjacent equipment.

1.2.2.1.3 The transformer shall be designed and provided with an oil collection pit for oil containment according to NFPA requirements. The oil collection pits of all transformers shall be connected to an oil separation pit.

1.2.2.1.4 Fire wall shall also be provided between transformers, between transformer and structures and/or other inflammable equipment if the clearance is less than what is shown below:

Transformer Capacity	Clearance (m)
above 1 up to 10	below 3
above 10 up to 40	below 5
above 40 up to 200	below 10
Above 200	below 15

1.2.2.2 Design Requirements

1.2.2.2.1 Ratings

1.2.2.2.1.1 Transformer rating, specified in the Technical Data Sheets of Section E.1.2 shall be the basis of the Contractor's guarantee as to performance and temperature rise. The ratings indicated are based on actual load requirements at the service and operating conditions specified herein.

1.2.2.2.2 Voltage

1.2.2.2.2.1 Unit auxiliary transformers and generator step-up transformer shall be designed to withstand the overvoltages for the duration of voltage excursions which may be expected as a result of full load rejection of the generator.

1.2.2.2.2.2. The unit auxiliary transformer shall be able to withstand the short circuit resulting from a secondary external fault on the unit transformer which is accompanied by a rise in generator voltage as specified in the Technical Data Sheets of Section E.1.2.

1.2.2.2.3 Frequency

1.2.2.2.3.1 Frequency for operation shall be 60 Hertz.

1.2.2.2.4 Overload Requirement

1.2.2.2.4.1 The overload rating and operation shall be in accordance with all cyclic loading duties as specified in IEC 60354. The overload capability of any auxiliary equipment such as bushings, LTC's, CT's, oil expansion tanks, leads, etc. shall not be less than the transformer overload rating. If other considerations will limit the overload capability of the transformer, the Contractor shall specify these limitations in his proposal.

1.2.2.2.5 Short Circuit Capability

1.2.2.2.5.1 The transformer, including its accessories such as, but not limited to, bushings, current transformers, tap changers, etc., shall be capable of withstanding the specified short circuit requirements without mechanical deformation or impairing the electrical capabilities.

1.2.2.2.5.2 The thermal and mechanical capability of the transformer and its accessories shall meet or exceed the requirements listed in ANSI C57.12.00, Section 7 or IEC 60076.

1.2.2.2.5.3 The above for unit auxiliary transformers and generator step-up transformers is appended as follows:

a. These transformers shall have increased mechanical and thermal capabilities to withstand three-phase short circuits external to the transformer with the maximum voltage as the driving voltage during the voltage excursions.

1.2.2.2.5.4 For transformer connection of wye-wye-delta or wye/wye-delta, the fault current produced by the short circuit shall be considered to be coming from both HV and LV sides.

1.2.2.2.5.5 The system impedance shall be obtained from the system fault capacity as specified in the Technical Data Sheets of Section E.1.2. The duration of the short circuit is limited to 2 seconds.

1.2.2.2.5.6 The transformer shall be so designed that the final winding temperature T_f reached at the end of the specified short circuit duration shall not exceed 250^0C for aluminum conductors or another temperature stipulated by the Contractor without annealing the conductor, without causing insulation damage and gas generation from oil or solid insulation. It shall be assumed that prior to and after the short circuit, the transformer is loaded at its maximum nameplate rating and the ambient temperature is the specified maximum.

1.2.2.2.5.7 The sudden pressure relay and other alarm initiating devices shall not respond to the effects of the through fault short circuit currents.

1.2.2.2.6 Impedances

1.2.2.2.6.1 Impedance between winding will generally vary with changes of transformer turns ratio. Limitations on this change of impedance shall apply to all fully-rated taps on all mainpower windings, but not to auto-transformers. These limitations are, in part, defined in terms of the tested impedance on the fully-rated tap nearest the middle of the fully-rated tap range. This impedance is called the mid-tap impedance.

a. The percent deviation of impedance on the extreme taps shall not be greater than the mid to extreme tap voltage range expressed as a percentage of rated voltage and the lowest impedance value shall be related to the highest current tap.

1.2.2.2.7 Audible Sound Level

1.2.2.2.7.1 The average sound power level LpA of the transformer shall not exceed the values as specified in the Technical Data Sheets of Section E.1.2 when measured in accordance with the conditions outlined in the latest ANSI/IEEE C57.12.90 or IEC 60076-10.

1.2.2.2.8 Transformer Loss Evaluation

1.2.2.2.8.1 The Contractor is required to fill- in all the information for the transformer losses in the Technical Data Sheets for the transformer in order for the NPC to fully determine the most cost effective of the proposed transformer(s) to be supplied considering both cost of losses and first cost.

1.2.2.2.8.2 Failure of the Contractor to completely fill- in all the information needed for proper evaluation by the NPC shall be a ground for rejection of his bid.

1.2.2.2.8.3 In considering the capitalized cost of transformer losses, and for purposes of comparing bids, the losses will be evaluated using the values ($/kW loss) specified in the Technical Data Sheets of Section E.1.2. In the bid evaluation procedure, each loss evaluation figure listed in the Technical Data Sheets will be multiplied by its respective guaranteed loss value in kilowatts, and the resulting figures will be added to the bid price to give a total evaluated price for bid comparison.

1.2.2.2.8.4 The transformer shall be designed for the most economical loss ratio (copper loss/iron loss) for the application as specified in the Technical Data Sheets for the transformer.

1.2.2.2.9 Tolerances

1.2.2.2.9.1 Values from tests shall meet those specified in the Technical Data Sheets of Section E.1.2 within tolerances stated in standards supplemented as follows:

a. Losses: Core loss after impulse tests shall be the value used in determining performance and shall not exceed the core loss before impulse test by more than 7-1/2 percent.

b. Exciting Current: The percent tolerances from specified values for exciting current shall be the same as those stated in the standards for no-load losses. If the value of the exciting current increase, after impulse tests by an amount 10 percent or more of its value before impulse tests, without an associated increase in core loss, the Contractor shall notify NPC and shall conduct such tests and examination as may be required to assure NPC that a turn-to-turn fault does not exist in the transformer winding.

c. Impedance: When parallel operation with other units is specified in the Technical Data Sheets for the transformer, impedance tolerances stated in standards shall apply to the tap voltages of like turns ratio, in addition to that of the rated voltage.

1.2.2.2.10 Bushings

1.2.2.2.10.1 All porcelains used in bushing shall be wet process, homogenous, and free from cavities or other flaws. The glazing shall be uniform in color and free from blisters, burrs and other defects. All porcelain parts shall be one piece.

1.2.2.2.10.2 The bushings of the same rating shall be interchangeable.

1.2.2.2.10.3 Bushing up to 110 kV BIL shall be porcelain bulk type whereas bushings above 110 kV BIL shall be condenser-type. In the latter case, the bushing shall be provided with capacitance test tap.

1.2.2.2.10.4 Should compound filled condenser type bushings be adopted, provisions shall be made to avoid compound entering the main tank during vacuum treatment.

1.2.2.2.10.5 Bushings shall have the continuous current-carrying capacity necessary to carry the full 65^0C rise current. The bushings shall also be capable of carrying overload currents as required by Paragraph 1.2.2.2.4.1.

1.2.2.2.10.6 Bushings shall be in accordance with ANSI C57.19.01 & 101 or IEC 60137. Strike distance in excess of those to meet the standard will be specified in the Technical Data Sheets for the transformer. (Extra strike distance may be required to accommodate multiple conductor connections, grading rings, heavy buswork, future external CT and isolated phase bus connections).

1.2.2.2.11 External Clearances

1.2.2.2.11.1 External clearances between energized parts and ground, and spacing between adjacent phases shall be coordinated with the transformer internal insulation class. However, when coordination is required with higher insulation levels of other associated substation facilities, the clearance requirements will be specified in the Technical Data Sheets for the transformer.

1.2.2.2.12 Oil

1.2.2.2.12.1 This technical specification apply for the condition of transformer oil at delivery. The oil shall be of such a quality that it is, suitable as an insulant and coolant for transformers.

1.2.2.2.12.2 The oil shall be new and napthenic based mineral oil. It shall be free from moisture, acid alkali and sulfur compounds and shall not form a deposit at normal operating temperature.

1.2.2.2.12.3 Except for inhibitors, no additives are permitted.

1.2.2.2.12.4 The oil furnished shall be compatible with other oils meeting the requirements of ASTM D3487 and this specification. The oil shall be suitable for mixing with other insulating oils in any combination and the mixture shall still meet the required functional properties of this specification. Any reservation to this requirement shall be clearly stated by the Contractor in his proposal.

1.2.2.2.12.5 The oil shall accept 2, 6-ditertiary-butyl-paracresol (DBPC) as an oxidation inhibitor, added as necessary to bring inhibitor content of the oil to the required ASTM D3487,

Type I or II value. The Contractor shall state if any other type of oxidation inhibitor is acceptable and if so, its advantages over DBPC.

1.2.2.2.12.6 The supply of insulating oil per transformer shall include a sufficient quantity to fill the tank and radiators up to the operating level plus an excess of 5%.

1.2.2.2.12.7 The power factor of the oil shall not exceed 0.05 percent at 25^0C or 0.3 percent at 100^0C, as determined by ASTM Test Method D924 (oil samples shall be taken in accordance with ASTM D923).

1.2.2.2.12.8 The oil flow pattern shall exclude turbulence and impinging of oil on any part of the solid insulation system.

1.2.2.2.12.9 Containers for oil shall be so designed that, with the indicated level for initial filling at 25^0C, the oil will not fall below a safe operating level, nor rise to such a height as to overflow or leak. Design shall be for a standard top oil temperature range or greater, if required by the upper and lower limits of ambient temperature specified in the Technical Data Sheets of Section E.1.1.

1.2.2.2.12.10 If the transformer oil will be delivered in containers or drums, these shall be approved by the NPC. The containers and/or drums shall be well-cleaned internally and shall otherwise be in such a condition that there is no risk of endangering the oil quality.

1.2.2.2.12.11 Before delivery, a test certificate shall be submitted to the NPC for approval. The test certificate shall contain result for tests carried out in order to confirm the oil's quality as specified.

1.2.2.2.13 Auxiliary Power and Control

1.2.2.2.13.1 Unless specified otherwise in the Technical Data Sheets for the transformer, the Contractor shall provide two full capacity, independent 460 - 480 volt, 3 phase, 4-wire power supplies for the transformer for its cooling and power requirements and one 125 volts dc supply for the annunciator and any other control requirements. For termination facility see Paragraph 1.2.2.3.9.18. The cooling devices shall be grouped into as many partial capacity groups as there are power supplies provided. Each group shall be supplied from its own power supply during normal conditions. If one supply fails it should be transferred automatically to the remaining power supply. Automatic transfer equipment shall include a time delay relay to prevent immediate transfer from normal to emergency source.

1.2.2.2.13.2 Contractor shall furnish any step-down transformers required for power supply requirements other than stated above.

1.2.2.2.13.3 A separate circuit breaker shall be furnished to supply 230 voltage ac power to all transformer space heaters as well as one 20 watt fluorescent lamp and one duplex convenience outlet 15 A, 250 V, 2-poles in the main control cabinet.

1.2.2.2.13.4 Air circuit breakers shall act as circuit protective devices for all circuits. For feeders, the breaker shall afford both overcurrent and short circuit protection to the conductor.

1.2.2.2.13.5 Circuit breakers shall be manually operated, trip-free, fitted with thermal-magnetic trip elements, auxiliary contacts and shall have the specified interrupting capacity.

1.2.2.2.13.6 DC coils, lamps and other devices shall be designed to withstand the battery equalizing voltage (112%) of battery voltage) continuously without malfunctioning.

1.2.2.2.13.7 All circuit breakers shall comply with IEC 60947-2.

1.2.2.2.14 Use of Inert Gas

1.2.2.2.14.1 Each core and coil unit shall be shipped in an atmosphere of inert gas to prevent moisture absorption. The core and coil shall be shipped as a unit in their tank.

1.2.2.3 Design and Construction Features

1.2.2.3.1 General

1.2.2.3.1.1 All transformers of the same design and rating, furnished on a given order, shall be electrical duplicates, shall have mechanically interchangeable parts and shall be operable in parallel.

1.2.2.3.1.2 Construction of transformer shall provide for successful transportation so that on arrival at destination, transformers shall be in condition for immediate permanent operation after having installed all the accessories and coolant have been added, if required.

1.2.2.3.1.3 Transformer and accessory design, manufacture and assembly shall minimize vibration and shall prevent damage by inherent vibration and stress during operation, transportation and short circuits. If a flood level is specified in the Technical Data Sheets of Section E.1.1, no device, control cabinet, fan, etc. should be located below that level.

1.2.2.3.1.4 Wheels, if specified in the Technical Data Sheets for the transformer to facilitate transformer movement, shall be rust and corrosion resistant and shall be lubricated for the lifetime of the transformer.

1.2.2.3.1.5 The assembled transformer including its accessories shall withstand the wind forces specified in the Technical Data Sheets of Section E.1.1.

1.2.2.3.1.6 Current carrying joints and splices shall be welded, brazed or made by compression fittings so that the contact resistance remains unchanged during the life of the transformer. Soldered connections shall not be used.

1.2.2.3.1.7 All leads not brought directly to bushing terminals or tap changers shall be brought to terminal boards, constructed over insulating material, and substantially and rigidly supported inside of case.

1.2.2.3.1.8 All terminal boards of liquid filled transformers shall have live parts submerged under the liquid and so located that any reconnections can conveniently be made from handhole or manhole with removal of a minimum quantity of liquid. Where compliance with this requirement is impractical due to large clearance and creepage distance necessary with high voltages, the Contractor shall so state in his proposal. There shall be a minimum of detachable fittings and other parts which might come loose and lodge in transformer windings.

1.2.2.3.1.9 The core shall be grounded to the tank cover at one point only through removable links in an appropriate terminal box, placed in an accessible position on the tank cover and

which, by disconnection, will enable the insulation between the core and transformer tank, etc., to be tested at voltages up to 2.5. kV for the purpose of checking deterioration during service.

1.2.2.3.1.10 Jacking facilities shall be in accordance with ANSI C57.12.10 with the locations stated in Paragraph 1.2.2.3.6.8.

1.2.2.3.2 Cores

1.2.2.3.2.1 Cores for the transformer shall be constructed of the highest quality, non-aging high permeability grain oriented silicon steel and the magnetic flux density shall not exceed 1.8 Tesla. The steel shall be in thin lamination, annealed after cutting and rolled to insure smooth surface at the edges.

1.2.2.3.2.2 The laminations must be free from impurities and must receive stress relief treatment after punching. The lamination shall be accurately flattened, especially at the edges and insulated by suitable procedures with long-life heat resistant insulating coat.

1.2.2.3.2.3 Both sides of each sheet shall be insulated with a durable heat resistant insulation. The core shall be held firmly by core clamp and braced to ensure adequate mechanical strength to support the winding and to withstand without damage or deformation, the forces caused by short circuit stresses, transportation or handling to prevent shifting of the core laminations.

1.2.2.3.2.4 The core shall be solidly grounded to the tank and shall be provided with approved lifting devices or lifting lugs at suitable points of the core assembly for core lifting.

1.2.2.3.3 Windings

1.2.2.3.3.1 Windings for the transformer shall be of the best modern design conductor having constant cross-section along the whole windings including those of built-in series reactors, if required particularly for EHV transformer and shall have uniform insulation or graded insulation as required. In case of graded insulation, the AC withstand voltage level for neutral points shall be at least one-third of that as applied for the related line terminals to withstand all AC voltage stresses caused by application of any of the short-time induced AC withstand tests to be performed in accordance with the applicable standard.

1.2.2.3.3.2 All windings and their leads shall be designed and arranged such as to withstand all kinds of transferred over-voltages. Built-in series reactors, if provided, are only permitted to be connected in-line with the leads to the entrances of delta-connected tertiary windings, and they shall be designed and arranged with particular attention to keep all transferred over-voltages as low as possible and to avoid serious resonance. Protective capacitors shall not be provided for any of the windings. Non-linear protective elements in any winding other than the regulation windings are not acceptable.

1.2.2.3.3.3 The design, construction, and treatment of windings shall give proper consideration to all service factors, such as high dielectric and mechanical strength of insulation, coil characteristics, uniform electrostatic flux distribution, prevention of corona formation and minimum restriction to free oil circulation.

1.2.2.3.3.4 Winding conductors shall be free from scale, burrs and splinters and shall be uniformly insulated. Permanent current-carrying joints for splices shall be welded or brazed, properly formed and finished, and insulated to conform to the basic insulation.

1.2.2.4.3.5 The completed winding assembly shall be securely held in place so that there will be no derangement or deformation by stresses incident to shipment.

1.2.2.3.3.6 The completed assembly of core and coils shall be vacuumed dried, immediately impregnated and immersed in dry oil. They shall be adequately braced to withstand ocean shipment, short circuit forces and earthquakes with seismic coefficient specified in the Technical Data Sheets of Section E.1.1. To increase the capability of the transformers of withstanding short-circuits, modern technology in design and construction shall be applied, i.e. by application of a low current density, not exceeding 2.7 A/mm^2 in any part of the windings at rated output, pre-drying and pre-compressing of the windings before mounting onto the core.

1.2.2.3.3.7 The windings shall be designed to permit practically no change or very small change in transformer impedance regardless of tap position.

1.2.2.3.4 Bushings

1.2.2.3.4.1 Each bushing rated below 2000 amperes shall be provided with a single-tang flat-pad terminal. Terminals rated 600 amperes and below shall have two or four hole pads. All others shall have four hole pads drilled in accordance with NEMA CC-1. The width of two hole pads shall be a minimum of 50 mm (2 in.). The minimum pad thickness shall be 6.25 mm (1/4 in.). Terminal construction shall permit terminal rotation round the bushing stud to facilitate connection to the bus.

1.2.2.3.4.2 The terminal pads shall be of high conductivity bronze or copper and shall be plated with hot-flowed electro silver or electro-tin to a thickness of not less than 0.0127 mm (0.005 in.), or an aluminum alloy with hardness Hb minimum of 750 N/mm^2.

1.2.2.3.4.3 Whenever, a larger terminal pad is required for higher current rating, the mounting holes shall conform to NEMA Standards and details of the mounting holes shall be submitted for approval.

1.2.2.3.4.4 All oil filled bushings shall be leak-proof and equipped with an oil level gage. Oil filled bushing may either be the sealed type or provided with an oil sampling drain valve.

1.2.2.3.4.5 All bushings shall be arranged on the tank top cover in such a manner, that removal of the same is possible without lowering of the oil to such a level where the windings are exposed to the atmosphere. Appropriate bushing turrets shall be provided for all of the bushings. Horizontal bushing arrangement is not permitted.

1.2.2.4.4.6 All bushings shall be designed for storage in a horizontal position without any restriction.

1.2.2.3.5 Gaskets

1.2.2.3.5.1 Gaskets shall be unaffected by hot insulating oil, retain their resiliency during the life of the associated equipment, and be unaffected by weather while maintaining oil and gas tightness. Nitrile rubber gaskets are acceptable. Gaskets of neoprene and/or any kind of impregnated/bonded cork or cork only are not acceptable. Gasket flanges shall have grooves or metal stops to prevent overcompression of gaskets. All bolted transformer tank or accessory openings shall be gasketed.

1.2.2.3.5.2 Hatches in the tank cover and sides, intended to be opened a number of times (e.g. connection and inspection hatches), shall have gaskets which can be reused after opening (rubber type, not glued).

1.2.2.3.6 Tanks

1.2.2.3.6.1 All seams required in the fabrication of the main tank, including those for the cover, shall be welded. All joints, which may be opened from time to time in the course of operation, shall be designed to be oiltight in reassembly.

1.2.2.3.6.2 The tank shall be capable of withstanding, without leakage or permanent distortion, an internal gas pressure of 1 kilogram per square centimeter (measured at the top of the tank) and a vacuum of 76 cm of mercury and shall be designed and constructed for vacuum filling in the field.

1.2.2.3.6.3 The transformer tank and its accessories shall be designed without pockets wherein gas may collect. For bushing turrets, etc., pipes shall be provided to vent the gas into the main expansion pipe. The vent pipes shall have minimum inside diameter of 25 mm.

1.2.2.3.6.4 All valves, fittings and pipings shall be designed and constructed for such vacuum filling.

1.2.2.3.6.5 The upperside of the tank shall be designed in such a way as to avoid water deposits on top of the tank.

1.2.2.3.6.6 Covers for manholes and handholes shall be provided with two lifting handles each.

1.2.2.3.6.7 The tank shall be provided with the fabricated or structural steel base designed and built to allow skidding or moving on wheels or rollers. The wheels or rollers, if required in the Technical Data Sheets of Section E.1.2 can be turned at right angle, thereby eliminating the need for a traverser for turning the transformer.

1.2.2.3.6.8 The jacking pads provided for the transformer tank shall be located at least 300 mm above the service level with the open space in front of the attaching plates or pads at least one meter above the service level.

1.2.2.3.6.9 Oil conservator or expansion tanks shall be of rugged design and of sufficient capacity to maintain an oil seal through a standard top oil temperature range or greater, if required by the upper and lower limits of ambient or water temperature specified in the Technical Data Sheets for the transformer. Each such tank shall be equipped with a weatherproof silica gel breathers in which only blue silica gel (pink colored when wet) has been filled as a dehydrating agent, an oil level indicator easy to see from the ground level with alarm contact for the low level and with isolating cock and a sump with a drain valve. Pipe connection between main transformer case and conservator or expansion tank shall include a shutoff valve to limit circulation of oil, and shall be arranged with a flanged joint or pipe union connection between main transformer case and shutoff valve. Conservator or expansion tanks shall be mounted so as to permit their removal.

1.2.2.3.6.10 A vacuum application valve and vacuum equalizing valves, one for diaphragm and one for LTC conservator, shall be installed at a convenient floor height between the air expansion pipes to the silica gel breathers.

1.2.2.3.6.11 The pipes connecting the conservator to the main tank shall be provided with:

a. a Buchholz relay with alarm and trip contacts for transformer main conservator which shall be free from operation due to vibration and pump surges (if transformer is provided with forced oil cooling)

b. an adequate isolating valve for each relay on conservator side, easily accessible from tank cover, to permit the removal of each relay

1.2.2.3.7 Filter Sampling and Drain Connections

1.2.2.3.7.1 Drain filter and sampling valves shall be provided as specified in ANSI C57.12.10, except for the following:

- Any pockets or loops provided for collecting moisture (such as in conservator type transformer), shall be equipped with suitable draw-off valves, located at the lowest points of the pockets or loops.

1.2.2.3.7.2 All drain and oil sampling, filling and filtering valves as well as vacuum application and vacuum equalizing valves shall be mounted at convenient floor height and shall be equipped with rigid padlocking facilities and padlocks provided with master key system separate for each transformer unit.

1.2.2.3.8 Radiators and Coolers

1.2.2.3.8.1 Self-cooled or forced-cooled transformers shall be equipped with removable radiators or coolers for heat radiation. Clearances shall permit painting and maintenance of tank, tubes, and radiators. Radiators and coolers shall be designed to withstand the same pressures and vacuum as the main tank.

1.2.2.3.8.2 Removable radiators and coolers shall be fastened to transformer case with bolted flange connections. The cooling fins of the radiators shall have a nominal width of not less than 470mm. The nominal sheet steel thickness of the radiator walls shall not be less than 2.0 mm. The radiator fins shall be welded with stiffening rods, horizontally and diagonally, to prevent vibration during operation of the transformers. It is to be considered that the distance between horizontally arranged bracing straps shall not exceed 100 cm and diagonal stiffening rods shall be welded between all of the horizontally arranged bracing straps. Butterfly valves, or other suitable devices shall be provided to permit the ready installation and removal of radiators, and drainage of oil from radiators without drawing oil from the transformer tank. Radiators and coolers shall be equipped with lifting eyes, and so designed that they may be handled without the addition of special bracing. Cooler units shall be of corrosion resistant metals and shall be designed to permit replacement of individual cooler tube groups. Welds shall be smooth to facilitate cleaning.

1.2.2.3.8.3 Forced-cooled transformers shall be provided with at least two completely independent groups of cooling equipment. The forced-cooled ratings should be obtained by the use of single stage fans (Class OA/FA) or two stages fans (Class OA/FA/FA), single stage fans and oil pumps (Class OA/FOA), or two stages fans and oil pumps (Class OA/FOA/FOA or OA/FA/FOA) or any combination thereof as specified in Paragraph B.1.1, Section E.1.2 of the Technical Data Sheets. However, the number of fans shall not be less than eight (8) fan units.

a. Each cooler pump combination for FOA, FOW, and OA/FOA/FOA types shall be mounted independently of the other and provided with valves on the tank side so that each cooler can be removed or replaced while the transformer remains in service.

b. Cable leads to cooling fans and pumps shall be connected to the power source through weathertight and vibration resistant plugs and connections in such a manner that the leads may be easily removed without shutting down the complete power source

c. For transformers with two stages of cooling, it should be that the transformer self-cooled "OA" rating be increased by 33.3% and 66.6% respectively with the addition of forced cooling units.

d. The forced cooling system of the transformer shall be designed in such a way that the loss of any two fans, or any fan plus any oil pump, or any oil pump plus any water pump shall not reduce the output of the transformer by more than 20% with temperature rise maintained within specified limits.

1.2.2.3.8.4 Indicating shutoff valves shall be located at the inlet and outlet connections to the transformer and shall be welded directly to the tank. No gasketed joints are allowed between the shutoff valves and the tank.

1.2.2.3.8.5 Valves shall be located between the transformer tank and the pump and between the pump and radiator or cooler to permit pump removal without draining oil from the radiator, cooler or tank. The valves used shall be of a type which offers a minimum restriction of oil flow and shall be provided with an adjustable stuffing gland.

1.2.2.3.8.6 Oil tight blank flanges shall be provided for all valves for use when oil lines are disconnected (e.g. valves at coolers, sample valves, fill valves, etc.).

1.2.2.3.8.7 The fan motors and pump motors shall be totally enclosed, suitable for operation in wind-driven rain. Motor bearings shall be designed for continuous as well as intermittent duty. The bushings and bearings shall withstand end thrust, when required.

1.2.2.3.8.8 Fan and pump motor leads shall be a part of the motor assembly and shall be weatherproof or totally enclosed in flexible weatherproof conduit and shall terminate in a weatherproof, locking type plug and receptacle located near the motors. The motor supply circuits shall then be routed to the cooling equipment control cabinet through rigid galvanized steel conduit.

1.2.2.3.8.9 Design of pumps shall be such that it will preclude any possibility of air infiltration into the insulating oil. Protective measures must also be made to prevent impurities due to pump wear. Simultaneous operation of oil pumps either starting or stopping, shall not cause any misoperation of the fault pressure relay and/or Buchholz relay.

1.2.2.3.8.10 Fans mounted off the horizontal shall be provided with a "rain shield" mounted on the motor shaft where it emerges from the motor housing. Fan blades shall be of SUS 316 stainless steel or aluminum alloy and shall have surfaces designed to keep fan noise to a minimum. Fan blades of any kind of plastics are not acceptable. Mechanical protection against touching of the fan blades shall be provided by galvanized round wire mesh guards on both sides of the fan blades.

1.2.2.3.8.11 The forced-cooling equipment shall include protective and control devices (Paragraph 1.2.2.4.2.6) assembled in a single control cabinet.

1.2.2.3.8.12 Circuit breakers shall be provided for manual switching of each cooling group. Fuses are not acceptable.

1.2.2.3.8.13 All cooling units shall be identical and interchangeable with one another.

1.2.2.3.9 Auxiliary Power and Control Wiring

1.2.2.3.9.1 Power and control wiring shall be 600 volt, 2.0 mm. sq. minimum, 7 strand, copper wire with heat, moisture and flame resistant cross-linked polyethylene insulation or alternate acceptable to NPC. The flame test shall be conducted in accordance with UL 44, Section 85. Where flexibility is required, 19 strand wire shall be used. Wiring shall be free of abrasions and tool marks. All wiring shall be adequately supported to prevent sagging and breakage caused by vibration in transit. Minimum bending radius of the wires shall not be less than 4 times its overall diameter. All wiring shall be brought out to a control terminal cabinet (see Paragraph 1.2.2.3.9.18).

1.2.2.3.9.2 Wire shall be of adequate rating for the current to be carried. All current transformer and cooling control circuits shall use nothing smaller than No. 8.0 mm.sq. wire with copper tape shielding and cooling control circuits shall use nothing smaller than 3.5 mm. sq. wire. On other circuits except current transformer secondary circuits were maximum current does not exceed 5 amperes, No. 2.0 mm.sq. wire may be used.

1.2.2.3.9.3 No overheating of the conductor itself or of insulation damage to adjacent conductor shall occur when current transformer secondary conductors carry 100 amperes for one second. For wires associated with dc and ac control circuits, the short circuit current value is 5000 amperes and 5000 amperes rms symmetrical, respectively, and the time interval is 0.016 seconds.

1.2.2.3.9.4 Wiring shall not be affected by transformer oil or its fumes.

1.2.2.3.9.5 Separate terminal blocks shall be provided for power and control wiring with metal barriers in both fixed and removable sections to separate the two wiring classes. They shall be rated not less than 25 amperes, 600 volts. Each terminal block shall be provided with barriers, marking strips and terminal screws. Each terminal point shall be marked with the designation shown on Contractor's wiring diagrams. Each terminal block, for external cable, shall have 12 points and 2 points out of these twelve shall be spares for NPC's future used. Terminal blocks shall be located so that they are accessible and in full view.

1.2.2.3.9.6 The Contractor's wiring shall be terminated on terminal blocks or on equipment terminals with insulated terminals. Spade or intended spade-type terminals with insulation grip shall be used. Ring-type terminals of approved type will also be acceptable. Splicing of wires is not acceptable.

1.2.2.3.9.7 No solder or "push-on" or "quick" type connectors shall be used in connection with any wiring.

1.2.2.3.9.8 Control wiring will be No. 3.5 mm. sq. or No. 2.0 mm. sq. stranded copper cables, terminated with terminals similar to those described above. CT secondary cable will be 8.0 mm. sq. with copper shielding unless otherwise specified.

1.2.2.3.9.9 Terminals for external connections shall be arranged for consecutive connection of conductors within one cable. Not more than one external wire will be connected to each outgoing terminal point.

1.2.2.3.9.10 In the Contractor's internal wiring, not more than one wire shall be connected to one terminal block point, except where jumper wires are needed, in which case two wires may be connected for internal wiring.

1.2.2.3.9.11 If accidental short circuiting of certain wires can result in malfunction of equipment, such as closing or tripping of a breaker, these wires shall not be terminated on adjacent terminal board points.

1.2.2.3.9.12 Detail wiring diagrams shall be made using a cross-indexing notation.

1.2.2.3.9.13 All current transformer terminal blocks shall have shorting provisions with all parts provided with the terminal blocks. Short circuiting of any of the terminals of any one current transformer shall not short circuit the terminals of any other current transformer. Current transformer cables shall have a sufficient service loop so as not to interfere with removal of other devices in cabinet.

1.2.2.3.9.14 Each current transformer circuit shall be arranged and terminated for external connections, as a two wire circuit and each set arranged with Phases 1, 2, 3, N from top to bottom, left to right, front to back.

1.2.2.3.9.15 Required grounding of each circuit shall be by connection to the internal ground bus, provided by the Contractor.

1.2.2.3.9.16 Wire raceway space around terminal blocks shall have a minimum cross section of 100 cm. sq. which shall be equally distributed on both sides of the terminal blocks for ease in terminating the wires.

1.2.2.3.9.17 All power and control wiring external to the control cabinets shall be installed by the Contractor in non-corroding metal cable raceway systems. When not feasible, flexible conduit may be used.

1.2.2.3.9.18 The Contractor shall provide a weatherproof terminal cabinet for terminating all external auxiliary wiring. This cabinet shall be provided with external sunshade sheets of stainless steel rigidly fixed by appropriate spacers in a certain distance not exceeding 20 mm around the cabinet and onto front door. The bottom of the terminal cabinet shall be equipped with removable blank cover plate on which four (4) knock-out type holes suitable for 80 mm rigid steel conduit shall be provided. Sufficient length of this rigid steel conduits shall be included in the scope of supply by the Contractor.

1.2.2.3.9.19 Space heaters shall be provided in each cabinet, including cabinets for annunciator and potential devices. The heaters shall be sized to provide a minimum temperature rise of 5^0F above ambient temperature. Low-high temperature alarms shall be provided as well as high temperature cut-off. Heaters should be protected against unintended touch.

1.2.2.3.9.20 All equipment installed in the cabinets shall be designed for a cubicle inside temperature of at least 70°C. Grounding wires for cabinets and related doors shall be of highly flexible stranded copper having a cross section of at least 14mm^2.

1.2.2.3.9.21 Rigid pockets (drawing holders) for storing all related drawings shall be securely fixed on the inner side of the front doors of the cabinets.

1.2.2.4 Relays, Instrumentation and Control

1.2.2.4.1 General

1.2.2.4.1.1 The Contractor shall provide all standard relays, instrumentation and control as well as the equipment specified hereunder. Whenever specified, the Contractor shall provide alarm contacts and shall wire them to the annunciator specified in Paragraph 1.2.2.4.2.7.

1.2.2.4.2 Relays and Instrumentation

1.2.2.4.2.1 Buchholz Relay

1.2.2.4.2.1.1 If a conservator tank is used, a Buchholz relay shall be mounted in the pipe connecting the conservator to the transformer tank.

1.2.2.4.2.1.2 This relay shall have two sets of contacts, completely and electrically isolated from each other. One set is intended for alarm and shall close for slow gas flow. The other is intended for transformer tripping or de-energization and shall close for rapid gas flows and oil rushing resulting from heavy fault. Contacts shall be ungrounded, normally open.

1.2.2.4.2.1.3 This relay shall be so arranged and designed that its active parts are accessible for inspection, repairs and replacement even when the transformer is in operation, and shall be of the type that will not operate during earthquake having seismic coefficient value specified in the Technical Data Sheets of Section E.1.1.

1.2.2.4.2.2 Sudden Pressure Relay

1.2.2.4.2.2.1 A sudden pressure relay shall be provided when required in the Technical Data Sheets of the transformer or elsewhere in the specification. This shall detect rapid rise of pressure rather than absolute pressure and shall react faster than the pressure relief valve to sudden abnormally high pressures.

1.2.2.4.2.2.2 When mounted below minimum oil level, it shall not be affected by the normal internal pressure fluctuation caused by the operation of the oil pump.

1.2.2.4.2.3 Gas Monitoring System

1.2.2.4.2.3.1 When specified in the Technical Data Sheets of Section E.1.2, the transformer shall be equipped with an Intelligent On-Line Continuous Gas-in-Oil Incipient Fault Monitor and shall include an Intelligent Transmitter with no moving parts and pumps to detect and continuously monitor possible existence of composite value of hydrogen, carbon monoxide, acetylene and other form of gases in the insulating oil. It shall also include a communication controller, to provide remote and local communications, dual level visual alarm indicators and continuous ppm display. The sensing instrument shall be suitable for tropical climate with high humidity and ambient temperature of up to 55^{o}C. All accessories necessary to have this device operate in extremely hot and humid climate shall be provided. The device shall operate on a system voltage specified in the Technical Data Sheets of Section E.1.2. The device shall provide visual indication and/or operate a closing contact to initiate an alarm when the percentage of total combustible gas reaches a predetermined level (adjustable).

1.2.2.4.2.3.2 The monitoring system shall be mounted in a suitable location with no internal restriction or in a place where good convection flow exists. It shall not be affected by vibration and oil flow surges resulting from operation of oil coolers.

1.2.2.4.2.4 Pressure Relief Device

1.2.2.4.2.4.1 A pressure relief valve shall be provided as a standard protective measure for the main tank. Two (2) pressure relief valves shall be provided for transformers with a rating greater than 50 MVA. It shall open and close automatically to prevent excessive pressure rise in the transformer tank.

1.2.2.4.2.4.2 Pressure relief vents for pressure relief valve shall be provided on both main tank and diverter switch compartment. The vents shall have the highest part not less than the height of their conservators and shall be designed to have the vent outlets face toward the ground with the height about 50 centimeters above the ground level in order to protect splash-over of oil in case the pressure relief valve is operated.

1.2.2.4.2.4.3 The device shall be provided with weatherproof hand reset contacts for tripping.

1.2.2.4.2.5 Oil and Winding Temperature Detector

1.2.2.4.2.5.1 When specified in Section E.1.2 of the Technical Data Sheets, winding hot spot temperature detectors of the copper resistance type 10 ohms at 25°C or equivalent shall be furnished together with necessary accessories arranged for remote indication for use with a temperature monitoring/recording equipment. The heater for the detector shall be connected to the secondary of a current transformer winding and shall be located in the oil near the top of the transformer. Leads from RTD's and/or from thermocouple, shall be brought out to terminal block(s) for Contractor's terminal connections. The Contractor shall supply description and details of the winding temperature detector equipment.

1.2.2.4.2.6 Cooling Control

1.2.2.4.2.6.1 The type of automatic cooling control, and characteristics of electrical circuit for motor drive shall be as specified in the Technical Data Sheets for the transformer. Control design features, unless specified otherwise in the Technical Data Sheets, shall be as follows:

a. One winding temperature replica shall be furnished to measure the winding temperature in each two winding transformer with capacity lower than 50 MVA. For transformer with capacity higher than 50 MVA, two (2) sets of winding temperature replica, one (1) for HV winding, the other for LV winding with their contacts in parallel shall be required. For three winding transformers, one simulator for each of the windings shall be furnished. Temperature simulator for three-phase transformers shall be responsive to loads on the center phase. Each simulator shall be furnished complete with associated equipment, including current transformer, heater well assembly, temperature detector and necessary wiring and capillary tubing. The dial indicators shall be accurate within 2 percent of full scale over a range of 150°C.

b. Hot spot temperature contacts shall be furnished as follows:

1. One contact to start the first set coolers
2. One contact to start the second set of coolers, if two step cooling is required
3. One back-up contact to start both sets of coolers, if the normal starting control failed
4. One contact for alarm
5. One contact for trip

c. Top oil temperature contacts shall be furnished as follows:

1. One contact to stop the second set of coolers, if two step cooling is required
2. One contact to stop the first set of coolers
3. One contact for alarm
4. One contact for trip

1.2.2.4.2.6.2 One or more manual power selector switches shall be mounted on the transformer to permit the use of each cooler group for either the "Run", "Energizing" or the "Thermal" sequence. The switches shall be located so that they may be operated without opening the control cabinet.

1.2.2.4.2.6.3 Alarm contacts (wired to the annunciator) shall be provided to indicate failure of the control sequence or power supply for each cooler group.

1.2.2.4.2.6.4 When a one step automatic control is specified for forced cooled transformers, all cooler group motors shall be connected to start simultaneously.

1.2.2.4.2.6.5 If two stages or steps of cooling is specified in the Technical Data Sheets of Section E.1.2, then the following should be observed by the Contractor:

First sequence when output of transformer reaches OA rating at temperature T_1 for first stage cooling	-	half of the cooling units should start simultaneously
Second sequence when output of transformer reaches FA or FOA or FOW rating at temperature, T_2 for second stage cooling	-	the remaining half of the cooling units should start simultaneously; the back-up contact should function at this temperature, if the normal stage cooling process is not successful.
Third sequence at temperature T_3	-	an alarm will be activated
Fourth sequence at higher temperature, T_4	-	tripping function should activate

With temperature decreasing, the third and fourth sequence contacts shall open within 5^0C below the closing values.

1.2.2.4.2.6.6 For forced oil-cooled transformer one oil flow indicator shall be installed in the oil line adjacent to each oil pump. Alarm contacts shall be provided which will indicate failure of the

oil pump to operate when the cooling equipment is energized. A time delay shall be provided to prevent unnecessary operation of the alarm during pump starting.

1.2.2.4.2.6.7 Each group of fans and pumps shall be provided with a common circuit breaker for short-circuit protection (this is in addition to overload protection of individual motors) and a common magnetic contactor. Each contactor shall have two spare auxiliary contacts, field adjustable to normally open or normally closed.

1.2.2.4.2.6.8 Each contactor coil circuit shall be protected by a separate thermal-magnetic circuit breaker. The circuit to coil leads shall be brought to a separate set of terminals in the control cabinet.

1.2.2.4.2.6.9 Cooling equipment groups for the transformer unless otherwise specified in the Technical Data Sheets of Section E.1.2, shall operate in parallel from the same power source with means provided to de-energize and isolate one group while the others remain in operation.

1.2.2.4.2.6.10 Each motor shall be provided with an overload protection device with adjustable current setting range(manual reset type).

1.2.2.4.2.6.11 All pressure relief devices shall be furnished with alarm contacts wired to the annunciator specified below.

1.2.2.4.2.7 Annunciator

1.2.2.4.2.7.1 When specified in the Technical Data Sheets of Section E.1.2, the Contractor shall furnish a solid state annunciator in a separate NEMA Type 3R cabinet. The rain hood shall prevent entrance of rain at a level higher than the lowest live part. The cabinet shall contain for the annunciator externally operable lamp test and reset controls; two external indicating lamps and one nameplate for each alarm point; and a thermostatically controlled cabinet heater. The annunciator shall have alarm retransmitting contact with reflash capability, all wired to terminals to permit easy grouping and connection by NPC (for Supply Contract) or Contractor (for Turnkey contract) to remote annunciator panel in the control room.

1.2.2.4.2.7.2 Transparent window shall be provided in the control cabinet in order that all individual trouble indicated on the annunciator panel can be visualized without opening the control cabinet cover. Spares completed with accessories of four annunciator windows shall be provided in addition to the windows required.

1.2.2.4.2.7.3 When any trouble contact is closed, the corresponding auxiliary relay of at least two independent contacts, one for signal lamp on annunciator panel and the other for remote indication shall be energized and self-held which shall be reset by the reset push button only if fault has cleared.

1.2.2.4.2.7.4 Separate terminals shall be provided for each contact for remote indication.

1.2.2.4.2.7.5 If there are more than one fault occurring simultaneously, windows shall be annunciated correctly and only a fault that has been cleared can be reset with the reset push button.

1.2.2.4.2.7.6 The tripping circuit part shall be independent from the annunciator circuit part in order that tripping is still possible while annunciator circuit is off.

1.2.2.5 Accessories

1.2.2.5.1 General

1.2.2.5.1.1 The Contractor shall furnish all standard accessories as well as the equipment described herein.

1.2.2.5.2 Spill Gaps and Arresters

1.2.2.5.2.1 When specified in Section E.1.2 of the Technical Data Sheets, surge arresters and spill gaps shall be provided.

1.2.2.5.2.2 Spill gaps of rugged design shall be incorporated in the transformer assembly on the exposed terminals designated in the Technical Data Sheets of Section E.1.2. Taps shall be mounted that bushing weather casing, gage glass, seal, or any other equipment or parts of the transformer shall not be damaged in the event of a flashover of the gaps. Spill gaps shall be rod gaps of standard design. Design of gaps, settings, and method of mounting on the transformer shall be those which have proven satisfactory in service and shall be subject to review by NPC. Ranges of adjustment and factory settings shall be in accordance with the following tabulation for the insulation levels of the respective windings.

Winding Insulation BIL kV	Spill Gap Settings Millimeters (Inches)		
	Adjustable		Factory Setting
	From	To	
95	25.4 (1.0)	101.6 (4.0)	63.5 (2.5)
110	38.1 (1.5)	114.5 (4.5)	76.2 (3.0)
150	76.2 (3.0)	152.4 (6.0)	114.3 (4.5)
200	127 (5.0)	228.6 (9.0)	152.4 (6.0)
250	177.8 (7.0)	279.4 (11.0)	203.2 (8.0)
350	254.0 (10.0)	457.2 (18.0)	304.8 (12.0)
450	330.2 (13.0)	609.6 (24.0)	406.4 (16.0)
550	406.4 (16.0)	711.2 (28.0)	520.7 (20.5)
650	508.0 (20.0)	889.0 (35.0)	660.4 (26.0)
750	635.0 (25.0)	1016.0 (40.0)	762.0 (30.0)
825	685.8 (27.0)	1168.4 (46.0)	838.2 (33.0)
900	787.4 (31.0)	1270.0 (50.0)	914.4 (36.0)

1.2.2.5.2.3 For a BIL up to and including 200 kV, exposed gaps shall be of double series gap type or equivalent to minimize interference from birds, and settings shall be adjustable in steps not greater than 6.35 mm (1/4 inch). For a BIL above 200 kV, gaps shall be adjustable in steps not greater than 12.7 mm (1/2 inch). On multiple series gaps, the sum of the separate gap setting shall equal the tabular settings. Spill gaps shall not be furnished for windings rated greater than 245 kV, unless otherwise specified in the Technical Data Sheets of Section E.1.2.

1.2.2.5.2.4 Surge arresters shall be supplied in accordance with ratings and requirements specified in the Technical Data Sheets of Section E.1.2. Arresters will be mounted by NPC on brackets furnished by the Contractor and attached to the main tank at locations convenient to the associated bushing.

a. When surge arresters are mounted on the transformer, all hardware and tubing for connecting arresters to bushing terminals shall be provided by the Contractor. Connections between transformer bushings and surge arresters shall be sized to carry the full rating of the transformer continuously.

b. The height of the bracket shall be adjusted so that the top of the arrester is at about the same elevation as the bushing terminal, but such that the lowest porcelain will be at least 2300 mm (7 ft. 6 in.) above the base of the transformer.

1.2.2.5.3 No-Load Tap Changer

1.2.2.5.3.1 When specified in Section E.1.2 of the Technical Data Sheets, tap changers shall be mechanically and electrically rugged, arranged to provide for convenient inspection and maintenance without necessity for untanking and provided with an external mechanism for manual operation. The tap changer, as well as the arrangement of leads and connections thereto, shall be designed for transient voltage conditions. The external mechanism shall be protected against authorized operation and provided with positive indication of the tap in use and so located that it may be observed without need for unlocking the mechanism. Its location shall be on the wall of the tank so that inspection is permitted without de-energizing any circuit.

1.2.2.5.3.2 To prevent mis-operation of the off-load tap changer while the transformer is still energized, two (2) sets of interlocking contacts, one for alarm and the other for tripping-off the circuit breaker with the provision that the circuit breaker shall be tripped before the possible operation of the off-load tap changer, shall be provided. The interlocking mechanism shall be provided with steel cover and/or padlock.

1.2.2.5.3.3 The tap changing mechanism shall be designed so that they can be operated conveniently by a man standing on the same level as the transformer base, and shall include an operating handle, indicating pointer and dial and means for locking the tap changer in any desired position. The locking device shall be arranged to prevent locking the tap changer in an intermediate position.

1.2.2.5.3.4 The mark to indicate the position of the tap changer shall also be provided at the transformer tank where the tap change mechanism shall enter the transformer tank, so that if the shaft linkage is broken or loosen, the top position is evident.

1.2.2.5.4 On-Load-Tap Changing Equipment

1.2.2.5.4.1 When specified in the Technical Data Sheets for the transformer, the on-load-tap changing equipment shall consist of a tap selector with change-over switch and a rotary diverter switch of the high speed transition resistor type (principle Dr. Jansen), a motor driven mechanism, as well as automatic control devices suitable for remote operation. All equipment related to LTC shall come from original LTC manufacturer. Licensee products are not acceptable. The mechanical and electrical requirements for arc interruption, compartmentation, automatic control, parallel operation with similar transformers, instrumentation, accuracy and burden of instrument transformers shall be those specified in ANSI C57.12.10 or IEC 60542. The oil in the switching compartment shall be kept separated from the oil in the main tank.

1.2.2.5.4.2 Overall design shall be simple and rugged, with arcing contacts suitable for long life. It shall be mechanically capable of performing 500,000 operations, and the tap changer contacts shall be capable of performing 200,000 operations at full load without parts having to be replaced or rebuilt, and at least 50,000 operations without maintenance required. Each

completely assembled tap changer shall be capable of withstanding, in any tap position, without damage the maximum short circuit stresses which would be imposed upon it when the transformer itself is subjected to short circuit currents in accordance with the requirements of ANSI C57.12.00 and Paragraph 1.2.2.2.5 of this specification. Overload currents allowed for the transformer shall be matched by the LTC, i.e. the permissible continuous through-current at rated switching capacity shall correspond at least to the current for long time emergency cyclic loading as specified in IEC 60354 at highest current tap.

1.2.2.5.4.3 The moving contact assembly shall be self-aligning and when in closed position, heavy contact pressure shall be applied. All current carrying parts shall be of sufficient area and cross section to insure that the temperature rise does not exceed 10^0C above adjacent bushing standard temperature under full load conditions. For star-point applications, the tap changing device shall be designed to withstand the applied potential tests of the winding to which it is connected; and for all applications where LTC are connected directly to the line terminals of any of the windings (e.g. in auto-transformers) they shall be insulated for at least two basic impulse insulation levels (BIL) higher than that as specified for the related line terminals.

1.2.2.5.4.4 In case of non-linear protective elements and/or tie-in resistors being provided, this shall be clearly indicated in the connection diagram. In case of tie-in resistors being provided at the middle of any regulation winding, they shall be connected via potential switches to the take-off terminal of the tap changer so that power dissipation only occurs during the short potential switch operation time. Any resistor made of graphite elements will not be accepted.

1.2.2.5.4.5 The LTC equipment shall provide a range of requlations and percentage of each step as specified in the Technical Data Sheets of Section E.1.2.

1.2.2.5.4.6 Local and remote control and indication for the LTC equipment shall be furnished.

1.2.2.5.4.7 The design of the tap changing equipment shall be such that the mechanism will not stop in any intermediate position, however, if the mechanism through faulty operation does stop in an intermediate position, full load must be carried by the transformer without injury to the equipment.

1.2.2.5.4.8 The mechanical position indicator shall be equipped in the motor drive cubicle. The LTC motor shall be designed to be of step control, which in any case the operation shall be of step by step.

1.2.2.5.4.9 The LTC shall be provided with overcurrent protective device in order to prevent the tap-change operation during a short circuit, which would too greatly stress the contacts of the diverter switch.

1.2.2.5.4.10 A voltage regulating relay shall also be supplied together with the timer and undervoltage relay which would signal and execute the tap changer operation when the regulating voltage is out of the voltage regulating level and shall be designed to be delayed by the timer with the setting time of 0-60 seconds.

1.2.2.5.4.11 The LTC circuit of the transformer shall be completely designed and provision shall be made for future parallel operation with another transformer, if required in the Technical Data Sheets of Section E.1.2.

1.2.2.5.4.12 The Contractor, if so stated in the Technical Data Sheets, shall supply a complete transformer operations control system mounted on an indoor free standing cabinet or a 19-inch standard rack equipped with the following control and protective devices, as a minimum;

a. tap changer control plug-in module comprising of:
   - "remote automatic", "local automatic", "manual", "off" selector switch
   - "raise/Lower" control switch
   - digital tap position indicator

b. microprocessor based voltage regulating unit following the step-by-step principle and comprising of:
   - overvoltage detection and automatic return control
   - undervoltage and overcurrent blocking
   - line drop compensation
   - load shedding capability

c. Parallel control device for automatic synchronized control of tap changers following the principle stated in the Technical Data Sheets of Section E.1.2 and suitable for the required number of transformers to be operated in parallel as specified in the Technical Data Sheets.

d. Temperature and gas monitoring devices

The function of the transformer operation control system panel shall be incorporated in the microprocessor-based substation control system (MBSC) for the substation, if required in the Technical Data Sheets of Section E.1.2.

1.2.2.5.4.13 In addition, the Contractor shall furnish and mount the following control devices in the transformer control cubicle:

a. "Remote-Local-Test" selector switch (push-button of Paragraph 1.2.2.5.4.13 (a) can be operated only in the test position;

b. "AUTOMATIC-MANUAL" control switch;

c. "RAISE-LOWER" control switch of automatic or spring returned type to an intermediate "OFF" position for manual control of the motor-operated tap changer;

d. Tap position receiver indicator. The tap position shall be indicated by..IL, N, IR;

e. Under voltage relay and timer for voltage regulating relay

f. Three-phase under voltage relay for AC supply

g. Under voltage relay for DC supply

h. Control and auxiliary relays

i. Voltmeter

1.2.2.5.4.14 The Contractor shall also furnish and mount the following control devices on the LTC driving mechanism:

a. "RAISE-LOWER" push-buttons;

b. Means for manual operation when power supply is lost;

c. Tap change operation counter with two sets of 5 digits registering number, one set for registering the accumulated number of tap change performed and another set with resetting knob for possible recount of tap change performed.

d. Step by step operation control devices;

e. LTC parallel operation checking device provided for possible future installation of other identical LTC power transformer;

f. Device for transmitting the tap changer position to the tap position receiver indicators located at the transformer control cubicle and remote transformer operation control system located at the control room;

g. Multi-tap resistor device with number of taps equal to number of required tap positions for possible remote tap position indication by telemetering through the tap position indication by telemetering through the tap position transducer;

h. Hand lamp controlled via door switch;

i. Space heater with thermostat and humidity control.

NOTE: Any alternative provision for possible remote tap position indication by telemetering may be considered if it complies with the NPC's requirement and shall be subject to NPC's approval.

1.2.2.5.4.15 The motor drive mechanism shall be housed in a weatherproof and corrosion-proof steel compartment or cast aluminum which will contain all the necessary devices to perform the proper tap changer operation both for local manual and automatic remote transfer operation.

1.2.2.5.4.16 Space heaters shall be located in the lower portion of the control housing with connections made from below to minimize deterioration of supply wire insulation. The space heaters shall be encased in an electrical insulating sheath. The surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheath or other components in the housing. The thermostats in the heater circuit shall be adjustable from 5^0C to 25^0C.

1.2.2.5.5 Anti-Earthquake Clamping Device

1.2.2.5.5.1 To keep the transformer from moving during earthquake, the Contractor shall provide a clamping device which is fixed to the foundation. The bolts for this clamp will be embedded in the concrete foundation so that the transformer, when positioned properly, maybe fixed securely. The transformer can be fixed to, or unfastened from these bolts as desired.

1.2.2.5.6 Oil Filter Units

1.2.2.5.6.1 If required in the Technical Data Sheets of Section E.1.2, stationary oil purification plants for drying and cleaning of the insulation oil in intermittent operation shall be provided for all on-load tap changers connected to line terminals of auto-transformers.

1.2.2.5.6.2 The oil filter unit shall comply with the required technical characteristics specified in the Technical Data Sheets of Section E.1.2.

1.2.2.5.6.3 There shall be no air bubbles in the filtered oil return from the filter units to the OLTC so that the units can be operated when the OLTC is in service.

1.2.2.5.6.4 The oil filter unit shall be automatically operated after each tap change operation. The operating time for the pumps shall be adjustable from 10 to 180 minutes. Moreover, an integrated time switch shall control the pump units in intervals of two hours per day independent of switching operations.

1.2.2.5.6.5 The oil filter unit shall be of integral type, each having pump and filter element combined in one filter tank. The filter tank shall be fixed at the transformer tank on suitable mounting brackets at an approved location. The filter tank shall be equipped with a pressure gauge with contact, temperature compensated by serial oil temperature switch, for initiating of a signal in case of overpressure. The filter tank cover shall be removable for a ready access to each filter unit for inspection and replacement.

1.2.2.5.6.6 The pumps and filter elements shall be designed to operate with high temperature oil (approx. 100°C) and shall not react with mineral oil. The filter elements shall be of the combined type to remove any solid foreign substances and water in the oil. The feed and return pipes of the filter tanks shall have minimum 25 mm inside diameter with standard flange connectors to be connected to the filter unit via isolating valves. Appropriate oil sampling valves shall be provided between the isolating valves and the oil filter units. Suitable air release and drain plugs shall be provided for each filter unit.

1.2.2.5.6.7 The oil filter unit shall include a weatherproof and corrosion proof control cabinet, rigidly framed and fabricated from 2-mm minimum thickness sheet steel.

1.2.2.5.6.8 All electrical components necessary for the proper operation and supervisory control of the oil filter unit including power connections shall be housed in the control cabinet.

1.2.2.5.6.9 The control cabinet shall be suitable for mounting on the transformer tank and shall not be affected by the vibration caused by the operation of the cooling units of the transformer. It shall be vermin proof, dust proof and weatherproof. Suitable door gaskets made of rubber shall be provided to prevent the ingress of moisture etc.

1.2.2.5.6.10 Access to all compartments shall be provided by hinged doors. Bolts or carriage keys shall not be used to secure the panels or doors. All fastenings shall be integral with the panel or door and provision shall be made for padlocking. Sufficient openings in the base of the control cabinet shall be provided for the incoming cables and entrance shall be accomplished using glands to fix and seal the cubicles.

1.2.2.5.6.11 The cubicles shall be furnished with space heaters with thermostat setting as well as one 20-watt fluorescent lamp and one duplex convenience outlet with rating specified in the Technical Data Sheets of Section E.1.2. The heaters shall be sized to provide minimum temperature rise of 5°F above ambient temperature. Low-high temperature alarm shall be

provided as well as high temperature cut-off. A manually 2-pole operated disconnect switch shall be provided to open and close both sides of the circuit for maintenance purpose.

1.2.2.5.6.12 Grounding terminals shall be provided at the bottom of all the panels for earthing. It shall be suitable for accepting 100 mm^2 stranded copper conductor.

1.2.2.5.7 Silicagel Breathers

1.2.2.5.7.1 The conservator vessel shall be fitted with two parallel breathers in which only blue silicagel (pink colored when wet) has been filled as a dehydrating agent. The containers for the dehydrating agent and the oil trap shall not be of transparent plastics.

1.2.2.5.7.2 The parallel breathers shall be connected to the air expansion pipes via two-position three-way valves with captive screwed caps. The three-way valves shall control the breathers in such a manner that each of the two parallel breathers can be in service while the other breather is in stand-by position, i.e. it must be possible to switch-off each of the two parallel silica gel breathers of the same group individually while the other one is still in operation. Any position other than specified above shall be mechanically interlocked.

1.2.2.5.7.3 In view of the excessive humidity, the breathers shall be larger in size and shall be provided with oil trap. The silica gel filling capacity of each breather shall be dependent on the size of the transformer (each having a silicagel filling capacity of minimum 3 kg for LTC conservators, 4 kg for main conservators of transformers up to 25 MVA per unit and 6 kg for transformers up to 100 MVA per unit, and minimum 8 kg for transformers above 100 MVA per unit shall be provided). The silica gel breathers and the three-way valves shall be rigidly fastened at an accessible position in a convenient floor height. For this purpose, the breathers shall be also fixed onto the tank by solid mounting brackets at the lower ends.

1.2.2.5.8 Transformer Explosion and Fire Prevention System

1.2.2.5.8.1 If required in the Technical Data Sheets of Section E.1.2, the transformers shall be equipped with Transformer Explosion Prevention and Fire Prevention/Protection System. The system shall be complete in all aspect to perform the required functions and shall include not only of the transformer tank explosion prevention and fire protection but also of the on-load-tap changers and the oil bushings or oil cable boxes using the principle of Rupture Disk with Integrated Explosion Detector coupled with Nitrogen Injection.

1.2.2.5.8.2 For power transformer having the oil filtration or filter units for the OLTC, the same shall be included in the explosion prevention and fire protection system for the transformer. The system shall ensure a complete protection for the transformer tank, on-load-tap changer, oil bushings and the oil filtration units from any explosion in case of occurrence of any kind of short-circuits.

1.2.2.5.8.3 The principle of operation shall be such that in the event of high intensity fault resulting to excessive energy or dielectric oil overpressure, the system shall initiate the depressurization process. This is done with the activation of the rupture disk with an explosion detector which shall then give the high pressure information when short circuit occurs. Immediately after depressurization, nitrogen flow shall forbid the self-inflammable gases contact with air (oxygen). However, nitrogen injection process shall operate only with the presence of the following signals:

a. The activation of any of the integrated rupture disk explosion detector confirming the overpressure state and the beginning of the depressurization process; and

b. The activation of any of the electrical protection signal, confirming the electrical fault of the protected transformer.

1.2.2.5.8.4 The system operation shall be properly coordinated with the required input to avoid mal-operation and malfunction of the total system. Activation of only one signal among the conditions stated in Paragraph 1.2.2.5.8.3 shall prevent the operation of nitrogen injection process and shall only generate remote annunciation/signal at the control room. Only at the presence of both signals shall the electrical actuator triggers the nitrogen injection process.

1.2.2.5.8.5 The nitrogen injection function shall:

a. immediately stop the explosive and flammable gas production (hydrogen, methane, acetylene, etc.);
b. evacuate the explosive hydrogen stocked in the tank upper parts;
c. replace the generated explosive and flammable gases by a nitrogen atmosphere inside the vessel;
d. avoid air-oil contact by slightly pressurizing the transformer with nitrogen gas;
e. limit the damage caused by temperature gradient in the metal parts;
f. completely cool down the transformer by injecting nitrogen at the required time (normally 45 minutes) to bring the short-circuited parts temperature down below the oil flash point.

1.2.2.5.8.6 It shall be that when the system operates, the oil from the conservator will be automatically isolated from the main tank and the OLTC, preventing the drawing of the oil from the main tank and the OLTC. Means shall also be provided in preventing the contact of air with the explosive and flammable gases before its evacuation towards a draining pit located at appropriate location. In case of oil flow, during the activation of the system, the system shall drive the oil straight inside the oil duct.

1.2.2.5.8.7 The design of the nitrogen injection process shall also include manual activation of the nitrogen in the event that the DC power supply source for the Transformer Protector System fails.

1.2.2.5.8.8 All alarm signals associated with the Transformer Protector System i.e., AC, DC power supply failure, nitrogen cylinder low pressure alarm, system actuation audible alarm, etc shall be sent to the control room at the control board annunciator system.

1.2.2.5.8.9 For substation being controlled with Microprocessor Based Substation Control (MBSC) System, these alarms shall be incorporated and interfaced with the MBSC. The design of the schematic diagram and logic for the Transformer Protector System shall be incorporated in the MBSC and can be accessed in the Operator Machine Interface (OMI) screen of the MBSC. It shall be possible that when the system operates, important action such as, isolation of conservator tank, injection of nitrogen, etc. can be monitored in the screen of the OMI.

1.2.2.5.8.10 The design of the transformer protector system shall be such that in maintaining the power transformer, the system can be isolated without affecting any of its components. All accessories necessary for this purpose shall be included in the scope of supply for the transformer protector system.

1.2.2.5.8.11 If required in the Technical Data Sheets of Section E.1.2, the explosion and fire prevention shall be backed up with a Nitrogen Fire Extinguishing System known as the "Drain and Stir" System. The principle shall consist of injecting nitrogen at the transformer base to extinguish the fire.

1.2.2.5.8.12 Just like the Explosion and Fire Prevention System, injection of nitrogen can be activated only in the presence of the following signals:

a. The activation of any of the fire detector confirming the occurrence of fire; and

b. The activation of any of the electrical protection signal, confirming the electrical fault of the protected transformer.

1.2.2.5.8.13 The system operation of the backup system shall be properly coordinated with the required input to avoid mal-operation and malfunction of the backup system. Activation of only one signal among the conditions stated in Paragraph 1.2.2.5.8.12 shall prevent the operation of nitrogen injection process and shall only generate remote annunciation/signal at the control room. Only at the presence of both signals shall the electrical actuator triggers the nitrogen injection process.

1.2.2.5.8.14 Fire detectors for the backup system, shall be located at appropriate location in the tank, OLTC, oil bushings and oil filter units (if oil filter units is required for the transformer).

1.2.2.5.8.15 The design of the whole system shall be submitted to the NPC for review and approval before any manufacturing has to be done for the Transformer Explosion Prevention and Fire Protection/Prevention System.

1.2.2.5.8.16 All devices, required fittings, piping, control cabinet, detectors and accessories necessary to fulfill the function of a complete Transformer Explosion and Fire Prevention System and the Backup System shall be furnished and included in the cost of the transformer.

1.2.2.5.8.17 The Transformer Explosion Prevention and Fire Protection/Prevention System shall be suitable for outdoor installation and shall not be affected by the operating environmental conditions specified in the Technical Data Sheets of Section E.1.1.

1.2.2.5.9 Other Accessories for the Transformer

1.2.2.5.9.1 In addition to the accessories mentioned above, the following shall also be included in the scope of supply for the transformer:

1. Oil level gauges with low level alarm contacts for main conservator and diverter switch conservator;
2. Oil temperature – oil level curve plate;
3. Separate ground terminal connectors of bolt fastened type provide for the following:
   a. LV lightning arresters
   b. TV lightning arresters
   c. Neutral bushing
   d. Tertiary bushing for grounding purpose (if any)
   e. Transformer Tank

NOTE: The ground terminal connectors shall be suitable for the grounding cable that will be applied by the Contractor, but should not be less than 100mm^2. Depending on Contractor's option, all ground leads shall be insulated ground wire, or combination of insulated ground cable from the arresters down to the operating counters and 30 x 5 mm copper bar fixed by porcelain insulators on the transformer tank for the rest. All ground leads shall be connected from the above mentioned equipment to ground terminal connectors.

4. Handholes and/or manholes for servicing. Dimensions to be provided by Contractor for NPC's approval;
5. Suitable pulling eyes and lifting lugs in addition to the jacking pads;
6. Lifting device fixed on transformer tank for lifting-off the LTC; and
7. Removable step ladder which can be attached and bolted on the transformer tank for servicing the transformer.

1.2.2.6 Equipment Marking

1.2.2.6.1 In addition to the provisions of Paragraph 1.1.12 of the General Technical Requirements, Section E.1.1, plates made of corrosion-proof material rigidly supported shall be supplied as specified hereinafter. Nameplates mounted outdoor shall be of polished stainless steel of top quality only (background clear, engraving black, depth of engraving 0.5mm). Nameplates mounted inside control and marshalling cubicles may be of material in accordance with manufacturer's standard, e.g. glass-fibers reinforced synthetic resin subject for approval by the NPC. All plates other than those located on tank cover shall be easily and clearly legible from ground level.

1.2.2.6.2 In general, the following nameplates for the transformer shall be provided:

- A rating plate. The transformer's nameplate shall contain the information outlined in ANSI C57.12.00, Paragraph 5.1.2.

- A connection diagram showing in an approved manner the internal connections and the vector relationship of the several windings and, in addition, a plan view of the transformer giving the correct physical relationship of the terminals.

- A diagram plate indicating the oil levels in the conservators dependent on the oil temperature.

- A plate showing the location and function of all valves and air release cocks, plugs and all monitoring equipment in the plan view and in different elevations of the transformer. This plate shall also warn the operator to refer to maintenance instructions before applying vacuum treatment and not to operate vacuum application and vacuum equalizing valves after oil filling under vacuum.

- A loading plan plate showing transport dimensions and masses. This plate shall also warn the erection staff, not to remove any cover before filling the tank with oil to such a level where the windings are not exposed to the atmosphere. This plate shall be fixed directly onto the transformer tank and shall not be removed for transport.

- Identification plates, alpha-numerical numbered in an approved manner, for all fans, marshalling cabinets, breathers, valves, cocks, accessories etc. (minimum size: 110 mm x 50 mm) rigidly fastened by rivets on corrosion proof base plates. In addition, the function (description) of the related devices shall be clearly indicated on these plates. The alpha-numerical numbers on the identification plates shall be of such a size as to be clearly legible from the floor level.

- Plates showing all control, measuring and monitoring circuits and terminal blocks. These plates shall be rigidly fixed at the inner side of the hinged door of the concerned marshalling kiosk.

- Plates showing the control circuit/block diagram of the LTC. These plates shall be rigidly fixed at the inner side of the hinged door of the motor drive cubicle.

1.2.2.7 Other Technical Requirements for the Transformer(s)

1.2.2.7.1 Other features for the transformer, if required by the NPC are stated in the Technical Data Sheets of Section E.1.2.

1.2.3 INSTALLATION

1.2.3.1 Installation will be by the Contractor unless specified otherwise in Paragraph A.2, Section E.1.1 of the Technical Data Sheets.

1.2.3.2 When the installation is by Contractor, such as for turnkey contracts complete details of proper handling, transport and storage, installation, testing and commissioning, performance, guarantees, etc. shall be provided for NPC's review and approval.

1.2.4 FACTORY ASSEMBLY AND TESTS

1.2.4.1 General

1.2.4.1.2 Each transformer shall be completely assembled and adjusted at the factory and given the manufacturer's routine shop tests and also other test as specified herein. All parts shall be properly marked for ease of assembly in the field. All tests required herein shall be witnessed by the NPC or his authorized representative unless waived in writing, and no equipment shall be shipped until released for shipment by the NPC or his authorized representative.

1.2.4.1.2 The test equipment, test methods, measurements and computations shall be in accordance with the latest applicable requirements of ANSI C57.12 and/or IEC60076.1 Parts 1-5, except in cases where otherwise set forth, and shall be subject to the approval of the NPC.

1.2.4.2 Shop Tests

1.2.4.2.1 Routine, design, "other" tests and optional tests, if specified in Section E.1.2 of the Technical Data Sheets, shall be performed in accordance with ANSI C57.12.00 and ANSI C57.12.90 and/or IEC 60076, except as modified by the requirements of the following paragraphs. If a transformer fails to pass the tests specified, additional tests shall be made to

locate the failure, and after reconstruction, testing shall be repeated to prove that the rebuilt transformer meets the specification in all aspects.

1.2.4.2.2. The standard tests are modified and supplemented as follows:

1.2.4.2.2.1 No-load loss and exciting current shall be measured from 90 to 120 percent of rated voltage in 5% intervals, and a respective magnetizing curve shall be drawn and added to the test report. No-load loss shall be measured at rated voltage both before and after impulse tests. Also refer to Paragraph 1.2.2.2.9 for tolerances.

1.2.4.2.2.2 Temperature rise test shall be performed as specified with all current carrying accessories (CT, etc.) in place. Tap connection(s) giving the highest winding temperature rise shall be used. In case of auto-transformers, the winding temperature rises shall be determined in the applicable highest current taps each for both, the common and the series winding. In case of any kind of forced air cooling the bottom oil temperature shall be measured only in headers affected by the forced cooling. The oil temperatures shall be measured at the inlets and outlets of the headers of the coolers by thermo-couples installed directly in the oil-flow. Measurements of top oil temperatures taken in pockets shall be corrected by +3 K independent on the applied standard. Measurements on radiator/cooler walls are not acceptable.

1.2.4.2.2.3 If allowed in Section E.1.2 of the Technical Data Sheets, duplicate temperature rise tests will be acceptable only to transformer having a maximum cooled rating capacity lower than 100 MVA and on the evidence that the total average losses do not exceed 105 percent of a previously tested and accepted duplicate unit. The Contractor shall submit the serial number, rating, a copy of the test report for the duplicate unit and justification as to classifying it as a duplicate. No duplicate temperature rise tests will be accepted for transformer having a maximum cooled rating capacity greater than 100 MVA. Temperature rise test shall be performed on each transformer with a capacity greater than 100 MVA.

1.2.4.2.2.4 If winding temperature equipment are specified, data shall be included for calibration of hottest spot temperature indicator. These tests should be conducted on each phase at the highest and lowest rating.

1.2.4.2.2.5 Temperature rise tests shall include a thorough examination of the tank wall surfaces to detect hot spots during the temperature tests.

1.2.4.2.2.6 During temperature rise tests of generator step-up transformer, the top of the tank temperature in the vicinity of the low voltage bushing outside where the isolated phase bus ducts join the transformer shall be taken and these locations shall be marked permanently so that they can be repeated with the bus installed.

1.2.4.2.2.7 The zero sequence impedance (when transformer design results in a zero sequence impedance different from that of the positive sequence), insulation power factor, and capacitance for each winding to ground and between windings shall be measured and recorded.

1.2.4.2.2.8 Impulse tests, if specified in Section E.1.2 of the Technical Data Sheets, shall be applied in accordance with ANSI C57.12.00 and C57.98 and/or IEC 60076-3 and the procedure outlined in the following paragraphs and shall be officially witnessed by NPC's representatives. No impulse voltage application shall be made to transformer prior to tests officially witnessed by NPC's representative without specific written approval by NPC.

1.2.4.2.2.9 Nothing in the preceding paragraph shall be construed to preclude or prohibit the Contractor from making other impulse tests in addition to those specified in Section E.1.2 of the Technical Data Sheets, provided:

a. The conditions of Paragraph 1.2.5.4.5.1 are carried out and impulse test record logged as specified in Paragraph 1.2.4.2.3.

b. Prior to shipment, the Contractor shall submit to NPC satisfactory evidence, by wave comparison or other means, that the transformer has not been injured thereby

1.2.4.2.2.10 During impulse and switching surge tests, cathode-ray or approved computerized oscillogram shall be made of the currents in grounded ends of windings being tested.

1.2.4.2.2.11 During each impulse test, spill gaps shall be temporarily removed from the terminal or terminals to which impulse voltage is to be applied.

1.2.4.2.3 Impulse Test Log

1.2.4.2.3.1 The Contractor shall maintain a complete log of all impulse voltage applications to transformer terminals, including all preliminary or calibrating tests as well as final tests. This log shall include a record of the nature of each test, oscillogram identification, test gap settings, connection of all transformer terminals, atmospheric conditions, number of waves and values of voltage applied, timing of wave and a record of any observed evidence of flashover of gaps, bushings, protectors in the test circuit, and any disturbance, or test failure, interior or exterior of the transformer. This log of impulse test circuit drawings shall be available to NPC at all times.

1.2.4.2.3.2 A cathode-ray oscillogram or an approved computerized oscillogram shall be taken of each impulse voltage applied to transformer terminals, including all preliminary or calibrating tests, as well as final tests. All oscillogram negatives, including oscillogram of current in windings tested, shall be permanently available for NPC's examination at Contractor's plant and the Contractor shall deliver copies of this file to the NPC.

a. When reproduced in report form, they shall be neatly presented and arranged so that the necessary comparisons between reduced and full magnitude waves can be conveniently made from the report

b. The amplitude of each test wave on the oscilloscope shall be adjusted to vie as large a deflection as possible. The waves intended for comparison shall be of identical amplitude.

c. The effect of internal surge limiting devices on the oscillographic record also shall be pointed out

1.2.4.2.3.3 A description, including drawings of the general test setup, comprising impulse generator, the circuit constants used for the terminals under test, and the connection of windings not tested shall be submitted to NPC.

1.2.4.2.4 If one-hour low-frequency induced dielectric test is required in Section E.1.2 of the Technical Data Sheets, the transformer should be connected as for service and the tap changer shall be adjusted such that the ratio for primary and secondary winding is as close as possible for the related highest system voltages for equipment, and the test shall comprise applying or inducing $\sqrt{3}$ times the highest system voltage for equipment / $\sqrt{3}$ (against ground) to the

transformer terminals for 120 x (rated frequency)/ (test frequency) seconds (but not less than 15 seconds), after which the test voltage should be reduced to 1.5 times the highest system voltage for equipment / √3 (against ground) and held for one hour. Partial discharges should be monitored continuously throughout the test and recorded every five minutes and should not exceed a mean value of 300 pC during the last 60 minutes of test. Continuous discharges of short duration and at irregular intervals can be accepted up to 500 pC provided that there is no increasing tendency.

1.2.4.2.5 The sequence of specified tests shall be as follows:

1.2.4.2.5.1 Short Circuit Capability

1.2.4.2.5.1.1 If required in Section E.1.2 of the Technical Data Sheets, this test shall be performed whenever the testing facilities are suitable for full scale test. If such full scale test is not feasible, a model test shall be performed.

1.2.4.2.5.1.2 If tests are not specified, the Contractor shall submit his related design criteria, short circuit effects calculations and design countermeasures for NPC's review.

1.2.4.2.5.1.3 Test reports on duplicate transformers lower than 100 MVA rating are acceptable, unless tests are specified. The validity of these test reports shall be justified by Contractor's analysis submitted together with the test reports for NPC's review.

1.2.4.2.5.2 Losses (no-load and load) concurrent with exciting current and impedance.

1.2.4.2.5.3 Temperature rise tests at all types of cooling (For auto-transformers one-hour tests for determination of the winding temperature rises shall be conducted each in the applicable highest current taps for both, the common and the series winding).

1.2.4.2.5.4 Switching Impulse Tests

1.2.4.2.5.5 Lightning Impulse: The following test procedure shall be applied for all transformers independent on the applied standard:

a. one 50 – 70% full impulse (lines and neutral)
b. one 80% full impulse (lines and neutral)
c. one 100% full impulse (lines and neutral)
d. one 50 – 70% chopped impulse (line terminals only)
e. two 110% chopped impulses (line terminals only)
f. two 100% full impulses (lines and neutral)
g. one 80% full impulse (lines and neutral)
h. one 50 – 70% full impulse (lines and neutral)

Tests impulses for reference as per item b. g. and h. are required only for winding where non-linear protective elements are installed in the regulation windings and/or LTC. Test impulses on neutral points shall be applied directly on neutral terminals with all line terminals grounded.

1.2.4.2.5.6 Repeat of no-load losses and exciting current

1.2.4.2.5.7 Noise-level test (special test on one unit)

1.2.4.2.5.8 Low frequency dielectric tests:

a. applied potential test

b. short-time induced AC voltage withstand test in accordance with IEC 76-3 or ANSI equivalent and monitoring of partial discharges. On transformers which have more than one non-uniformly insulated winding, the voltage on the neutral shall be raised by application of a bias voltage by connection of an auxiliary booster transformer to the terminals in question to achieve tests voltages on the line terminals of all non-uniformly insulated windings under tests as assigned in the relevant tables of IEC 76-3 and the tap changer shall be adjusted accordingly. On single-phase units, this auxiliary transformer may be another unit of the same transformer type related to the three-phase bank in question.

c. one-hour low frequency, induced voltage dielectric and partial discharge test

1.2.4.2.5.9 Insulation power factor and capacitance tests at 10 kVac

1.2.4.2.5.10 Tests for unintentional core grounds at 2500 Vdc, 60 sec. to be performed immediately after completion of all other shop tests.

1.2.4.3 Other Tests

1.2.4.3.1 In addition to the tests mentioned above, other equipment attached as an accessory to the transformer, i.e. bushing current transformers, potential device, arresters, etc. shall be tested in accordance with the tests mentioned on the applicable provisions for each of the equipment.

1.2.4.4 Failure to Meet Guarantees

1.2.4.4.1 Losses

1.2.4.4.1.1 If the transformer losses, as determined by test, at rated voltage, frequency and 100% rated KVA (on principal tapping) exceed the guaranteed total losses, the excess in losses shall be evaluated at the following rates and the resulting amount shall be deducted from the contract price.

$$S = 2\,[(N_{L\text{-}L})\,(N_{LM1}\text{-}N_{LG1}) + (L_L)\,(L_{LM1} - L_{LG1}) + (Aux_{L1})(Aux_{LM1} - Aux_{LG1}) + (Aux_{L2})\,(Aux_{LM2} - Aux_{LG2})]$$

where:

S	=	amount to be deducted from contract price expressed in US $
$N_{L\text{-}L}$	=	price in US$/kW for the no-load losses as stated in Paragraph B.9 of the Technical Data Sheets
L_L	=	price in US$/kW for the load losses as stated in Paragraph B.10 of the Technical Data Sheets
Aux_{L1}	=	price in US$/kW for the auxiliary cooling losses for stage 1 cooling as stated in Paragraph B.9 of the Technical Data Sheets
Aux_{L2}	=	price in US$/kW for the auxiliary cooling losses for stage 2 cooling as stated in Paragraph B.9 of the Technical Data Sheets

N_{LM1}	=	measured no-load losses expressed in kW
N_{LG1}	=	guaranteed no-load losses expressed in kW
L_{LM1}	=	measured load losses expressed in kW
L_{LG1}	=	guaranteed load losses expressed in kW
Aux_{LM1} kW	=	measured auxiliary cooling losses for stage 1 cooling expressed in
Aux_{LM2} kW	=	measured auxiliary cooling losses for stage 2 cooling expressed in
Aux_{LG1} in kW	=	guaranteed auxiliary cooling losses for stage 1 cooling expressed
Aux_{LG2} in kW	=	guaranteed auxiliary cooling losses for stage 2 cooling expressed

1.2.4.4.2 Temperature Rise

1.2.4.4.2.1 The temperature rise of windings shall be determined by type tests. If, according to the results of the tests carried out within the scope of the contract, the measured temperature rise exceeds the guaranteed value, the price for all transformers of the same type to be paid to the Contractor shall be reduced by a compensation for decreased life expectancy. The compensation shall be computed as follows:

Temperature rise over the permissible limit K (°C)	Compensation of percent of the total FOB price for the transformer
0-1.99	0
2-2.99	4.5
3-3.99	9.0
4-5.00	13.5

1.2.4.4.3 Rejection

1.2.4.4.3.1 The NPC may, during tests at factory, reject a power transformer for the following reasons:

a. if the tolerance limit specified in Paragraph 1.2.2.2.9.1 for core loss has been exceeded and any of the losses have reached ten percent (10%) more than the guaranteed losses;

b. if the impedance voltage exceeds ten percent (10%) of the guaranteed value;

c. if the temperature rise exceeds the permitted values more thank 5K.

1.2.4.4.3.2 For each rejected transformer, the NPC may, at his own judgment, direct the Contractor to make any necessary corrections or alterations to it or to replace it forthwith. Any and all expenses that might result by the supply and installation of new parts or by the modification of existing parts and any and all expenses resulting in additional tests made necessary by failure of equipment to meet the guarantees and other requirements of the Specifications shall be borne by the Contractor.

1.2.5 DATA AND DOCUMENTATION REQUIREMENTS

1.2.5.1 General

1.2.5.1.1 Contractor-furnished data and information shall be the guaranteed performance data, predicted performance, interface requirements and construction features of all Contractor's furnished equipment. The accuracy of such information and its compatibility with overall performance requirements specified by NPC are the sole responsibility of the Contractor.

1.2.5.1.2 All information submitted as part of Proposal Data will become part of contract data for successful bidder. Any deviation from such data requires NPC's approval.

1.2.5.2 Data and Information to be Submitted with the Proposal

1.2.5.2.1 Contractor shall furnish with his proposal the filled-in Annex "A" of Section E.1.2 of the Technical Data Sheets.

1.2.5.3 Data and Information to be Submitted During Post Qualification

a. Properly filled-in Annex "B" of Section E.1.2 of the Technical Data Sheets

b. Preliminary general assembly drawings indicating approximate overall dimensions, cable entrances, weights, nameplates, location of accessories, plans and section views, mounting and other details and clearances needed for operation and maintenance;

c. Illustrative and descriptive material such as catalogs; drawings showing tank dimensions, bushing height above ground and locations, surge arrester dimensions and locations and number, size and locations of radiators;

d. Tentative QA Program and ISO 9001 Certification of the proposed manufacturer;

e. Contractor shall furnish a list of recommended spare or replacement parts as follows:
   1. Identification (Name of Part);
   2. Replacement time or parameters indicating the need to replace the above;
   3. Unit price of "1" above;
   4. Contractor shall specify the availability and location of spare parts permanently stocked by Contractor; and

f. Proof of satisfactory performance from at least three (3) different power utilities shall be submitted as compliance with the requirements and for NPC reference. Non-submission of the requirement shall also be considered as a disqualification of the bid being offered. See also E.1.2, paragraph B.2.3.1 of the Technical Specifications

1.2.5.4 Data and Information to be Submitted After Award of Contract

1.2.5.4.1 Final outline drawings showing dimensions: weight; dimensioned location of the transformer center of gravity, completely assembled with oil and as shipped (with oil or gas filled); the dimensioned location of all parts and accessories, the flood level; and the overall

height required to remove high voltage and low voltage bushings. The drawings shall clearly show transformer base construction.

1.2.5.4.2 The Contractor shall furnish in the manner, number of copies, and within the time as set forth in the purchase order, instruction manuals and information in accordance with Paragraph 1.0.8 of the General Administrative Requirements, Section E.1.0 of the Specifications. The Contractor shall also furnish the following information:

a. Outline drawings of transformer and accessories showing all critical dimensions and weights, including the following:
   1. Base mounting and transport dimensions;
   2. Bushing and cable box locations;
   3. High, low and tertiary voltage terminal arrangement;
   4. Control cabinet size and location;
   5. Connection points for all external connections;
   6. Conservator;
   7. Nameplate connection plate and all other designation plate drawings.

b. Equipment layout, including mounting details, schematic and control circuit diagrams and drawings for the following:
   1. Gas monitoring system for the transformer;
   2. Oil filter units for the on-load tap changer;
   3. Cooling fans and pump motors. The supply voltage and current required for operation of motors shall also be shown;
   4. Indoor Transformer Control and Operation System;
   5. Outdoor tap-changing operating control cubicle and mechanism. The supply voltage and current required for operation of motor shall also be shown.
   6. Transformer Blast and Fire Prevention Equipment, if required in the Technical Data Sheets of Section E.1.2.

   NOTE: Control circuit diagrams indicating the interfacing with the MBSC for the above items shall also be provided, if substation supervisory control and monitoring functions is through the MBSC.

c. Layout, including mounting details, schematic and control circuit diagrams (alarm and trip) and drawings for all transformer relays;

   NOTE: Control circuit diagrams indicating the interfacing with the MBSC for the above item shall also be provided, if substation supervisory control and monitoring functions is through the MBSC.

d. Description and instructions covering the installation, operation and maintenance of the transformer and all accessories; drawings or cuts showing assembly of the accessories including, but not limited to:
   1. Tap changer;
   2. Inert gas or conservator systems;
   3. Hot spot devices;
   4. Temperature indicators;
   5. Transformer relays;
   6. Oil filter units (if required);
   7. Gas monitoring system;
   8. Temperature monitoring and recording system;

9. Fans and pump cooling control;
10. Silica gel breathers;
11. Transformer Blast and Fire Prevention System, if required;
12. Transformer Control and Operation System.

e. Assembly drawings for core and coils, including the location of ground strap and means of access for the core ground strap;
f. Dimensioned cross-sectional drawings of all bushing pockets showing flanges, current transformer pockets and all aluminum clearances;
g. Bushing drawings including terminal details, voltage rating, BIL, cantilever strength, minimum creepage distance, etc.;
h. Surge arrester drawings and performance characteristics including terminal and connection details;
i. Drawings showing the height, inside and outside diameters, mounting dimensions and method of mounting for current transformers, whether or not they are furnished with the transformer;
j. Instrument transformer connection diagrams;
k. Detailed radiator drawings showing number, dimensions, spacing and configuration of radiator coolers; fan mounting details and foundation load if radiators are self-supporting;
l. Foundation outline for the transformer detailing the location and distances of anchor bolts, rails (if transformer is mounted on wheels);
m. Complete instructions for untanking the core and coils;
n. Earthing details;
o. Piping layout and diagrams;
p. The final design short circuit strength calculations including basic equations and references to the literature;
q. Detailed QA Program based on ISO 9001 Certification;
r. Routine Test Results duly signed and witnessed by NPC's representative(s) if Factory Acceptance Tests are required to be witnessed by NPC's representative(s);
s. Field Tests to be performed and test reports duly signed and witnessed by NPC's representative;

1.2.5.4.3 Schematic and connection diagrams for cooling and tap changer control equipment, including supply and control circuits. The supply voltage and current required for operation of motors shall also be shown.

1.2.5.5 Diagram of Alarm Circuits

1.2.5.5.1 Description and instructions covering the installation, operation and maintenance of the transformer and all accessories; drawings or cuts showing assembly of the accessories including, but not limited to, the tap changer, inert gas or conservator systems, hot spot devices, temperature indicators, relays, and cooling control draining of oil.

1.2.5.5.2 Complete instructions for untanking the core and coils.

1.2.5.5.3 The sealed dry (drained of oil) shipped weight of the transformer.

1.2.5.5.4 A complete set of finally accepted drawings.

1.2.5.5.5 NPC's general review of drawings and information or waiver of same shall not in any way relieve the Contractor of any of responsibilities to meet all requirements of this specification or the NPC order.

1.2.5.6 Certified Test Reports

1.2.5.4.5.1.1 The Contractor shall supply, at the time stated in the NPC order, the required quantity of certified copies of final test reports, including data and results of all tests required by this specification with respect to all values or relations specified herein or stated in the standards. This shall include copies of voltage and current oscillogram, with magnitude and time calibrations.

1.2.5.4.5.1.2 For transformers failing to meet the specified tests, a supplemental report shall be made prior to final acceptance of the transformer, describing the failures, method of detection, including evidence in oscillographic or photographic form and the corrective measures taken. This shall include a reproduction of the test log detailed in Paragraph 1.2.4.2.3.

E.1.9: POWER, CONTROL AND INSTRUMENTATION CABLES

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E.1.9: POWER, CONTROL AND INSTRUMENTATION CABLES

1.9.0 SCOPE

1.9.0.1 General

1.9.0.1.1 This specification covers the technical and associated requirements of 600 V power, control and instrumentation cables, and medium voltage power cable for use in switchyards and substations.

1.9.0.1.2 It is not NPC's intent to specify all technical requirements nor to set forth those requirements adequately covered by applicable codes and standards. Contractor shall furnish high quality power and control cables meeting the requirements of these specification and industry standards.

1.9.0.1.3 Contractor shall bear full responsibility that the cables have been designed and fabricated in accordance with all codes, standards, and applicable governmental regulations and performs under the condition and to the standards specified herein.

1.9.0.1.4 No departure shall be made from these specification and standards unless waived or modified in writing by NPC. The Contractor shall obtain from its subcontractors a statement as to the compliance with this specifications without exception and/or if there are any exceptions, these shall be described in detail and included in the Contractor's proposal. The Contractor shall add a statement that no other exceptions are taken to this specification.

1.9.0.2 Works to be Provided by the Contractor

1.9.0.2.1 The work to be provided by Contractor shall include, but not necessarily be limited to, supplying the cables and services delineated in Paragraph A.2, Section E.1.1 of the Technical Data Sheets.

1.9.0.3 Works to be Provided by NPC

1.9.0.3.1 NPC shall provide the materials and services listed in Paragraph A.2, Section E.1.1 of the Technical Data Sheets.

1.9.1 CODES AND STANDARDS

1.9.1.1 General

1.9.1.1.1 The cables to be furnished shall be manufactured in accordance with, but not limited to the latest issues of the following codes and standards including all addenda, in effect at time of purchase order unless otherwise stated in this specification.

ASTM	**American Society for Testing and Materials**
B3	Specification for Soft or Annealed Copper Wire

B8	Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
B33	Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes
B189	Specification for Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes
D1248	Specification for Polyethylene Plastics Molding and Extrusion Materials

IEC **International Electrotechnical Commission**

60028	International Standard of Resistance for Copper
60060	High Voltage Test Techniques
60093	Methods of Test for Volume Resistivity and Surface Resistivity of Solid Electrical Insulating Materials
60183	Guide to selection H.V. cables
60189	Low frequency cables and wires with PVC insulation
60227	Specification for Cables and Flexible Cords for Electric Power and Lighting
60228	Conductors of insulated cables
60229	Tests on Cable Over-Sheaths, which have a special protective function and are applied by extrusion
60230	Impulse test on cables and their accessories
60270	Partial Discharge Measurements
60287	Calculation of the current rating
60331	Fire Resistant Test
60332	Tests on Electric Cables Under Fire Conditions
60364	Continuous Transmission Capacity
60446	Color code for conductors
60502	Extruded solid dielectric insulated power cables for rated voltages from 1 to 30 kV
60538	Test methods for PE insulation and sheaths
60540	Test methods for elastomeric and thermoplastic compounds
60708	Low frequency cables with polyolefin insulation
60754	Halogen Content Test
60811	Common Test Methods for Insulating and Sheating Materials of Electric Cables
60885-2	Electrical Test Methods of Electric Cables Partial Discharge Tests
60949	Calculation of Thermally Permissible Short circuit currents, Taking into Account Non-adiabatic Heating Effects
60986	Guide to short circuit temperature limits of electric cables with a rated voltage from 1.8/3(3.6) kV to 18/30(36) kV
1034	Smoke emission tests

ISO **International Standards Organization**

9001	Quality System Model for Quality Assurance in Design/Development, Manufacture and Testing
9002	Quality System Model for Quality Assurance in Production, Installation and Servicing

NEC **National Electrical Code**

PEC **Philippine Electrical Code, Part I**

1.9.1.1.2 These codes and standards set forth minimum requirements which may be exceeded by Contractor if, in Contractor's judgment and with NPC's acceptance, superior or more economic designs or materials are available for successful and continuous operation of Contractor's equipment required by this specification.

1.9.2 TECHNICAL REQUIREMENTS

1.9.2.1 General

1.9.2.1.1 The cables shall be designed for trouble-free service for the highest system voltage.

1.9.2.1.2 All cables and their accessories to be supplied shall have insulation levels able to withstand any voltage surges which are normally expected to occur in the power system in which the cable is to be employed, due to switching operations, sudden load variations, faults etc.

1.9.2.1.3 All cables shall be selected to withstand without distress any short-circuit currents in the conductor and sheath related to the existing fault levels.

1.9.2.1.4 The cables and its accessories shall be constructed to fulfill the requirements when operating with full load or at any load factor.

1.9.2.1.5 The cable shall be suitable for use in ducts, trays and for direct burial in ground.

1.9.2.2 Conductor

1.9.2.2.1 Copper conductors for power, control and instrumentation cables shall be concentric-lay-stranded, bare, or coated in accordance with ASTM B3, ASTM B8, or ASTM B33 or equivalent IEC Standards.

1.9.2.3 Insulation

1.9.2.3.1 Insulation shall be of the type specified in the Technical Data Sheets of Section E.1.9. Insulation type shall be in accordance with National Electrical Code Designation or equivalent IEC Standards.

1.9.2.4 Jacket

1.9.2.4.1 A tough, ozone, low chlorine, heat, flame and moisture-resistant PVC or HDPE jacket capable or providing protection against sunlight, acids, alkalis and oils shall be furnished for all cables. Jacket materials shall meet the requirements of applicable IEC Standards.

1.9.2.5 Grounding Conductor

1.9.2.5.1 Copper grounding conductors shall be furnished within-multi-conductor 600 V power cables. Total cross-sectional area of the grounding conductors shall be in accordance with the National Electrical Code requirements or equivalent IEC Standards. Grounding conductors shall be bare.

1.9.2.6 Assembly

1.9.2.6.1 All multi-conductor cables shall be bundled together with non-hygroscopic fillers to assure a smooth circular assembly. A lapped core binding tape shall be applied over the assembly.

1.9.2.7 Technical Requirements for Control and Instrumentation Cable

1.9.2.7.1 For Instrumentation Cables, the following additional criteria shall apply:

1.9.2.7.1.1 Drain Wire

1.9.2.7.1.1.1 Class B, 7 strands, annealed, tinned copper drain wire (not less than two AWG sizes smaller than the insulated conductor but not smaller than 20 AWG), to be laid spirally with the same direction and lay as the twisted pair.

1.9.2.7.1.2 Shielding Tape

1.9.2.7.1.2.1 Type of shielding tape, if not specified in the Technical Data Sheets of Section E.1.9 shall be a 100 percent coverage of a minimum of 2.0 mil Aluminum/polyester tape with metallic face of tape in continuous positive contact with the drain wire. Minimum overlap of shielding tape shall be not less than 20% of its width. The twisted pairs shall have their shields isolated from one another.

1.9.2.7.1.2.2 The semi conducting thermosetting compound screen layer shall be able to be peeled –off easily, without leaving any residue on the insulation.

1.9.2.7.1.3 Cabling

1.9.2.7.1.3.1 Pairs are to be cabled with fillers, if required, and binder tape which are flame resistant and non-hygroscopic.

1.9.2.8 Technical Requirements for Medium Voltage Power Cables

1.9.2.8.1 For medium voltage power cables, the following criteria, in addition to Paragraphs 1.9.2.1 thru 1.9.2.4 shall apply:

1.9.2.8.1.1 Strand Shield

1.9.2.8.1.1.1 Extruded layer of semiconducting thermosetting compound compatible with the insulation. It shall be continuous, with a minimum thickness of 0.5 mm, with no rough surfaces and keeping close contact with the insulation. The semi-conducting screen shall withstand the temperature in the conductor and the admissible mechanical forces in the insulation, and shall have no detrimental effect on the conductor or the insulation. The insulation semi-conducting screen shall be directly applied upon the insulation and shall make a perfect continuous and discharge free contact, with a minimum thickness of 0.1 mm.

1.9.2.8.1.2 Insulation Shield

1.9.2.8.1.2.1 Extruded layer of semiconducting thermosetting compound compatible with the insulation. Average thickness of the insulation shall be not less than the nominal value specified in IPCEA or IEC 60502. The maximum thickness in any particular point shall not be greater than 25% of the nominal value specified.

1.9.2.8.1.3 Metal Tape

1.9.2.8.1.3.1 Annealed copper tape over insulation shielding per ICEA S-19-81, Paragraph 4.1.1.2, with a minimum overlap of 12%. The construction of the metallic screen shall guarantee a perfect contact with insulation semi-conducting screen to constitute an equipotential system. The dimensional characteristics shall be calculated in such a way as to ensure a permissible short circuit current specified in the Technical Data Sheets of Section E.1.9 during 3 sec., without causing overheating in the close layers.

1.9.2.8.1.4 Oversheath or Outer Jacket

1.9.2.8.1.4.1 The oversheath shall consist of a compound applied by an extrusion process, adequate to the rated cable temperatures, if one of the following alternatives to be specified by the Contractor.

a. Sheath of polyvinyl chloride (PVC) colored black, with anti-termite repellant, non-poisoning type adequate for termite type "ODONTERMUS FORMASANUS" and "COPTERMES FRENCHI".

b. Black sheath of high density polyethylene (HPDE), with characteristics according to IEC 60811, ST4 type or equivalent IPCEA or ASTM Standards.

1.9.2.8.1.4.2 The nominal thickness shall be 0.3 mm and the maximum thickness in any particular point shall not be greater than 25% of the nominal value.

1.9.2.8.1.5 Maximum Conductor Temperature

1.9.2.8.1.5.1 The insulating material shall be able to withstand the maximum permissible temperature for conductor, as stated below:

Continuous : 90°C
After short circuit: 250°C

1.9.2.9 Application

1.9.2.9.1 All cables shall be suitable for installation in cable tray (NEC type TC), conduit, trench, underground duct in wet and dry locations, and above ground raceway in damp and dry locations.

1.9.2.10 Accessories

1.9.2.10.1 Each end of each cable shall be hermetically sealed with a heat shrinkable elastomeric cap fitting or other suitable means, to protect against the entrance of moisture.

1.9.2.11 Cable and Cable Reel Marking

1.9.2.11.1 Cable shall be identified by surface printing of the jacket indicating: manufacturer, conductor metal (thermocouple cable only), size, insulation type, voltage rating, number of conductors, and sequential meter marker and date of manufacture.

1.9.2.11.2 Each cable reel shall be marked on both sides with indelible lettering as indicated in the Technical Data Sheets of Section E.1.9.

1.9.2.12 Color Coding

1.9.2.12.1 All three conductor power cables shall be color coded in accordance with method 4 of the ICEA standard unless otherwise amended in the Technical Data Sheets of Section E.1.9.

1.9.2.12.2 All control cables shall be color coded in accordance with the K2 sequence as specified in the ICEA standard unless otherwise amended in the Technical Data Sheets of Section E.1.9.

1.9.2.12.3 Instrumentation cable shall have individual pairs colored Black/White. On multi pair construction, the pairs shall be numbered unless otherwise amended in the Technical Data Sheets of Section E.1.9.

1.9.2.12.4 For thermocouple extension cable type E the positive conductor (chromel) shall be purple, and the negative conductor (constantin) shall be red.

1.9.3 INSTALLATION

1.9.3.1 Installation will be by Contractor, unless specified in Paragraph A.2, Section E.1.1 of the Technical Data Sheets.

1.9.3.2 When the installation is by Contractor, such as for turnkey contracts complete details of proper handling, transport and storage, installation, testing, commissioning, performance guarantees, etc. shall be provided for NPC's review and approval.

1.9.4 TESTS

1.9.4.1 Factory (Production) Tests

1.9.4.1.1 General

1.9.4.1.1.1 Cables shall be tested at the factory in accordance with applicable standards to determine their compliance with the requirements of this specification. Tests shall be conducted on samples and on the entire length of cables in accordance with the applicable standards.

1.9.4.1.1.2 The costs of all tests and test reports shall be borne by the Contractor.

1.9.4.1.2 Design Tests

1.9.4.1.2.1 Cable and materials shall be subjected to the design (or type) tests, if specified in accordance with the test standards specified herein. Design test can be omitted if a design test record of the same cables can be submitted. In general, the following test shall be performed as a minimum:

a. Conductor Tests. Tests shall be performed on selected samples of the conductors before the application of any covering. These tests shall include as a minimum:

   1. Tensile strength test
   2. Elongation test

3. Conductor resistivity test
4. Dimension measurement
5. Surface finish inspection
6. Water and saline absorption test
7. Shrinkage test
8. Water penetration test

b. Physical and Aging Tests on the Cable, Insulation and Jacket. Tests shall be performed on selected samples of the cable insulation and jackets. These tests shall include as a minimum:

1. Thickness measurement
2. Tensile strength test
3. Elongation test
4. Aging test
5. Head distortion test

1.9.4.1.3 Routine Tests

1.9.4.1.3.1 As part of routine testing at least the following test and measurements shall be carried out as a minimum:

a. Checking of the conductor, insulation and oversheath dimensions

b. Conductor resistance measurements

c. Dielectric tests

Additionally for the high voltage cables, the following tests shall also be performed:

a. Partial discharge test

b. Impulse voltage test 1.54 x BIL at +20 °C, each 3 negative and positive impulses (followed by power frequency test) on one sample of each cable type to be supplied.

c. Capacitance test

d. Insulation resistance test
e. Test on outer sheath (IEC 229)

f. Water penetration test

1.9.5 DATA AND DOCUMENTATION REQUIREMENTS

1.9.5.1 General

1.9.5.1.1 Contractor furnished data and information shall be the guaranteed performance data, and construction features of all Contractors' furnished materials. The accuracy of such information and its compatibility with overall performance requirements specified by NPC are the sole responsibility of the Contractor.

1.9.5.1.2 All information submitted as part of Proposal Data will become part of contract data for successful bidder. Any deviation from such data require NPC approval.

1.9.5.2 Data and Information to be Submitted During the Post Qualification

1.9.5.2.1 Contractor shall furnish during post qualification the filled-in Annex "B" of Section E.1.9 of the Technical Data Sheets.

1.9.5.3 Data and Information to be Submitted After Award of Contract

1.9.5.3.1 Contractor shall furnish the following information for each type of cable:

a. Brochures and catalogues to support the filled-in Annex "B" of the technical data sheets to allow NPC to evaluate the equipment/materials being offered;
b. Complete description of technical characteristics of each type of cables;
c. Design (Type) Test Reports, if not submitted with the proposal
d. Cross-section and details of power, control, and instrumentation cables
e. Cable rating calculations;
f. Make of each cable and cable reel;
g. Description of cable supporting structures, cable tray, cable rack, cable fixing method, cable connection, cable spacer, cable clamps, bending radius, etc.;
h. Power, control and instrumentation cable routing plan;
i. Cable schedule, including cable numbers, identification, sizes, etc.;
j. Detailed QA Program based on ISO 9002 Certification;
k. Routine Tests Reports; and
l. Field Tests to be performed and Field Test Reports duly signed by NPC's representative(s).

1.9.5.3.2 The Contractor shall furnish in the manner, number of copies and within the time set forth in the contract, instruction manuals in accordance with Paragraph 1.0.8, Section E.1.0 of the General Administrative Requirements.

TECHNICAL SPECIFICATIONS

(CIVIL WORKS)

SECTION VI – TECHNICAL SPECIFICATIONS

CW – CIVILWORKS

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CW - CIVIL WORKS

CW-1.0 GENERAL CONSTRUCTION FACILITIES

CW-1.1 SCOPE

This section covers the construction and/or maintenance of access roads, drainage system and other appurtenant structures, moving-in of the Contractor's construction equipment, setting up of the Contractor's camp and the disposition of the Contractor's various facilities at the end of the Contract.

CW-1.2 MOVING-IN

The Contractor shall bring to the site all his necessary construction equipment and plant and install all stationary construction equipment and plant at location and in the manner approved by the NPC. The Contractor shall submit sufficient detailed plans showing the proposed location of such stationary equipment and plant and other pertinent data. No installation of such stationary equipment shall be undertaken unless the corresponding plans have been approved by the NPC.

CW-1.3 CONTRACTOR'S CAMP FACILITIES

The Contractor shall provide and grade his camp site, construct his camp, employee housing, warehouse, machine and repair shops, fuel storage tanks and provide such related facilities and sanitary conveniences that the Contractor deems necessary for maintaining health, peace and order in the camp and work areas. The areas that may be used by the Contractor within the plant site shall be designated by the NPC.

The Contractor shall provide, maintain and operate, under competent direction, such camps and facilities as are necessary for the housing, feeding and accommodation of his employees.

CW-1.4 WATER SUPPLY

The Contractor shall, at his own expense, be responsible for the supply, installation, operation and maintenance of a safe and adequate supply of drinking and domestic water. Whenever there is a possibility of contamination of the water supply for drinking and domestic purposes, chlorination or some other approved methods of sterilization shall be carried out. The installation and maintenance of these services shall be subject to the approval of the NPC.

CW-1.5 SEWERAGE DISPOSAL AND SANITATION

The Contractor shall, at his own expense, be responsible for the installation operation and maintenance of an adequate sewerage disposal and sanitation system and shall provide adequate toilet and wash-up facilities for his employees at his camp and in the areas where work is being carried out.

The Contractor shall execute the work with due regard to adequate sanitary provisions and applicable codes and shall take all necessary steps to prevent the pollution of water in any spring, river, or other sources of water supply. All toilets or wash-up facilities shall be subject to the prior and continuing approval of the NPC.

CW-1.6 FIRE PROTECTION

The Contractor shall observe all necessary precautions against fire, shall provide and maintain at his own expense, portable fire-fighting equipment he may deem necessary, and shall comply with all applicable laws of the Philippines relating thereto.

In the event of an uncontrollable fire occurring in the area of the Contractor's operation, the Contractor shall have to extinguish the fire immediately at his own expense, to the full extent of the manpower and equipment employed under the contract at the time of the fire.

The Contractor shall indemnify NPC against all liabilities, claims, damages and/or lawsuits arising thereto.

CW-1.7 CONSTRUCTION POWER

The Contractor shall be responsible for providing his own electric power supply required for construction and erection/installation. If power is available from NPC and should the Contractor elect to utilize the NPC's power supply, he shall make an arrangement with NPC concerned group as to the billing rates and other requirements needed for direct connection to NPC.

CW-1.8 CAMP SECURITY

The Contractor shall provide his own security force to the extent that he deems necessary for maintaining peace and order in the camp and work areas and to safeguard materials and equipment. Nothing under the provisions of this paragraph shall relieve the Contractor from full responsibility for the maintenance of peace and order and protection of life and property in all areas where he operates.

CW-1.9 CONSTRUCTION MATERIAL STORAGE

The Contractor is required to put up warehouse(s) with capacities sufficient to store the construction materials required in the work. The warehouse(s) shall be specifically for this contract, notwithstanding his other facilities in the site that may serve the purpose.

CW-1.10 REMOVAL OF CAMP AND CONSTRUCTION FACILITIES

After the completion of the work covered by the contract and prior to acceptance of the completed work, the entire camp facilities of the Contractor, including its water supply system, electric distribution system, quarters, warehouses, shops, dining halls, commissaries, temporary shed and other facilities therein shall be removed by the Contractor. The site shall be cleared and cleaned as directed by the NPC.

CW-1.11 Measurement and Payment

No separate measurement and payment will be made for the Contractor's Construction Facilities. The entire cost thereof shall be included in the various pay items in the Bill of Quantities.

CW-2.0 CARE OF WATER DURING CONSTRUCTION

CW-2.1 SCOPE

In accordance with the specifications contained in this section or otherwise directed, the Contractor shall construct and maintain all necessary temporary drainage ditches and other temporary protective works and he shall also furnish, install, maintain and operate necessary pumping equipment and other devices to protect construction operations free from water coming from any source, including rain.

CW-2.2 DRAINAGE AND DEWATERING

The Contractor shall be responsible for dewatering foundation areas so that work can be carried out on a suitably dry condition. The Contractor shall construct drainage ditches, holes, culverts, furnish, maintain and operate at his own expense all necessary pumps and other dewatering devices to keep all work areas free from water.

After the work is completed and before it is accepted by the NPC, the Contractor shall remove all pumping equipment and shall remove, fill or plug all temporary drainage structures as directed, all at his expense.

CW-2.3 MEASUREMENT AND PAYMENT

No separate measurement and payment will be made for the Care of Water During Construction operations. The cost of furnishing, constructing, maintaining, operating and removing of temporary drainage structures, pumping system and other dewatering devices necessary to keep construction operations free from water, shall be included in the various pay items in the Bill of Quantities for structures where such care of water is required.

CW-3.0 ENVIRONMENTAL REQUIREMENTS FOR CIVIL WORKS

CW-3.1 SCOPE

This section pertains to the environmental and safety provisions, requirements and conditions that shall govern during the execution of all civil works under this project.

CW-3.2 GENERAL CONDITIONS

The Contractor shall ensure compliance with the applicable environmental and safety regulations, as well as any ECC conditions, during installation/construction of this project through the implementation of measures that shall include, but not limited to, the following:

a) Designate a Safety Officer and a Pollution Control Officer who shall respectively handle all safety and environmental concerns of the project.

b) Prepare and submit Construction Safety and Health Plan (CSHP) as provided in Section IV – General Conditions of the Contract.

c) Properly manage debris and various waste generated during installation/construction, such as the following:

- Dispose of demolition and construction debris in a designated or NPC approved disposal area(s);
- Stockpile (and cover if possible) or haul to the designated and/or pre-developed dump sites (spoil disposal areas) that shall be provided with suitable drainage – equipped with sediment traps, stripped top soil, spoils from quarry/borrow sites and excavated materials;
- Segregate solid wastes, such as empty cement sacks, scraps of tin or wood, used wires and other domestic garbage, for recycling or storage in NPC-approved temporary storage areas and further disposal to LGU-designated disposal sites.
- Properly handle, store and dispose off, through DENR-accredited transporter/treater, hazardous wastes i.e. used oils, paints, thinner, etc.

d) Limit construction activities that generate excessive noise to daytime works only to prevent nuisance to nearby residents during rest hours.

e) As far as practicable, undertake site stripping, grading and excavations during dry weather.

f) Construction/Installation shall be carried-out in a manner where landslides and erosions are minimized.

g) Avoid unnecessary opening/clearing of areas outside construction sites or destruction of vegetative cover, especially cutting of existing trees; and to re-vegetate disturbed areas.

h) Implement biological control measures such as maintenance of vegetation buffers (i.e. sodding of grass, planting of creeping vines, herbs, shrubs and trees) to shield streams/rivers from sedimentation; planting of vegetative cover over erodible surfaces; and planting of exposed sloping areas with shallow-rooted species like grasses, herbs or creepers.

i) Locate fill slopes and spoil heaps away from drainage routes and properly remove/dispose the same as soon as practicable.

j) Preserve or replace, if practicable, natural drainage patterns (when disturbed by civil works) with appropriate drainage channels.

k) Convey oil-contaminated wastewater from workshops, garages, or gas filling stations through an oil trap (i.e. improvised oil-water separator) prior to discharge.

l) Spray water, wherever and whenever necessary, to minimize dust generation.

m) Provide PPEs and other safety provisions required by DOLE, for its project/site works.

n) Take all necessary steps to prevent the pollution of groundwater and/or water bodies in the vicinity of the project site.

CW-3.3 MEASUREMENT AND PAYMENT

No separate measurement and payment will be made for the Contractor's compliance to the foregoing. The entire cost thereof shall be included in the various pay items in the Bill of Quantities.

CW-4.0 SITE GRADING

CW-4.1 SCOPE

In accordance with the specifications contained herein and in conformance with the lines, slopes, grades and extent shown on the plans or otherwise directed by the NPC, the Contractor shall furnish all equipment, labor and materials and shall perform the required grading work.

CW-4.2 CLEARING, GRUBBING AND MISCELLANEOUS WORK

CW-4.2.1 CLEARING AND GRUBBING

The Contractor shall perform clearing and grubbing on the project site[1]. The site shall be cleared and grubbed of all trees and brush except particular trees, which may be retained by the NPC for preservation. Particular trees to be left in place shall be protected from scarring and/or other injuries during clearing and grubbing work and other construction operations.

All stumps, roots and brush shall be removed to a depth of thirty (30) cm below original ground surface and disposed of in a place designated by the NPC. Downed timber, which may be ordered saved by the NPC for future use, shall be cut into logs as directed and neatly piled in a place designated by the NPC, otherwise they shall be disposed of same as above.

[1] Site refers exclusively to the area affected by this project.

CW-4.2.2 MISCELLANEOUS WORK

Where shown on the drawings or if not shown but directed by the NPC, the Contractor shall perform miscellaneous work like demolition, removal, chipping, replacement or transfer of existing structures and other miscellaneous work. All demolished structures shall be disposed of as directed by NPC.

CW-4.3 GRADING

CW-4.3.1 GENERAL

The word "grading" as defined herein means bringing to required grades all areas in accordance with the lines, slopes, elevations and grades shown on the drawings or as directed by the NPC.

CW-4.3.2 CLASSIFICATION OF MATERIALS

All materials in grading work shall be unclassified regardless of the nature of materials encountered during grading excavation and of materials used in grading fill. It is on the basis of unclassified material that Contractor shall determine his unit bid price for grading excavation and grading fill.

CW-4.3.3 STRIPPING

Fill areas to be brought to grade shall first be stripped of their top soil as directed but in no case less than twenty (20) centimeters in depth and disposed of properly in spoil areas designated by the NPC. Only materials from grading excavation and intended to be used for filling or backfilling purposes shall be stripped of top soil in the same manner as above.

CW-4.3.4 EXCAVATION AND FILL

Areas required to be brought to grade shall be excavated or filled as the case may be. Grading work shall be carried out in such a manner that the free drainage is maintained at all times and nowhere shall pondage be found in any part of the work.

The NPC may require the modification of slopes and grades according to the conditions actually encountered during excavation, but such change or modification shall not be construed to mean by the Contractor as a basis for additional compensation over and above the contract unit prices.

Any over-excavation performed by the Contractor for any purpose or reason, except as may be ordered by the NPC, shall be at the Contractor's expense and any excess of excavation shall be refilled, where required, with approved materials that shall be furnished, place and properly compacted at the expense of the Contractor.

Unsuitable materials, as determined by the NPC, which may be encountered below established grade, shall be removed to a depth as directed and accordingly replaced with suitable materials approved by the NPC. The removal and proper disposal of such unsuitable materials shall be paid for at the contract unit price for the item, Grading Excavation, and

payment for placing and compacting suitable material be made at the contract unit price for the item, Grading Fill, in the Bill of Quantities.

Fill work shall not be started until the area has been inspected and approved by the NPC after stripping. Grading fill shall be spread and compacted in layers of 15 cm. loose volume and compacted with approved roller weighing not less than 10 tons. Each layer shall be moistened or dried as directed for maximum compaction. No succeeding layer shall be placed thereon unless the preceding layer has been tested for compaction and approved by the NPC.

In the event that construction of concrete footing or other concrete foundations is on fill, the fill shall be compacted efficiently and thoroughly so that when the fill is tested for compaction at the required foundation elevation for the structure, the required bearing capacity is attained but in no case less than 143 kPa. In no case shall filling and compaction work to be done without the presence of NPC's inspectors. The Contractor shall be held liable for any structural instability or damage that might result in consequence to non-compliance of this requirement. The Contractor shall institute corrective measures to bring the foundation base to a condition or state that will conform to the required bearing capacity; and also to repair and make good any damage on the structure to the satisfaction and at no cost to NPC.

CW-4.3.5 SLIDES

In the event that slides occur along excavated slopes during grading operations or after completion of grading but prior to acceptance of the work, the Contractor shall remove and dispose the slide materials and also to trim the slopes as directed to leave the slopes in a safe and neat condition all at no additional cost to NPC, unless occurrence of such slides is occasioned by causes beyond control of the Contractor. In such event, payment for the satisfactory removal and proper disposal of slide material and finishing and rounding of slopes will be paid for at the equivalent of thirty percent (30%) of the contract unit price per cubic meter for the item Grading Excavation.

CW-4.3.6 SLIP-OUTS

In the event of slip-outs in any part of the grading fill prior to final acceptance of the work, the Contractor shall rebuild such portion of the fill. In the case it is determined that the slip-outs was caused through the fault of the Contractor, the rebuilding of the fill shall be performed by the Contractor at no extra cost to NPC; otherwise, the reconstruction of the fill will be paid for thirty percent (30%) of the contract unit for the item, Grading Fill.

CW-4.4 DISPOSAL

All excess materials from grading work (including excess materials in structural excavation and miscellaneous work) shall be disposed of the by the Contractor. The acquisition of the right-of-way for the area of disposal including the access thereto, permits, and other requirements, shall be the responsibility of the Contractor at no cost to NPC. The Contractor shall be held solely liable for any claim by third parties that may arise from

improper transport and disposal of excess materials. The cost of acquisition of the above-mentioned right-of-way shall be included in the unit bid price for excavation.

CW-4.5 SOURCES OF FILL MATERIALS

When suitable materials from grading excavation are deficient to meet the quantity required for grading fill, additional fill materials shall be obtained from other sources proposed by the Contractor and approved by the NPC. Cost of excavating, hauling, placing and compacting additional materials from borrow sources shall be included in the unit price bid for the item, Grading Fill. Acquisition of right-of-way to these sources shall be the responsibility and account of the Contractor.

CW-4.6 MEASUREMENT AND PAYMENT

CW-4.6.1 CLEARING AND GRUBBING

Unless otherwise specified in the bill of quantities, no separate measurement and payment will be made for Clearing and Grubbing. Corresponding cost hereof shall be included in the unit bid price of relevant item(s) in the bill of quantities that necessitate this work.

CW-4.6.2 MISCELLANEOUS WORKS

Measurement for payment for miscellaneous work such as demolition, restoration, etc., shall be made on a lot basis unless otherwise specified in the bill of quantities. Payment will be made at the contract unit price for the item Miscellaneous Works, which payment shall cover all cost for furnishing labor, equipment and incidentals necessary for demolition and restoration, disposal, and other related works required to complete the item.

CW-4.6.3 STRIPPING

Unless otherwise specified in the bill of quantities, no separate measurement and payment will be made for Stripping. Corresponding cost hereof shall be included in the unit bid price of relevant item(s) in the bill of quantities that necessitate this work.

CW-4.6.4 GRADING EXCAVATION

Measurement for payment for Grading Excavation shall be based on the number of cubic meters excavated and properly disposed. Volume shall be computed by the average end area method which shall be the volume between the original ground (as determined by survey to be made by representatives of both NPC and the Contractor) and graded surface on the drawings or as established by NPC. To this volume shall be added, for purpose of payment, all authorized excavations below grade.

Payment will be made at the contract unit price for the item Grading Excavation in the Bill of Quantities, which payment shall constitute full compensation for furnishing of all labor, construction equipment and incidentals necessary excavate, dispose and other related work required to complete the work item.

CW-4.6.5 GRADING FILL

Measurement for payment for Grading Fill shall be based on the number of cubic meters of the materials placed, graded, compacted and accepted. Volume shall be computed by the average end area method which shall be the volume between the ground surface after stripping and the finished grade surfaces on the drawings or as established by NPC.

Payment will be made at the contract unit price for the item Grading Fill in the Bill of Quantities, which payment shall constitute full compensation for furnishing of all materials, labor, construction equipment and incidentals necessary to complete the work item.

CW-5.0 STRUCTURAL EXCAVATION, FILL AND BACKFILL

CW-5.1 SCOPE

In accordance with the specifications contained herein and as shown on the drawings and otherwise directed, the Contractor shall perform all the required structural excavation, fill and backfill for the entire project, including the proper disposal of excess excavated materials.

CW-5.2 MATERIALS

CW-5.2.1 STRUCTURAL EXCAVATION

No classification will be made on the materials excavated. The Contractor shall determine his unit bid price for structural excavation based on unclassified material regardless of the nature of the materials actually encountered and excavated.

CW-5.2.2 STRUCTURAL FILL

a. Sand and Gravel Fill

The material shall be of the same classification as the sand and gravel base consisting of river sand and gravel as approved by the NPC. The composite material shall be free from vegetable matter and lumps or balls of clay, and shall be uniformly graded from coarse to fine in accordance with the grading requirements shown below:

Sieve Designation (Square Mesh Sieves)	Percentage by Weight Passing
50.0 mm (2")	100
25.4 mm (1")	55-85
9.5 mm (3/8")	35-60
4.76 mm (No. 4)	25-50
2.08 mm (No. 10)	20-40
0.42 mm (No. 40)	8-20
0.074 mm (No. 200)	2-8

b. Structural Earth Fill

Structural earth fill shall consist of filling with suitable materials obtained from grading excavation or from borrow areas approved by the NPC.

CW-5.2.3 SPECIAL FOUNDATION, IF ANY

The NPC shall have the option to use one or both of the following materials for special foundations, whether or not shown on the drawings:

a. Lean Concrete

The strength of lean concrete shall be 13.79MPa or as designated by the NPC.

b. Selected Materials

Selected materials shall consist of compactable material which, when compacted, shall attain the required bearing capacity. The material could be a combination of earth and rock particles not greater than 8 cm including sandy clay, gravelly clay, or shale, all approved by the NPC.

Bed materials for water pipes and/or drainage culverts shall use sand fills,

CW-5.2.4 STRUCTURAL BACKFILL

Backfill for Structures Other Than Pipes – Material for backfill shall consist of compactable and approved material taken from grading and structural excavations. Any additional material needed shall be obtained from borrow areas proposed by the Contractor and approved by the NPC.

Backfill for Sewerage and Drainage Pipes – The layer of backfill materials immediately above, up to 60 cm. from the top of pipe, and on the sides of the pipe shall consist of selected material consisting of clay soil and/or other fine materials that are free from stone particles, roots, debris. The upper layer shall consist of compactable materials taken from pipe trench and other structural excavation.

Backfill for Water Supply Pipes – Backfill for water supply pipes shall consist of compactable materials taken from trench excavation and approved by the NPC.

CW-5.3 CONSTRUCTION

CW-5.3.1 EXCAVATION

a. General

The Contractor shall notify the NPC sufficiently in advance before the beginning of any excavation so that a joint survey for baseline data and cross-sectional measurements can be undertaken on the undisturbed/natural ground surface. All excavation shall be carried out according to the lines, slopes and grades shown on the drawings. In case an increase or decrease in quantities occur as a result of changes made by the NPC to such lines, slopes, and grades, the provisions on Variation Orders under the General Conditions of Contract (GCC) shall apply.

After each excavation is completed or where replacement of unsuitable material below required foundation grade has been undertaken, the Contractor shall notify the NPC so that proper inspection and confirmatory

test on the bearing capacity of the foundation material can be made. In no case that concrete, sewer, drainage or water supply pipe can be placed unless a written approval has been issued by the NPC.

Over-excavation performed by the Contractor due to his carelessness shall be filled and properly compacted with the suitable material approved by NPC, at no additional cost to NPC.

b. Structural Excavation, Structure Other Than Pipes

The Contractor shall excavate the foundations to the specified side slopes and depths shown on the drawings, after which the NPC will conduct tests on the underlying material below foundation grade to determine the actual bearing capacity at such depth. If the required bearing capacity is not attained, the NPC shall instruct the Contractor to excavate further down until, in the opinion of the NPC, the bearing capacity is adequate to sustain the applied load on the foundation.

Compliance to such instruction shall not entitle the Contractor for additional compensation over and above the unit prices for excavation regardless of the nature of material excavated. For purposes of measurement, the applicable paylines for the excavation under this condition or situation shall be as shown on the drawings that show the paylines for excavation and special foundation materials.

c. Drainage and Sewerage Pipes and Cable Trench

The width of trench excavation for drainage and sewerage pipes and cable trench shall be as indicated on the drawings. All trench bottoms shall be excavated to the foundation grade indicated, regardless of the foundation material classification.

d. Water Supply Pipes

Trenches for main or feeder lines shall be excavated to the depth of no less than 0.25 meter on open ground and 0.60 meter under roadways and parking areas, both depths measured from the finished grade surface.

Service pipes shall be buried to a depth of at least 0.15 meter below grade line.

CW-5.3.2 STRUCTURAL FOUNDATION FILL

No fill materials shall be placed in any part of the fill foundation unless the foundations have been inspected and approved by the NPC. Fill materials shall be placed and spread in layer covering the entire length and breadth of the section under construction, each layer not to exceed 15 cm. in loose volume thickness and compacted thoroughly to the desired compaction as determined by the NPC. No succeeding layer shall be placed until the previous layer has been tested and approved, as to compaction, by the NPC.

CW-5.3.3 SPECIAL FOUNDATIONS

If unsuitable material is encountered or if the foundation material is unsuitable such that the required bearing capacity of the foundation cannot be attained at the required elevation, further excavation shall be performed by the Contractor as stated in CW-4.3.1b.

Excavated materials below foundation grade shall be replaced at the direction of the NPC, either by lean concrete or by selected materials as mentioned in CW-4.2.3.

Selected materials shall be placed in 15-cm. layers and compacted until the required bearing capacity is attained.

CW-5.3.4 BACKFILL

1. Structures, Other Than Pipes

Excavated areas around structures for backfilling shall be backfilled with approved materials in horizontal layers, each not exceeding 15cm. (6") in loose volume thickness. Each layer shall either be moistened or dried as directed and thoroughly tamped with tampers having no less than 160 cm^2 of tamping area and weighing not less than 20 kg. The last layer shall be neatly brought up to the level of the adjoining finished grade surface.

In no case shall backfill be placed around concrete structures until after fourteen (14) days from placement of the concrete.

2. Drainage and Sewerage Pipes

After the pipes have been installed and grouted joints sufficiently cured, but in no case less than seven (7) days allowed for curing as specified in NSCP and the whole pipeline inspected, backfill materials specified herein shall be placed in layers as directed, each layer either dried or moistened as directed and thoroughly tamped. The backfill shall be brought up evenly on both sides of the pipe up to the top of the pipe and finally up to the finished grade surface.

3. Water Supply Pipes

After the pipeline has been installed and tested it shall be backfilled in layers as directed and compacted to the satisfaction of the NPC.

CW-5.4 MEASUREMENT AND PAYMENT

CW-5.4.1 STRUCTURAL EXCAVATION

Measurement for payment for structural excavation performed by the Contractor for structures (except drainage, sewerage and water supply pipes, and appurtenances of which cost of excavation and backfill is included in the cost of installed pipe and constructed appurtenances) will be based on the number of cubic meters of materials excavated.

For purpose of payment, all authorized excavation below foundation grade (like in the case of unsuitable materials encountered) shall be included in the measurement.

Payment will be made at the contract unit price for Structural Excavation in the Bill of Quantities, which payment shall constitute full compensation for furnishing all labor and equipment necessary for excavation work and proper disposal of excess material excavated.

CW-5.4.2 STRUCTURAL FOUNDATION FILL

Measurement for payment for Structural Foundation Fill will be based on the number of cubic meters of fill materials placed within the neat lines as shown on the drawings.

Payment will be made at the contract unit price for the item, Sand and Gravel Fill/Base, in the Bill of Quantities, which payment shall constitute full compensation for furnishing, placing and compacting fill materials; labor which include spreading, compacting, etc., equipment and other incidentals necessary to complete the item.

CW-5.4.3 SPECIAL FOUNDATIONS

Measurement for payment for lean concrete and/or selected materials placed within the pay lines for excavation will be based on the number of cubic meters in-place and accepted.

Payment will be made at the contract unit price for the corresponding item shown in the Bill of Quantities, which payment shall cover all costs for furnishing all labor, materials, equipment and tools necessary to complete the item.

CW-5.4.4 STRUCTURAL BACKFILL

Measurement for payment for Structural Backfill (except backfill for drainage and sewerage pipes, appurtenances and other structures of which cost of backfill is included in the cost of installed pipes and appurtenances) will be based on the number of cubic meters of approved materials, backfilled, satisfactorily compacted and accepted. Any backfill material placed outside the pay lines for excavation to replace slides or over-excavation will not be paid.

Payment will be made at the contract unit price for the item, Structural Backfill, in the Bill of Quantities, which payment shall constitute full compensation for furnishing all labor, materials and equipment necessary for backfilling work.

CW-5.4.5 TRENCH EXCAVATION AND BACKFILL FOR SEWERAGE, DRAINAGE AND WATER SUPPLY PIPES

No separate measurement and payment will be made for trench excavation and backfill for all sewerage, drainage and water supply pipes. Payment for trench excavation and backfill for pipes shall be included in the payment pertaining to pipes as shown in the Bill of Quantities.

CW-6.0 CONCRETE

CW-6.1 SCOPE

In accordance with the specifications contained in this section, the Contractor shall furnish all materials, labor, equipment and tools and perform all concreting works in accordance with the drawings, or as otherwise directed.

CW-6.2 CLASS OF CONCRETE

Class of concrete or strength shall be as indicated on the drawings, which shall conform to the minimum requirement for compressive strength indicated on the provision of NSCP for Concrete and, in no case, shall not be less than 20.7 MPa.

CW-6.3 MATERIALS

CW-6.3.1 CEMENT

Cement for concrete works shall be furnished by the Contractor and shall conform to the requirements of the latest edition of the Standard Specifications for Portland Cement (ASTMC150).

Unless otherwise specified, cement shall be ordinary Portland Cement Type I for general construction which concrete is not in contact with soils or ground water and Type II for concrete in contact with soil or ground water.

Changing of brand or type of cement within the same structure will not be permitted unless with prior permission and approval obtained from the NPC.

CW-6.3.2 REINFORCING STEEL

The Contractor shall furnish all reinforcing steel of the sizes shown on the drawings and in accordance with the herein specifications for reinforcing steel.

CW-6.3.3 WATER

Water for use in concrete shall be subject to the approval of the NPC. It shall not be salty and shall be reasonably clear and free from oil, acid, injurious alkali or vegetable matter.

CW-6.3.4 AGGREGATES

All coarse and fine aggregates shall consist of hard, tough, durable and clean, uncoated particles. All foreign materials and dust shall be removed by processing. Aggregates shall generally be rounded and reasonably free from thin, flat and elongated particles in all sizes and well graded from coarse to fine.

CW-6.3.5 FORMWORK

Timber, lumber and plywood to be used for falsework and formwork shall be sound and shall comply with the requirements of this specifications. Use forms where a smooth form finish is required. Lumber shall be square-edged or tongue-and-groove boards, free or raised grain, knotholes and the other surfaces defects. Steel when used shall conform to the requirements of the ASTM A36. Steel form surfaces shall not contain irregularities, dents, or sags.

Forms shall be wood, plywood, or steel. Wood forms for surfaces exposed to view in the finished structure and requiring a smooth form finish, shall be plywood. For unexposed surfaces, undressed square-edge lumber may be used. Forms for surfaces requiring special finishes shall be plywood, or shall be lined with plywood, a non-absorptive, hard-pressed fiberboard, absorptive-type lining or other suitable material. Plywood, other than for lining, shall be concrete-form plywood free of raised grain, torn surfaces, worn edges, patches, or other surface defects, which would impair the texture of the concrete surface. Surfaces of steel forms shall be free from irregularities, dents, and sags.

CW-6.4 STORAGE OF MATERIALS

CW-6.4.1 CEMENT AND AGGREGATES

All cement shall be stored, immediately upon delivery at the Site, in weatherproof building that will protect the cement from dampness. The floor shall be adequately raised from the ground and in buildings placed in the locations approved by NPC. Provisions for storage shall be ample, and the shipments of cement as received shall be separately stored in such a manner that allows the earliest deliveries to be used first and to provide easy access for identification and inspection of each shipment. Storage buildings shall have capacity for storage of sufficient quantity of cement to allow sampling at least twelve (12) days before the cement is to be used. Bulk cement, if used, shall be transferred to elevated air tight and weatherproof bins. Stored cement shall meet the test requirements at any time after storage when NPC orders retest. At the time of use, all cement shall be free flowing and free of lumps.

Handling and storing of concrete aggregates shall be such that segregation or inclusion of foreign materials is sufficiently prevented. NPC may require that aggregates be stored on separate platforms at satisfactory locations.

In order to secure greater uniformity of concrete mix, NPC may require that the coarse aggregate be separated into two or more sizes. Different sizes of aggregates shall be stored in separate bins or in separate stockpiles and relatively away from each other to prevent the material at the edges of the piles from intermixing.

CW-6.4.2 REINFORCING STEEL

Reinforcing steel shall be stored in accordance with the specifications for reinforcing steel.

CW-6.5 CONCRETING

CW-6.5.1 GENERAL

The written approval of the NPC shall be secured prior to any concreting work. All concrete shall be poured on dry and cleaned surfaces.

CW-6.5.2 FORMWORK CONSTRUCTION

Forms shall be installed mortar and watertight, true to the dimensions, lines and grades of the structure and with the sufficient strength, rigidity, shape and surface smoothness as to leave the finished works true to the dimensions shown on the drawings or required by NPC and with the surface finish as specified.

The inside surfaces of forms shall be cleaned of all dirt, mortar and foreign material. Forms, which will subsequently be removed, shall be thoroughly coated with a release agent or coating prior to its use. The release agent shall be commercial quality form oil or other approved coating which will permit the ready release of the forms and will not discolor the concrete.

Formwork for concrete placed underwater shall be watertight.

Forms shall be constructed so that the form surface of the concrete does not undulate excessively in any direction. Undulations exceeding either 2 mm or 1/270 of the center distance between studs, joints, form stiffeners, form fasteners, or wales will be considered to be excessive. Should any form of the forming system, even though previously approved for the use, produce a concrete surface with excessive undulations, its use shall be discontinued until modifications, satisfactory to NPC's Representative, have been made. Portions of concrete structures with surface undulations in excess of the limits herein stated may be rejected by the NPC.

Form fasteners consisting of bolts, clamps or other devices shall be used as necessary to prevent spreading of the forms during concrete placement. The use of ties consisting of twisted wire loops to hold the forms in position will not be permitted.

All formworks shall be provided with adequate clean-out openings to permit inspection and easy cleaning after all reinforcement has been placed. Where forms for continuous surfaces are placed in successive units, the forms shall be fitted over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Panel forms shall be constructed so that they can be removed without damaging the concrete. All exposed joints, edges, and external corners shall be chamfered a minimum of 20 mm unless specified otherwise herein. Forms for heavy girders and similar members shall be constructed with a proper camber.

- Coating: Before placing the concrete, the contact surface of forms shall be coated with a non-staining mineral oil or suitable non-staining form coating compound or shall be given two coats of nitrocellulose lacquer, except as specified otherwise. Mineral oil shall not be used on forms for surfaces, which are to be painted. For surfaces not exposed to view in the finished structure, sheathing may be wetted thoroughly

with clean water. All excess coating shall be removed by wiping with cloths. Reused forms shall have the contact surfaces cleaned thoroughly. Those that have been coated shall be given an additional application of the coating. Plaster waste molds shall be layered with two coats of the thin shellac or lacquer and coated with soft or thinned non-staining grease.

- Tolerance and Variations: The Contractor shall set and maintain concrete forms to ensure that, after removal of the forms and prior to patching and finishing, no portion of the concrete work will exceed any of the tolerances specified. Variations in floor levels shall be measured before removal of supporting shores. The Contractor shall make the necessary corrective measures for the variations resulting from deflection, or when the latter affects concrete quality or curing. The tolerances specified shall not exceed by any portion of the concrete surfaces; the specified variation for one element of the structure shall be considered unacceptable when it permits another element of the structure to exceed its allowable variations. Except as otherwise specified herein, tolerances shall conform to ACI 347.

CW-6.5.3 PLACING REINFORCEMENT

Reinforcing steel and embedded items shall be properly and securely installed prior to the placing of concrete.

In no case shall concreting start without prior inspection and approval by the NPC of the placed reinforcement and other embedded items.

CW-6.5.4 MIXING CONCRETE

Mixing of concrete shall conform to the requirements of ACI Code for Concrete Construction.

CW-6.5.5 PLACING CONCRETE

Concrete shall be conveyed from mixers to the forms or to the place of deposit as rapidly as possible and by methods that will prevent segregation or loss of ingredients. There shall be no vertical drop greater than 1.5 meters except where suitable equipment like metal pipe or tremie is used. The pipe or tremie shall be kept full of concrete and its end shall be kept buried in the newly placed concrete. Chutes through which concrete is delivered to the structure in a thin, continuously exposed flow will not be permitted except for very limited or isolated sections of the work.

Earth surfaces, upon which concrete shall be placed, shall be cleaned, dry and thoroughly compacted before placing the concrete.

Rock surface, upon which concrete shall be placed, shall be thoroughly cleaned of loose or semi-detached or unsound rock particles. Before placing concrete, all surfaces shall be wetted thoroughly to keep them in a completely moist condition, after which leveling mortar of the same cement ratio as the concrete mix complete contact between concrete and the leveled surface.

CW-6.5.6 FINISHING CONCRETE

After the concrete has been deposited, distributed and vibrated, the concrete shall be struck off and screened by mechanical means approved by the NPC. The finishing machine shall be of the screening and troweling type designed and operated both to strike off and to consolidate. Hand finishing may be employed when suitable finishing machines are not available. Finishing of concrete shall be done, as directed, to the satisfaction of the NPC.

All finished surfaces shall be tested with 3 meters straight edge and any variation of the surface from the desired crown or cross section shall be properly corrected.

CW-6.5.7 REMOVAL OF FORMS

Formwork shall not be removed without the permission of NPC; where such permission, however, shall not relieve the Contractor of its responsibility for the safety of the work. Blocks and bracing shall be removed at the time the forms are removed and in no case shall any portion of the wood forms be left in the concrete.

Falsework removal for continuous structures shall be as directed by NPC but in which case shall be temporarily supported such that the structure is gradually subjected to its working stresses. False work shall not be released in any span until the strength specified hereunder is attained.

When concrete strength tests are to be used as basis for the removal of forms and supports, the compressive strength of concrete must meet the following minimum requirements:

	Min. Time	Min.% Strength
Centering under girders and beams	14 days	80%
Sides of beams and all vertical surfaces	1 day	70%
Floor Slabs	14 days	80%

The site shall be cleared of all debris and refuse resulting from work.

CW-6.5.8 CURING AND PROTECTION

Concrete shall be cured for a period of not less than fourteen (14) consecutive days by keeping the surfaces of concrete continuously (not periodically) wet. Where tongue and groove forms were used and left in place of curing, they shall be kept wet at all times prevent opening at the joints and drying out of the concrete.

CW-6.5.9 SAMPLING AND TESTING OF CONCRETE

The Contractor shall furnish all materials, either separately or mixed, as required by NPC. Selection of materials and the making of test specimens shall be made under the supervision of NPC and delivered to

NPC laboratory or any NPC-accredited testing agency at the Contractor's expense.
The expense of making and curing all concrete specimens including the materials comprising the concrete specimens shall be borne by the Contractor. The cost of shipping and testing the concrete shall likewise be at the expense of the Contractor.

No concreting work on the project will be permitted to be done until NPC signifies in writing that, following the performance of the necessary tests, he gives his approval to the use of all materials involve in making the concrete.

As work progresses, test cylinders shall be fabricated from the concrete samples and tested in accordance with ASTM C31 and ASTM C39. At least one set of four (4) cylinders shall be made from each 10 cu.m of the concrete placed of each class. Also at least one set shall be made per day for each class of concrete placed each day.

Two (2) cylinders shall be tested at 28 days for specification compliance and one shall be tested at 7 and 14 days respectively for information. The acceptance test result shall be the average of the strength of the two cylinders tested at 28 days.

The compressive strength of the concrete shall be deemed acceptable if the averages of the three consecutive strength test results is equal to or exceeds the specified strength and no individual test falls below the specified strength by more than 3.50 MPa.

Concrete deemed to be not acceptable using the above criteria maybe rejected unless the Contractor can provide evidence, by means of core tests, that the quality of concrete represented by the failed test result is acceptable in place. Three (3) cores shall be taken in accordance with ASTM C42 and soaked for 24 hours prior to testing. Concrete in the area represented by the cores will be deemed acceptable if the average strength of the cores is equal to at least 85% of and no single core is less than 75% of the specified strength.

CW-6.5.10 TOLERANCES AND REPAIR FOR CONCRETE CONSTRUCTION

Concrete structures shall be constructed to the lines shown on the drawings or where so required to suit actual field requirements. Any structure that does not conform to such lines shall be repaired or removed and made anew by the Contractor at no additional cost to the Corporation.

Repairs shall be made at surface imperfections due to faulty placing of concrete and cuts on the structures due to the removal of excess concrete on the lines shown on the drawings. Such repairs shall be made immediately after early stripping of the forms, after the imperfections have been identified and the methods of repair appropriately established.

CW-6.5.11 SECOND STAGE CONCRETE

The second stage of concrete finishing shall be done only after the final installation of all pertinent equipment, anchorages, pipings, conduits and

other embedded items as may be required for all electromechanical works.

CW-6.6 MEASUREMENT AND PAYMENT

Measurement for payment for Concrete (except concrete which shall be measured for separate payment) will be based on the volume of concrete placed and accepted within the neat lines of the structure as shown on the drawings or in accordance with the manner of measurement set forth in the various sections of the Technical Provisions. No deduction will be made for rounded or beveled edges or space occupied by the metal items 10 sq. cm. or less in cross section, embedded in concrete.

Payment will be made at the corresponding contract unit price for the various items of concrete shown in the Bill of Quantities. Payment shall cover all costs for furnishing all labor, materials, including equipment and tools required for concreting work. Payment shall also include non shrink cementitious grout and epoxy grout inside foundation block out and above engine base plate and care of water.

No separate measurement for payment will be made for formworks of which the cost shall be included in concreting works.

CW-7.0 REINFORCING STEEL

CW-7.1 DESCRIPTION

This work shall consist of furnishing, fabricating, and placing of steel reinforcement of the type, size, shape and grade required in accordance with these specifications and in conformity with the requirements shown on the Drawings or as directed by the NPC.

CW-7.2 MATERIAL REQUIREMENT

All material shall conform to the requirements hereinafter given. Certified test reports (mill test or other) shall be submitted to the NPC for all steel reinforcement used. These tests shall show the results of all chemical and physical tests made.

CW-7.2.1 BAR REINFORCEMENT

Reinforcement bars for concrete shall be hot-rolled, weld able, deformed billet-steel bars conforming to the requirements specified in ASTM A615 and PNS 49 unless shown on the Drawings or as required by the NPC. The use of the cold twisted bars is not permitted. Bar reinforcement shall be shipped in standard bundles, tagged and marked in accordance with the Code of Standard Practice of the Concrete Reinforcement Steel Institute.

CW-7.2.2 SAMPLING

The NPC's Representative will sample reinforcement bars at the source of supply or at the point of distribution, and the Contractor shall notify the NPC in sufficient time advance to permit sampling and testing before

shipment is made. Three (3) samples from each size and class shall be taken at random representing five (5) tons or fraction thereof of each size.

CW-7.3 CONSTRUCTION REQUIREMENT

CW-7.3.1 ORDER LIST FOR BENT BARS

Before materials are ordered, the Contractor shall furnish all order lists and bending diagrams for the approval of the NPC. The approval of order lists and bending diagrams by the NPC shall in no way relieve the Contractor of responsibility for the correctness of such lists and such lists and diagrams. Any expenses incident to the revisions of materials furnished in accordance with such lists and diagrams to make them comply with the drawings shall be borne by the Contractor.

Shop Drawings for Reinforcing Steel (ACI 315): Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions and details of bar reinforcing, accessories and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing steel.

CW-7.3.2 FABRICATION

Bent bar reinforcement shall be cold bent as shown on the drawings or as required by the NPC. Bars shall be bent around circular pin having the following diameters (D) in relation to the diameter of the bar (d):

Bars 6mmΦ to 20mmΦ inclusive	D=6d
Bars 25mmΦ and 28mmΦ	D=8d
Bars 32mmΦ and greater	D=10d

Bends and hooks in stirrups and lateral ties may be bent to the diameter of the principal bar enclosed therein.

CW-7.3.3 PROTECTION OF MATERIAL

Steel reinforcement shall be protected at all times from injury. When placed in the work, it shall be free from dirt, detrimental scale, paint, oil or other foreign matter. However, when steel has on its surface easily removable and detrimental rust, loose scale or dust, it shall be cleaned by a satisfactory method, approved by the NPC.

Store reinforcement of the different sizes in racks raised above the ground with accurate identification. Protect reinforcing steel from contaminants such as grease, oil and dirt.

CW-7.3.4 PLACING AND FASTENING REINFORCEMENT & MISCELLANEOUS MATERIAL (ACI-301)

All reinforcement bars, stirrups, hanger bars, wire fabric, spirals and other reinforcing materials shall be provided as indicated in the drawing or required by the specification, together with all necessary wire ties, chairs, screws, supports, and other devices necessary to install and secure the reinforcement properly. All reinforcement, when placed, shall be free from rust, scale, oil, grease, clay, and other coatings, and foreign substances that would reduce or destroy the bond. Rusting of reinforcement shall not

reduce the effective cross sectional area of the reinforcement to the extent that the strength is reduced beyond specified values. Heavy, thick rust or loose, flaky rust shall be removed by rubbing with burlap or other approved method, prior to placing. Reinforcement that has bends not shown on the project drawings or on approved shop drawings, or is reduced in section by rusting such that its weight is not within permissible ASTM tolerances, shall not be used. All reinforcement shall be supported and wired together to prevent displacement by construction loads or by the placing of concrete. Unless directed otherwise by the NPC, reinforcement shall not be bent after being partially embedded in hardened concrete. Detailing of reinforcing shall conform to ACI 315. Where cover over reinforcing steel is not specified or indicated, it shall be in accordance with ACI 318.

All steel reinforcement shall be accurately placed in position shown on the drawings or as required by the NPC and firmly held there during the placing and setting of the concrete. Bars shall be tied at all intersections except where spacing is less than 30 mm in each direction, when alternate intersections shall be tied. Ties shall fasten on the inside.

Distance from the forms shall be maintained by means of stays, blocks, hangers or other approved supports. Blocks for holding reinforcement from contact with the forms shall be pre-cast mortar blocks of approved shape and dimensions or approved chairs. Layers of bars shall, be separated by pre-cast mortar blocks or by other equally suitable devices. The use of pebbles, pieces of broken stone or brick, metal pipe and wooden blocks or metal chairs shall not be permitted. Unless otherwise shown on the Drawings or required by the NPC, the minimum distance between bars shall be 40mm. Reinforcement in any member shall be placed and then inspected and approved by the NPC before the placing of concrete commences. Bundled bars shall be tied together at not more than 1.80 meters intervals.

Reinforcement shall be placed accurately and secured. It shall be supported by suitable chairs and spaces or by metal hangers. On the ground, and where otherwise subject to corrosion, concrete or other suitable non-corrodible material shall be used for supporting reinforcement. Where the concrete surface will be exposed to the weather in the finished structure or where rust would impair the appearance or finish of the structure, all reinforcement supports, within specified concrete cover, shall be galvanized or made of a suitable non-corrodible material.

All placement or movement of reinforcing steel after placement, to positions other than indicated or specified, shall be subject to the approval of the NPC.

Concrete protection for reinforcement shall be as indicated, or if not indicated, in accordance with ACI 318.

The minimum concrete cover for reinforcement specified in the bid documents shall takes precedence over all permissible reinforcement placement variations; nothing in the variations listed below is to be constructed as permitting violation or compromise thereof:

a.	Height of bottom bars	±6mm above form
b.	Lengthwise positioning	±50mm of bars
c.	Spacing bars in walls and solid slabs	±25mm
d.	Spacing bars in beams and footings	±6mm
e.	Height of top bars	±6mm
f.	Stirrup spacing:	
	(1) For any one stirrup	±25mm
	(2) For over-all group	±25mm of stirrup

Anchors and bolts; including but not limited to those for the machine and equipment bases: frames or edgings, hangers and inserts, door bucks, pipe supports, pipe sleeves, pipe passing through walls, metal ties, conduits, flashing reflects, drains and all other materials in connection with the concrete construction shall, where practicable be placed and secured in position when the concrete is placed. Anchor bolts for machines shall be set to templates, shall be plumbed carefully and checked for location and elevation with an instrument, and shall be held in position rigidly to prevent displacement while concrete is being placed.

CW-7.3.5 SPLICING

Splicing of reinforcement shall be in accordance with ACI 318, except as indicated otherwise or modified herein. Where splices in addition to those indicated on the drawings are necessary, they shall be approved by the NPC prior to their use. Splices shall not be made in beams, girders, and slabs at points of maximum stress. Butt Splicing shall preferably be used over lapping for bar sizes larger than 32 mmΦ. Splices to be welded shall conform to AWS D1.4; certification of weld ability of the reinforcement by the manufacturer, shall be submitted to the NPC. If the Contractor elects to use butt splicing of reinforcing, he shall submit complete details of the process to be used by the NPC. If the butt splices are used the Contractor shall ensure that the splice meets the requirements specified herein by performing at least three splices which shall be submitted for tests to a testing laboratory that has been approved for such testing by the NPC. The cost of these shall be borne by the Contractor.

All reinforcement shall be furnished in the full lengths indicated on the Drawings. Splicing of bars, except where shown on the Drawings will not be permitted without the written approval of the NPC. When allowed, splices shall be staggered as far as possible and with a minimum separation of not less than 40 bar diameters. Not more than one-third of the bars may be spliced in the same cross section, except where shown on the Drawings.

Unless otherwise shown on the Drawings, bars shall be lapped a minimum distance of:

Splice Type	Grade 40 Min.Lap	But Not Less Than
Tension	24d	300mm
Compression	20d	300mm

Where d is the diameter of the bar. In lapped splices, the bars shall be placed in contact and wired together. Lapped splices will not be permitted at locations where the concrete section is insufficient to provide a minimum clear distance of one and one-third the maximum size of coarse aggregate between the splice and the nearest adjacent bar. Welding of reinforcing steel shall only be done if detailed on the Drawings or if authorized by the NPC in writing. Spiral reinforcement shall be spliced by lapping at least one and half (11/2) turns or by butt-welding unless otherwise shown on the drawings.

CW-7.4 MEASUREMENT AND PAYMENT

The quantity to be paid for shall be the calculated theoretical number of kilograms of reinforcement steel bars as determined from the net length of the steel shown on the drawings, incorporated in the concrete and accepted.

The weight of deformed bars will be computed from the theoretical weight of the same nominal size as shown in the following tabulation:

Designation	Size (mm)	Weight (kg/m)
#2	6	0.222
#3	10	0.616
#4	12	0.888
#5	16	1.579
#6	20	2.468
#8	25	3.854
#9	28	4.833
#10	32	6.313
#11	36	7.991

Clips, ties, separators and other related materials used for positioning and fastening the reinforcement in place as required by the NPC shall not be included in the weight-calculated payment under this item. If bars are substituted upon the Contractor's request and as result, more steel is used than specified; only the amount specified shall be included.

When laps are made for splices, other than those shown on the drawings or required by the NPC and for the convenience of the Contractor, the extra steel shall not be measured nor paid for.

The accepted quantity shall be paid at the corresponding unit price for the item, Reinforcing Steel as shown in the Bill of Quantities which price and payment shall be made in full compensation for furnishing materials, labor, equipment and incidentals necessary to complete this item.

CW-8.0 STRUCTURAL STEEL

CW-8.1 GENERAL

This section covers the fabrication, erection, and shop painting of structural steel in accordance with the AISC "Manual of Steel Construction" referred to herein. In the AISC "Manual of Steel Construction" referred to herein, the Specification for Design, Fabrication,

and Erection of Structural Steel for Buildings," and "Structural Joints using A325 or A490 Bolts" shall be considered a part thereto.

CW-8.1.1 SUBMITTALS

Shop Drawings of all structural steel in five (5) copies for approval prior to fabrication of structural steel with complete information necessary for the fabrication and erection of the component parts of the structure including the location, type and size of all bolts and welds, member sizes and lengths, camber & connector details, blocks, copes, and cuts. Include all welds by standard welding symbols.
Erection Plan consists of descriptive data to illustrate the structure steel erection procedure including the sequence of erection and temporary shoring and bracing, and written description of the detailed sequence of all welding, including each welding procedure to be performed.

Certificates of Conformance for the following:

- Bolts, Nuts and Washers
- Welding Electrodes and Rods
- Paint
- Steel
- Certified Test Reports

Chemical Analysis and Tensile Strength Test of structural steel in accordance to ASTM A53.

For high strength bolts and nuts, the Contractor shall also submit chemical analysis, including tensile strength and hardness tests as required by ASTM A325.

CW-8.1.2 DELIVERY AND STORAGE

All materials shall be handled, shipped and stored in a manner that will prevent distortion or other damages. Materials shall be stored in a clean and properly drained location and out of contact with the ground. Damaged materials shall be replaced or, when permitted by NPC, may be repaired in an approved manner at no additional cost to NPC.

CW-8.2 MATERIALS

All the materials shall be of the best quality of their kind, well graded and within the allowable distortions. They shall be free from flakes, corrosion, scales or fragments that could reduce the resistance and durability or injure the external appearance.

Except as modified herein, blast clean surfaces in accordance with SSPC SP6. Wash clean surfaces that become contaminated with rust, dirt, oil, grease or other contaminants with solvents until thoroughly clean. Ensure that steel to be embedded in concrete and surfaces when assembled, are free from rust, grease, dirt and other foreign matter.

CW-8.2.1 STEEL

Materials shall conform to the respective specifications specified herein. Materials not otherwise specified herein shall conform to the AISC "Manual of Steel Construction".

Structural Steel:	ASTM A36
Steel Pipe:	ASTM A53, Type E or S, Grade B, ASTM A501
Steel W-Shape Piles (Soldier Piles):	ASTM A328

CW-8.2.2 BOLTS, NUTS AND WASHERS:

All bolts, nuts and washers shall be of hot-dip galvanized steel, in accordance with the following:

Bolts:	ASTM A307, Grade C or ASTM A36 for Anchor Bolts; ASTM A325 for Fastening Bolts
Nuts:	ASTM A563, Grade A, heavy hex style, except nuts less than 38mm may be provided in hex style
Washers:	ANSI B18.22.1, Type B

CW-8.2.3 ACCESSORIES:

Welding electrodes and steel structural members shall use:

Rods	E70XX electrodes
Non-shrink Grout	ASTM C827, non-metallic

CW-8.3 EXECUTION

CW-8.3.1 FABRICATION

Structural steel fabrication shall be in accordance with the applicable provisions of the Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings as set forth in the AISC "Manual of Steel Construction".

CW-8.3.2 WELDING OF STRUCTURAL STEELWORK:

All welding works shall be as indicated in the drawings and shall conform to AWS D1.1 - 77 "Structural Welding Code". Unless specified on the drawings, fillet welds shall be a minimum of 5 mm (3/16") and welding electrodes shall be with a tensile strength of 485 MPa.

All welding works shall be executed by the AWS D1.1 qualified welders, welding operators and trackers, whose workmanship shall be subject to the approval of NPC.

CW-8.3.3 SHOP PAINTING

Except as otherwise specified, shop prime surfaces of all structural steel, except steel to be embedded in concrete or mortar. Surfaces to be welded shall not be coated within 12 mm from the specified top of the weld prior to welding. Insure that the surfaces are thoroughly dry and clean when the paint is applied. Do not paint on wet weather except under cover. Do not apply paint to steel, which is at a temperature that will cause blistering or porosity, or will otherwise be detrimental to the life of the paint. Apply paint in a workmanlike manner, and coat all joints and crevices thoroughly. Prior to assembly, paint all surfaces that will be concealed or inaccessible after assembly.

Shop prime coat surfaces as soon as possible after cleaning. Apply one coat of inorganic zinc to a minimum dry film thickness of 100 microns.

- Field painting: When the erection work is complete, the heads of field bolts, all welds and any surface from which the shop coat of paint has become worn off or has otherwise become defective, shall be cleaned and thoroughly covered with one coat of shop coat paint. When the paint applied for touching up bolt heads and abraded surfaces has become thoroughly dry, apply two field coats of marine epoxy paint subject to the approval of NPC.

- Marking: Prior to erection, members shall be provided with a painted erection mark. In addition, connecting parts assembled in the shop for remaining holes in field connections shall be matched marked with scratch and notch marks. Do not locate erection markings on areas to be welded. Do not locate erection markings in areas that will decrease member strength or cause stress concentrations.

CW-8.3.4 ERECTION

Except as modified herein, erect steel in accordance with the AISC "Manual of Steel Construction". Where parts cannot be assembled or fitted properly as a result of errors in fabrication or of deformation due to handling or transportation, report such condition immediately to the NPC's Representative and obtain approval there from for the methods of correction for straightening, including members of steel conforming to ASTM A514.

Drain Steel work properly; fill pockets in structures exposed to the weather with an approved waterproof material.

Provide safety belts and lines for workmen aloft on high structures unless safe working platforms or safety nets are provided.

When calibrated wrenches are used for tightening bolts, calibrate them at least one each working day using not less than three typical bolts of each diameter. Do not use impact torque wrenches to tighten anchor bolts set in concrete.

Connections: Connections shall be executed as shown on drawing. In case, connections are not detailed, it shall be designed in accordance with

AISC "Manual of Steel Construction". Build connections into the existing work. Punch, sub-punch and ream, or drill boltholes.

Tolerances: Structural steel shall be furnished and installed to the lines and levels as shown on the drawings.

Any structure that does not conform shall be repaired, removed and/or erected anew by the Contractor at no additional cost to NPC.

Tolerances on structural steel shall be in accordance with the "Code of Standard Practice" of the AISC "Manual of Steel Construction".

CW-8.3.5 TESTS AND INSPECTIONS

Visual Inspection of Welding: After the welding is completed, hand or power wires brush welds, thoroughly clean them before the inspector makes the check inspection. Inspect welds with magnifiers under strong, adequate light for surface cracking, porosity, and slag inclusions; excessive roughness; unfilled craters; gas pockets; undercuts; overlaps; size and insufficient throat and concavity. Inspect the preparation of groove welds for adequate throat opening and for snug positioning of backup bars.

Non-Destructive Testing[2]: In accordance with AWS D1.1 Twenty-five percent (25%) of the total number of joints, as selected by the NPC, shall be tested. If more than 20 percent of welds contain defects identified by testing, then all welds shall be tested by radiographic or ultrasonic testing, and to be approved by the NPC. When all welds made are required to be tested, magnetic particle testing shall be used only in areas inaccessible to either radiographic or ultrasonic testing. Retest defective areas after repair.

CW-8.4 MEASUREMENT AND PAYMENT

Measurement for payment for structural steel shall be based on the total kilogram of structural steel placed and accepted.

Payment will be made at the contract unit price for the item Structural Steel in the Bill of Quantities, which payment shall constitute full compensation for furnishing all labor, materials and equipment necessary to complete the item.

CW-9.0 DRAINAGE SYSTEM AND APPURTENANT STRUCTURES

CW-9.1 SCOPE

In accordance with the specifications contained herein, the Contractor shall furnish all materials, labor, equipment and tools, perform all required excavation and backfill, install all pipes and construct canals and ditches, as the case may be, where indicated on the drawings or where directed conforming with the lines and grades as established in the field by the NPC. The Contractor shall also construct or install, where required, appurtenant structures like street inlet, street inlet-catch basin

[2] Not applicable on non-critical structures/joints and as directed/required by NPC Design Engineer.

combination, manhole, catch basin for downspouts, catch basin for intersecting perforated PVC pipes, septic tank, drainage outlets, etc. as well as joints and connections as may be required to complete the system.

CW-9.2 MATERIALS

CW-9.2.1 NON-REINFORCED CONCRETE DRAINAGE PIPES

Non-reinforced concrete drainage pipes shall meet the requirements of ASTM C14-68.

One pipe length shall be taken at random representing a group of fifty (50) pipes or fraction thereof of the same size and shall be submitted for test. Any group represented by corresponding test specimens that do not meet the strength and other test requirements shall not be used in the work.

CW-9.2.2 REINFORCED CONCRETE DRAINAGE PIPES

Reinforced concrete drainage pipes shall meet the design and test requirements for Class II Reinforced Concrete Pipes in accordance with ASTM C76-68 and ASTM C497-67.

One (1) pipe length shall be taken at random representing a group of fifty (50) pipes or fraction thereof of the same size and shall be submitted for test. Any group represented by corresponding test specimens that do not meet the strength and other requirements shall not be used in the work.

CW-9.2.3 PVC PIPES

Polyvinyl Chloride (PVC) Pipes shall be unplasticized conforming to ISO4435 or equivalent. Details/scheme of perforation shall be as indicated in the bid drawing or as directed by NPC.

CW-9.2.4 CONCRETE COVERED RECTANGULAR DITCH

Cement, reinforcing steel, aggregate and water to be used for the construction of concrete covered rectangular ditch and open rectangular canal shall conform to the requirements set forth in Section CW-6.0 – Concrete. Foundation base material for concrete canal shall be sand and gravel as described in Section CW-4.0.

CW-9.2.5 BEDDING MATERIAL

A. For Stable Soil and Rock Foundation

Bedding material for sewerage and drainage pipes in stable soil and rock foundation, as determined by NPC, shall consist of sand or natural sandy soil in which all the materials passes a 9.5 mm (3/8") sieve but not more than 10% passes a 0.074 mm (No. 200) sieve.

B. For Unstable Foundation

Bedding for sewerage and drainage pipes in soft and unstable foundation as determined by the NPC, shall consist of 13.79MPa concrete cradle in

conformity with the dimensions shown on the drawings, or as determined by the NPC.

C. Foundation under Roadways and Parking Areas

Bedding for sewerage and drainage pipes crossing under roadways and parking areas with pipe cover (excluding concrete or asphalt pavement) of 60.9 cm (2 ft.) or less shall consist of 13.79MPa concrete cradle in conformity with the dimensions shown on the drawings, or as determined by the NPC.

CW-9.3 CONSTRUCTION

CW-9.3.1 TRENCH EXCAVATION AND BACKFILL

Trench excavation and backfill work shall be done in accordance with the pertinent provisions of Section CW-4.0.

CW-9.3.2 CONCRETE CANAL

Concrete canal, open or covered, shall be constructed in accordance with the lines and grades shown on the drawings. Class of concrete shall be as indicated on the drawings or directed by the NPC.

CW-9.3.3 APPURTENANT STRUCTURES

Appurtenant structures like street inlet, street inlet-catch basin combination, manhole, catch basin for downspouts, catch basin for intersecting perforated PVC pipes, septic tank, drainage outlets, etc. shall be constructed at locations indicated on the plans or at the other convenient locations designated by the NPC. All appurtenant structures shall be of 17.30 MPa concrete unless otherwise shown on the drawings.

CW-9.4 PIPE INSTALLATION

CW-9.4.1 GENERAL

Before any drain pipe is installed, the sand or concrete bedding shall have been prepared and approved in accordance with the grade, shape, and dimensions shown on the drawings, or as directed by the NPC. No pipe over 45.7 cm (18") in diameter shall be laid on concrete bedding until seven (7) days have been elapsed after placing the concrete bedding. Pipes under 45.7 cm (18") in diameter may be laid after five (5) days elapsed after placing the concrete bedding.

All drain pipes shall be laid carefully, hubs upgraded, ends fully and closely jointed, and true to the lines and grades given. Succeeding pipe shall be jointed to the previously laid pipe, correct in alignment and grade. Any pipe, which has been damaged during installation or before acceptance of the work, shall be replaced and laid by the Contractor at his expense.

CW-9.4.2 NON-REINFORCED AND REINFORCED CONC. DRAINAGE PIPES

Whenever possible, concrete pipes shall be handled and installed with the aid of mechanical equipment and not just rolled or pushed into the trench

from the bank. For small pipes, rope slings may be placed at both ends of the pipes and the rope slowly paved out until the pipe rests on the trench bed. Proper and careful handling and laying should be observed at all times to prevent unnecessary structural damage to the pipe, especially at the pipe ends.

For pipes on sand bedding, before jointing the next pipe length to the last pipe already laid, the bottom of the trench shall be excavated to the shape, size and location of the collar below the joint. The next pipe section shall then be securely attached to the previously laid pipe seeing to it the correct alignment and grade is always attained. Same procedures shall be observed for the remaining pipes.

All pipe joints shall be filled with stiff mortar composed of one (1) part cement and two (2) parts clean sand and enough water. The inside part of the joint shall be plastered properly to bring the inside surfaces of jointed pipe ends flush even. Sufficient mortar shall be placed on the outside surface of joint to form a bead around the joint. Plastering work shall be as directed and approved by the NPC. After initial set, the mortar on the outside surface shall be protected from air and sunlight with a cover thoroughly wetted earth or burlap. Curing of the joint shall be done for a period of at least seven (7) days within which no backfill shall be placed on the installed pipeline.

CW-9.5 MEASUREMENT AND PAYMENT

CW-9.5.1 CONCRETE RECTANGULAR DITCH

Measurement for payment for rectangular ditch and other channels will be based on the number of linear meters of canal constructed and accepted.

Payment will be made at the corresponding contract unit price per linear meter of the pertinent items shown in the Bill of Quantities. Payment shall constitute full compensation for furnishing all labor, materials, equipment and tools necessary for the construction of the concrete canal including attendant excavation and backfill.

CW-9.5.2 CONCRETE DRAINAGE PIPES AND PVC PIPES

Non-reinforced and reinforced concrete drain pipes, and perforated PVC pipes in place and accepted will be measured by the linear meter along the centerline of the pipeline.

The quantities measured as provided above, completely installed and accepted, will be paid at the contract unit price for each size and kind of pipe shown in the Bill of Quantities. Payment shall constitute full compensation for furnishing all labor, material, equipment and tools for fabricating, hauling, installing and jointing of pipes. Payment shall also include the cost of attendant excavation, bedding and backfilling.

CW-9.5.3 APPURTENANT STRUCTURES

Measurement for payment of appurtenant structures like street inlet, street inlet-catch basin combination, manhole, catch basin for downspouts, catch basin for intersecting perforated PVC pipes, septic tank, drainage

outlets, etc. will be based on the number of structures constructed/installed and accepted.

The Contractor will be paid at the contract unit price for the pertinent item for each appurtenant structure shown in the Bill of Quantities. Such payment shall cover all costs for furnishing all equipment, labor, materials and tools necessary to complete the construction of the aforementioned appurtenant structures. Payment also includes the cost of attendant excavation and backfill, furnishing, scheduling, cutting, bending and placing of reinforcing steel.

CW-9.5.4 BEDDING

Measurement for payment for sand or natural sandy soil bedding and concrete cradle will be based on the number of cubic meters of materials placed and accepted.

Payment wick be made at the corresponding contract unit price for the item. Sand Bedding for Pipes, and item, Concrete Cradle for Pipes, in the Bill of Quantities, which payment shall constitute full compensation for furnishing all labor, materials, equipment and tools necessary to complete the items.

CW-10.0 PERIMETER FENCE

CW-10.1 SCOPE

In accordance with the specifications contained herein, the Contractor shall furnish all labor, materials, equipment and tools for the construction of perimeter and seclusion fences, including the fabrication and installation of vehicular and pedestrian gates, to the length or extent shown on the drawing or as established in the field.

CW-10.2 MATERIALS

CW-10.2.1 CEMENT AND REINFORCING STEEL

Cement and reinforcing steel shall conform to the requirements set forth in CW-6.0 – Concrete. Class of concrete shall be 20.7 MPa or as shown on the drawings.

CW-10.2.2 CONCRETE HOLLOW BLOCKS (CHB)

Concrete hollow blocks shall be 150 mm x 200 mm x 400 mm (6"x 8"x 16") non-load bearing with a compressive strength of 3.10MPa. CHB units shall be free of chips, splits or other defects, which in the opinion of the NPC, might impair their strength and durability. At the option of the NPC, CHB units delivered to the site shall be tested to check on their specified strength. One specimen taken at random representing 500 units shall be tested. Sampling shall be done by the NPC. The group represented by a specimen that fails the compression test shall not be used in the work.

CW-10.2.3 FINE AND COARSE AGGREGATES AND WATER

Fine and coarse aggregates and water shall conform to the requirements stated in CW-6.0 – Concrete.

CW-10.2.4 STRUCTURAL STEEL

All structural steel (rolled shapes and plates) for the fabrication of the vehicular and pedestrian gates, unless otherwise specified on the drawings, shall conform to ASTM A36.

CW-10.2.5 HEAVY GALVANIZED CYCLONE WIRE

The material shall be made from steel wire helically wound and interwoven in such a manner as to provide a continuous mesh without knots or ties except in the form of knuckling or of twisting and barbing the ends of the wires to form the selvage of the fabric. The base metal shall be steel of such quality and purity that, when drawn to the size of wire specified and coated with zinc either before or after fabrication, the finished fencing shall be or uniform quality and have the properties and characteristics conforming to ASTM Designation A392. Fabric that is zinc coated after weaving and produced in accordance with this specification shall be hot-dip galvanized. Fabric that is zinc coated before waving may be either electronically or hot-dip galvanized.

CW-10.2.6 BARBED/RAZOR WIRES

1) Galvanized Barbed Wire

Barbed wire shall consist of three (3) strands of 2.7mmØ heavy galvanized wire with 2.2mmØ four-point barbs. It shall be of the coating class as specified in the drawings.

Individual wire specimen shall stand being bent cold through 180° without fracture on the wire and without flaking off of the zinc coating.

2) Galvanized Razor Wire

Razor wires shall be hot-dipped galvanized (line, single coil or cross coil) which, unless specified in the drawing, shall have the following properties:

- Wire Diameter : 2.5 mm
- Razor Length/Width : 12 – 21 mm / 13 – 21 mm
- Spacing : 26 – 100 mm

CW-10.3 CONSTRUCTION

CW-10.3.1 GENERAL

Excavation, backfilling and concreting work shall be in accordance with the applicable provisions of CW-5.0 – Structural Excavation, Fill and Backfill, CW-6.0 – Concrete and CW-7.0 – Reinforcing Steel and as prescribed hereunder.

CW-10.3.2 CHB CONSTRUCTION

a) Laying

All masonry units shall be plumbed, leveled and accurately spaced. All units shall be wetted before laying. The block should be laid on full mortar bedding and in such a way that no cracks are formed between the blocks and the mortar at the time it is laid. Any horizontal and vertical CHB wall reinforcements shall be anchored to concrete works by means of 10 mm (3/8") round by 609 mm (24") long dowels. Embedding of anchor bolts, expansion shields, conduits, etc. shall be done as the erection progresses.

b) Cutting and Patching

Cutting and patching of masonry, as may be required to accommodate the work of other trades, shall be performed by masonry mechanics.

c) Finishing

All hollow block wall surfaces to be applied with cement plaster will be cleaned, evenly wet slushed with a wash of neat cement and sand followed by 1:2 cement mortar mix 10 mm (3/8") thick which shall be applied with a wooden float.

d) Mortar Proportions

Cement mortar for laying concrete hollow blocks shall consist of one (1) part Portland cement, one-fourth (1/4) part lime and three (3) part sand. Only sufficient water to make a workable mix will be permitted.

Masonry grout for filling cells of concrete hollow blocks shall consist of one (1) Portland cement, one-fourth (1/4) part lime, three (3) parts sand to which three (3) parts gravel is added by volume. Mortar materials shall be accurately measured by volume and thoroughly mixed until evenly distributed throughout the batch mechanical mix. The actual mixing time shall not less than two minutes.

e) Reinforcement

All horizontal reinforcement shall be tied to vertical reinforcement.

CW-10.3.4 CYCLONE AND BARBED WIRES

Fabrication and installation of the heavy galvanized cyclone wire seclusion fence and gate, including barbed and razor (line, single coil or cross coil) wires, shall be in accordance with the drawings or as directed by the NPC.

CW-10.4 MEASUREMENT AND PAYMENT

CW-10.4.1 PERIMETER FENCE

Measurement for payment for perimeter fence will be based on the number of linear meters of fence constructed and accepted or as indicated in the Bill of Quantities which payment shall cover all cost of furnishing all labor, materials, equipment and tools necessary for the construction of the fence.

CW-10.4.2 CYCLONE AND BARBED WIRE FENCE(S)

Measurement for payment for cyclone and/or barbed wire fences will be based on the length of fence in linear meters furnished, installed and accepted including wire anchorage as indicated in the Bill of Quantities.

CW-11.0 GRAVEL SURFACING

CW-11.1 SCOPE

The Contractor shall furnish gravel surfacing in areas as required in the drawings or as directed by the NPC. The Contractor shall furnish all materials, labor, equipment and other necessary accessories so as to complete the work satisfactorily.

CW-11.2 MATERIALS AND WORKMANSHIP

All gravel surfacing as shown in the drawing shall consist of a base layer and finish layer. Material for base layer shall be natural or crushed stone of a clean, hard and durable quality. Before placing of the base course, the surface of the subgrade shall be cleaned of all objectionable substances and properly shaped and drained. The material for base layer shall not be more than 5 cm. in size, and placed and spread on the prepared subgrade to a thickness of 7.5 cm. Spread materials shall be compacted by means of rammer, tapping machine or approved equal equipment. The material for finish layer shall not be more than 2.5 cm. in size, and placed, spread, and compacted satisfactorily.

CW-11.3 MEASUREMENT AND PAYMENT

Measurement and payment will be based on the number of cubic meters of materials placed and compacted according to the drawings or as directed by NPC.

Payment will be made at the contract unit price for the item Gravel Surfacing in the Bill of Quantities. The unit price shall include all cost of subgrade preparation, materials, hauling, compacting equipment need to complete the item.

CW-12.0 GROUTING

CW-12.1 SCOPE

This specification covers the requirements for the furnishing and installation of 2 component concrete epoxy grout unless shown otherwise on the design drawings.

CW-12.2 PHYSICAL PROPERTIES

The cured product shall have the following properties:
Tensile Strength = 27.65 MPa (4000 psi) min.
Compressive Strength = 63.60 MPa (9200 psi)

CW-12.3 SUBMITTALS

The Contractor shall submit copies of brochures/specifications for NPC's approval.

CW-12.4 MEASUREMENT AND PAYMENT

Measurement for payment for Grouting will be based on the number of liters placed and accepted by NPC unless otherwise specified in the Bill of Quantities. Payment shall be made at the corresponding contract price for Grouting shown in the Bill of Quantities. Payment shall include all costs including supply of labor and materials and other incidentals necessary for the completion of the work.

CW-13.0 PAINTING REQUIREMENTS

CW-13.1 GENERAL

The Corroded Metal Clad Switchgear, steel structure and other surfaces shall be painted in accordance with first class standard practices suitable for the purpose.

All paints and shop primer to be used shall be of standard types of a well-known manufacturer subject to the approval of NPC.

CW-13.2 SURFACE PREPARATION

Prior to painting all weld spatter, mill scale, burrs, rust, loose particles, and flux shall be removed. Grinding and deburring shall be performed with a wheel that will assure a clearly cut surface.

Blast cleaning with iron-free sand or grit shall be used. The grit shall be new and unused. Surface preparation of external surface of tank that will be carried-out at the site shall be done by power tool cleaning to avoid scattering of abrasives caused by blast cleaning.

All cleaned surfaces shall be primed within six (6) hours or before any rust bloom forms on the blasted surface.

CW-13.3 PAINTING APPLICATION

Application of painting shall be in accordance with the Manufacturer's recommendations and standard practices. No painting shall be applied on wet or damp surfaces.

The Corroded Metal Clad Switchgear shall be painted to conform with the following:

a)	Primer Coat (50 microns DFT)	:	Zinc rich epoxy polyamide primer
b)	Intermediate Coat (100 microns DFT)	:	Polyamide amine cured epoxy coating
c)	Final Coat (100 microns DFT)	:	Polyamide amine cured epoxy coating

The Corroded Metal Clad Switchgear shall be coated with coal tar epoxy, 400 microns DFT.

The Contractor shall provide test instruments used for testing dry film thickness.

Should the measured dry film thickness result to less than the specified one, the Contractor shall apply additional paint to the coat inspected or shall increase the thickness of succeeding coat, as applicable, to conform with the specified total dry film thickness.

Final color of paint on external surfaces shall be silver or as directed by NPC.

CW-13.4 MEASUREMENT AND PAYMENT

Measurement of payment for **Painting** will be based on the area applied and accepted by the NPC Representative.

Payment will be made at the corresponding contract unit price per square meter for the pertinent items under Civil Works in the Bill of Quantities.

Payment shall constitute full compensation for all labor, materials, equipment, tools and incidentals necessary for the completion of this work.

TECHNICAL SPECIFICATIONS

(ARCHITECTURAL WORKS)

SECTION VI – TECHNICAL SPECIFICATIONS

AW – ARCHITECTURAL WORK

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TECHNICAL SPECIFICATION

AW- ARCHITECTURAL WORKS

AW-1.0 GENERAL ARCHITECTURAL REQUIREMENTS

AW-1.1 General

The work to be done under this section shall include the furnishing of all labor, materials, equipment, tools, storage and stockyards of the pertinent materials and structural components and other incidentals for all architectural works enumerated hereunder, as shown on the accompanying drawings or as otherwise directed.

The work shall be performed and completed with high quality workmanship, in accordance with generally accepted modern practice in carpentry fenestrations, tinsmithing, plumbing, painting, landscaping and masonry work, etc. notwithstanding any omission from these Specifications or drawings.

Materials and structural parts that the Contractor shall supply and install and which will be incorporated in the structure shall be new and unused. They shall be suitable for their intended purpose and appropriately matched to each other complying with all applicable regulations, quality and dimensions standards. Defective work is not acceptable.

AW-1.2 Submission of Samples

At least one (1) month before the start of any installation or application of materials, the Contractor shall submit samples of materials for all sections for evaluation and approval. No work shall be done until after samples are approved by the NPC Representative in writing. All work must strictly conform to approved samples as to quality, texture, color and finish.

Failure of the Contractor to comply with the preceding stipulation shall not entitle them of any extension of time nor any claim whatsoever for any delay in the work after rectification due to disapproval of work.

To avoid unnecessary delay, it is suggested that the orders and/or purchase of imported or local materials shall be made within sufficient period in order that adequate supply is available at any time when needed.

AW-1.3 Substitution of Materials

The Contractor shall submit a written request for substitution of materials in lieu of those specified when deemed very necessary and urgent. Such request shall indicate the reasons for substitution. No substitute material shall be used without written authorization from the NPC Representative.

In case of approved substitution of an inferior kind of material, a reduction in the contract price equal to the difference in cost of the two kinds of materials shall be made. Market prices at the provincial capital or at a commercial center agreed upon by the NPC Representative and the Contractor on the

date upon which authority for substitution is granted shall be the basis of said price reduction. Price differentials shall be determined and agreed upon immediately by both parties and incorporated in the approved letter of substitution.

The Contractor shall submit written request for substitution at least one (1) month before such materials are actually needed. Such request shall be accompanied by samples to be substituted and corresponding certification.

No price increase will be allowed for a better kind of material.

AW-1.4 Certification of Materials

The Contractor shall submit to the NPC Representative signed certificates from manufacturer or sole distributor of equipment and materials to be furnished and installed by the Contractor, certifying as to the kind, quality, rated capacity, quantity, performance and other descriptions of the equipment and materials delivered under a receipt number and date. No equipment or materials shall be erected, installed or applied such as electrical fixtures and accessories, concrete reinforcing steel, cement, G.I. and C.I. pipes, valves and fittings, plumbing and sanitary fixtures, building materials and finishes, paint and waterproofing, etc., without the required certificates.

AW-1.5 Other works which even if not specially mentioned in the Section and Bill of Quantities shall be included:

- The measurements for the execution and payment of the Works, including provisions of the measuring equipment and the engagement of labor
- Connecting up of water, gas and electricity from the mains of the site indicated by the NPC Representative to the points of use
- Provision of small equipment and tools
- Safeguarding the Works against surface water, which shall normally be reckoned with, and its possible necessary removal
- Protecting the Works from heat, wind and rain
- Protection and safety measures required
- Protecting the executed works and the items handed over the execution of same from damage and theft up to the time of acceptance
- Supplying of the operational materials
- Supplying of consumable stores
- Supplying of fitting dowels
- Supplying of simple type pipe covering, e.g., in the shape of pipe sheathings with corrugated cardboard and the like
- Supplying and fitting of pipe fastening elements, e.g., pipe clips, hangers, etc.
- installing and dismantling as well as providing all framework and scaffolds
- Making blackouts on concrete
- Chemical preservation of timber

- Instructing the operating and maintenance personnel

NOTE: The above provisions are general for all types of buildings. The Contractor shall be guided accordingly by the applicable provisions in the specifications and what is shown in the drawings for each type.

AW-1.6 Measurement and Payment

Measurement for payment for different items in **Architectural Works** will be based on the areas, lengths, volumes and quantity placed and accepted by the NPC Representative.

Payments for each architectural item will be made at the corresponding contract unit price per square meter, linear meter, cubic meter and number of pieces/sets, for the pertinent items under Architectural Works in the Bill of Quantities.

Payment shall constitute full compensation for all labor, materials, equipment, tools and incidentals necessary for the completion of each work.

AW-2.0 CONCRETE MASONRY WORKS

AW-2.1 General

The work to be done under this section shall include the furnishing of all labor, materials, equipment, tools and other incidentals to complete the work.

Concrete masonry units of the type and thickness indicated shall be provided, and shall be properly coordinated with the work of other trades. The source of supply for material which will affect the appearance of the finished work shall not be changed after the work has started.

Masonry units shall be handled with care to prevent chipping and breakage. Storage piles shall be so located as to avoid being damaged by construction operations and traffic. Cement and lime shall be stored off the ground under watertight cover until ready for use. Damaged materials shall be rejected.

AW-2.2 Materials

Concrete Hollow Blocks shall be of standard manufacture, machine-vibrated, fine and even textured and well-defined edges.

Unless otherwise shown on the drawings, concrete hollow blocks to be used shall conform to the requirements of ASTM Specification C-129-39 Minimum Compressive Strength of not less than 4.48MPa average of the fine specimens.

Mortar Proportions

a) Cement mortar for laying concrete hollow blocks shall consist of one (1) part Portland cement, one-fourth (1/4) part lime and three (3) parts sand. Only sufficient water to make a workable mix will be permitted.

1) Masonry grout for filling cells of concrete blocks shall consist of one (1) Portland cement, one-fourth (1/4) part lime, three (3) parts sand to which three (3) pea gravel is added by volume. Mortar materials shall be accurately measured by volume and thoroughly mixed until evenly distributed throughout the batch mechanical mix. The actual mixing time shall not be less than two minutes.

2) Intersecting hollow blocks walls and partitions shall be bonded by overlapping units on alternative course or by the use of 6.3mm (1/4") diameter ties at 610mm (24") O. C. every second course (maximum) anchored in filled cells.

b) Concrete lintel beams shall extend 305mm (12") beyond both sides of the opening and reinforced with four 12.7mm (1/2") bars placed over and below window openings.

1) Concrete studs, reinforced with one 12.7mm (1/2") diameter bar, shall be placed at both sides of all window and door openings.

2) All horizontal reinforcement shall be tied to vertical reinforcement.

3) Reinforcement shall be as specified in Section "Structural Steel".

Cement shall be Portland cement of approved brand conforming to ASTM Specifications C150, Type I.

Lime shall be made with pulverized and quicklime or with hydrated lime.
Sand shall be clean, washed and free from deleterious substances.
Water for mixing shall be clean and potable.

AW-2.3 Installation

Laying of all masonry units shall be plumbed, leveled and accurately spaced. All units shall be wetted before laying. The block should be laid on full mortar bedding and in such a way that no cracks are formed between the blocks and the mortar at the time the blocks are placed. All joints should be filled with mortar at the time it is laid. Any horizontal and vertical CHB wall reinforcements shall be anchored to concrete works by means of 10mm (3/8") by 609mm (24") long dowels. Embedding of anchor bolts, expansion shields, conduits, etc. shall be done as the erection progresses.

Cutting and patching of masonry required to accommodate the work of other trades shall be performed by masonry mechanics.

Finishing of all hollow block wall surfaces to be applied with cement plaster will be cleaned and evenly wet slashed with a wash of neat cement and sand followed by 1:2 cement mortar mix 10mm (3/8") thick which shall be applied with a wooden float.

AW-2.4 Concrete Lintel

Unless otherwise indicated, provide concrete lintels over all openings in concrete unit masonry walls. Lintels shall be cast-in-place and reinforced with longitudinal bars at the bottom, and of sizes as indicated on the plans. Concrete works shall conform to Concrete Works of these Specifications.

AW-2.5 Testing of CHB

Test samples from every 500 units shall be taken at random from the CHB to be used before installation. The testing shall be performed by a laboratory approved by the NPC Representative and the cost thereof shall be charged to the account of the Contractor. Concrete hollow blocks represented by such samples, failing to meet the requirements under the latest edition ASTM 6129-70 shall be rejected.

AW-2.6 Measurement and Payment

Measurement and payment for **Concrete Hollow Blocks** including its reinforcing bars will be based on the area in place and accepted by the NPC Representative.

Payment will be made at the corresponding contract unit price per square meter for the pertinent items under Architectural Works in the Bill of Quantities.

Payment shall constitute full compensation for all labor, materials, equipment, tools and incidentals necessary for the completion of this work.

AW-3.0 PLASTERED PLAIN CEMENT FINISH

AW-3.1 General

The work to be done under this section includes furnishing of all labor, materials, equipment and other facilities and the satisfactory performance of all work necessary to complete all cement plaster finish.
Plaster mixture is applied in layers to masonry and reinforced concrete, surface to interior or exterior walls and ceilings.

AW-3.2 Materials

a) Portland cement conforming to the latest edition of ASTM Standards C-150

b) Lime - Slaked quicklime or hydrated lime to make lime putty

c) Sand - Natural sand, white or light grey, washed and cleaned, strong and free from injurious amount of dust and flaky particles.

d) Water - Clean and fresh contains no salt, potable and free from sulfur oil and other impurities that may cause discoloration of the finish.

Accessories for plaster work, includes nails, picture, moulds, casings, window stools, bases, etc.

AW-3.3 Application

The total thickness of masonry and plaster shall be 15mm (5/8"). For a three-coat plastering, the scratch coat and brown coat shall be at least 6.3mm (1/4") thick and the hard finish 3.2mm (1/8") thick with a minimum thickness of 1.6mm (1/16") at any point. For a two-coat work the base shall be 12.7mm (1/2") thick and the hard finish the same as for a three-coat work.

The lath for plastering shall be leveled, plumb and well secured to the backing material. The leveling elements installed would include grounds and screeds. For walls, a screed shall be installed at the base of the wall with its top about 102mm (4") above finish floor. The screed is run horizontally, leveled and set at the exact thickness of finished plaster. Around all openings and the intersection with the ceiling grounds are installed.

All anchorage for cabinets, furniture, stair, handrails, electrical outlets, etc., should be installed before plastering is started.

All internal corners should be reinforced by lapping wire lath.
Mixture for various coats should be checked to see that proportions are correct.

Installation. For hollow wood doors and frame, uniform application regardless of function completely reversible for R.H. or L.H. doors.

NOTE: All cement plaster finish shall be painted.

AW-3.4 Measurement and Payment

The measurement for payment for all **Plaster Plain Cement Finish** will be based on the area applied and accepted by the NPC Representative.

Payment will be made at the corresponding contract unit price per square meter for the pertinent item under architectural works in the Bill of Quantities. Payment shall constitute full compensation for all labor, material including metal lath, equipment, tools and incidentals necessary for the completion of this work.

AW-4.0 VITRIFIED TILE AND NATURAL STONE

AW-4.1 General

The work to be done under this section shall consist of furnishing all labor, materials and other facilities to complete all tile and natural stone works shown on the drawings and specified herein.

AW-4.2 Materials

- Floor tiles shall be vitrified unglazed and glazed ceramic tiles (toilet) using white clay.
- Wall tiles shall be vitrified glazed ceramic tiles using white clay.
- Listel tiles shall be vitrified glazed ceramic tiles.
- Marble countertops, splashboards and floor slabs shall be 20mm, Cebu variety of the best quality conforming to samples approved by the NPC Representative.
- Granite countertops, splashboards and floor slabs shall be non-porous, dark shade color, has a 98% gloss recovery on edge glazing.
- Granite floor tiles shall be non-porous granite dark color as specified in the bill of quantities.

AW-4.3 Samples

Sample of various types/kinds of tiles shall be submitted to the NPC Representative.

AW-4.4 Shop Drawings

Contractor shall submit shop drawings of works to be done. Details shall show sizes, section joints and other required details for the approval of the NPC Representative.

AW-4.5 Execution

All surfaces to receive tiles, shall be structurally sound, plumb level and true, free from dust, grease, calcimine water and other foreign matter.

Wall and floor surfaces with minor variations (1/8" or less) shall be true and smooth with a skim coat of adhesive applied with flat of trowel. Allow to dry before spreading more adhesive for setting the tile.

AW-4.6 Tile Preparation

Tiles - may be set dry or pre-soaked depending on grouting methods to be used. Wall tile may be prepared by soaking in clear water for not less than 15 minutes. If pre-soaked method is used, drain excess water on tile before setting.

Grouting - After floor on tile have been in place for not less than four hours, all joints shall be grouted and cleaned. Tile which becomes dry after setting shall be soaked at the joints with a wet sponge, or sprayed with water before grouting to prevent cracking of the grouting compound, grout used with floor tile must be kept moist until properly cured.

Caulking - At completion of tile work, clean out joints between tile and other built-in fixtures and apply this bead of caulking compound tooled slightly below tile surface.

Clearing - Upon completion, clean all tile surfaces with warm water and a good washing compound and stiff brushes as recommended by tile manufacturer.

Protection - Before traffic is permitted over finished tile floor, cover floors with building paper. Lay board walkways on floor that are to be continuously used as passageway by workmen. Tile floor areas to be trucked over have suitably constructed continuous plank runaways of required width installed over building paper. Remove cracked, broken or damage tile and replace with new one.

AW-4.7 Measurement and Payment

Measurement and payment for **Vitrified Tile and Stone Work** will be based on the area in place and accepted by the NPC Representative.

Payment will be made at the corresponding contract unit price per square meter for the pertinent items under Architectural Works in the Bill of Quantities.

Payment shall constitute full compensation for all labor, materials, equipment, tools and incidentals necessary for the completion of this work.

AW-5.0 VINYL QUARTZ TILES

AW-5.1 General

The work to be done under this section shall consist of furnishing all labor, materials, equipment, tools and the satisfactory performance of all work necessary to complete vinyl quartz tile work shown and indicated in the drawings or herein specified.

AW-5.2 Materials

Vinyl Quartz Tiles shall be 300mm x 300mm (12" x 12") and 3mm thick. Tiles shall have a smooth surface, containing no sand or grit and shall be free from the lumps and unmixed coloring pigments. Materials shall consist of only the highest grade laboratory approved uPVC resin, plasticizer and stabilizers, pigments and quartz filler, which is used to insure abrasion resistance and dimensional stability.

Tiles must be equal or better than "British Standard 3250" in terms of squareness, gauge, stability, abrasion and indentation resistance. It must be fire-resistant.
Adhesive shall be water-resistant type and recommended by the tile manufacturer to be the best suited for tropical installation and for use with the particular type of floor. Adhesive shall be applied in accordance with the adhesive manufacturer's printed instructions unless directed otherwise by the NPC Representative.

Plastic emulsion (seal polish) shall be best suited for the particular type of floor as recommended by the tile manufacturer.

Metal edge strips shall be provided at all exposed edges of vinyl quartz tiles. Metal strips shall be extruded aluminum or brass, butt type and beveled at exposed edges. Top surface metal strips shall be finished flush with the tiles. Strips shall be secured at the ends and between at about 200mm apart with screws. Where two different floor finishes meet on the same level of the surface, the vinyl tile shall be provided with a metal edge strip. Brass metal strip edge nosing shall be provided between vinyl tile floor finish and ceramic tile floor finish.

AW-5.3 Sample

Samples must be submitted to the NPC Representative for approval as to color and quality.

AW-5.4 Installation

All concrete floors must be checked for even level and finish. All cracks, holes, depression, etc. must be filled or leveled with suitable fillers. They must also be free from dirt, dust, wax, oil, grease, or foreign matter that may affect properties of adhesive.

Preparation – Concrete sub-floors to receive the tile shall be clean, thoroughly dry, smooth, firm and sound; and they shall be free from oil, dirt, curing compounds, or other deleterious materials. Sub-floors shall be swept, vacuumed and damp-mopped when necessary to remove dust and oil. It shall be scrubbed with a strong detergent solution, thoroughly rinsed, and spot primed, when necessary to remove oil or grease stains. All edges shall be ground smooth and all holes and cracks less than 1.6mm shall be filled with an approved plastic emulsion. Large holes and depressions, if any, shall be filled and treated with underlayment mortar troweled on to smooth surface and shall be completely dried before the application of adhesive.

Tile-laying Design – Floor covering shall be applied in patterns selected by the NPC Representative for each area. Joint lines shall be parallel to wall lines. Where line patterns of tiles run perpendicular to lines of other tiles, they shall be laid truly at right angles. Tiles shall be neatly cut as required to form neat edges around permanent fixtures, built-in furniture and cabinets, pipes and other items attached to the floor or wall.

Adhesive – Recommended adhesives are neoprene, rubber based contact adhesive, rugby-type adhesive. The adhesive shall be applied in a thin film

while it is still tacky and spread evenly both on floor and tile, allowing ten (10) minutes drying time prior to installation.
Application of Tiles – Tiles shall be laid cut from midpoint of the long axis of the area to be tiled so that opposite borders will be of equal width. Starting at established guidelines, the approved adhesive shall be spread over and under floor with a fine notched trowel covering approximately 4.0sq.m. per liter and immediately the tiles shall be embedded into the adhesive. Tiles shall be rolled in both directions with a 70kg roller to assure contact of tiles and adhesive and to bring edges of the tiles flush.

All junctions with vertical surfaces, tiles shall be carefully scribed so as to form a neat joint at this point. Tile shall never be placed or laid under pressure.

Cleaning and Waxing - Not earlier than five days after installation, floors shall be washed with an approved cleaning solution and rinsed thoroughly with clean cold water. Vinyl tiles shall be waxed with two coats of water emulsion wax, buffed to an even luster with an approved emulsion.

AW-5.5 Measurement and Payment

Measurement and payment for **Vinyl Quartz Tiles** will be based on the area installed and accepted by the NPC Representative.

Payment will be made at the corresponding contract unit price per square meter for the pertinent items under Architectural Works in the Bill of Quantities.

Payment shall constitute full compensation for all labor, materials, equipment, tools and incidentals necessary for the completion of this work.

AW-6.0 PEBBLE WASHOUT FLOOR FINISH

AW-6.1 General

The work to be done under this section shall consist of furnishing all labor, materials, equipment, plant and other facilities and the satisfactory performance of all work necessary to complete all pebble washouts shown on the drawings and specified herein.

AW-6.2 Materials

a) Portland Cement and Sand shall be used for scratch coat.

b) Pebble size and color shall be determined by the NPC Representative.

c) White Cement. - as approved by the NPC Representative.

AW-6.3 Samples

Samples of washouts in tile form shall be submitted to the NPC Representative. No washout work shall be done until after samples are

approved by the NPC Representative in writing. All work must strictly conform to approved samples as to texture, color and finish.

AW-6.4 Application

Before commencement of the work, desired pitch for drainage should be provided in the concrete slab. Concrete must be rough and all loose particle or anything which would prevent bond should be thoroughly cleaned off with water. The concrete surfaces must be kept wet for at least four (4) hours before scratch coat is applied. The required scratch coat of cement mortar in the proportion of one (1) part Portland cement of two (2) sand, by volume, shall not be more than 19mm (3/4") in thickness.

Washout finish shall be applied with pressure to obtain solid adhesion to the concrete which shall not be more than 10mm (3/8") thick, composed of one (1) part Portland or white cement, and three (3) parts pebbles, troweled to a hard, smooth even plain, rodded, and floated to a uniform surface with clean water evenly with a spray machine to wash out all cement on the surface so that the pebble quarts shall be partly exposed, and by means of soft brush and water to remove and wash down the remaining cement paste, leaving the pebble in their natural textures and appearances.

AW-6.5 Cleaning

After all trades have completed their work, wash the surface with clean water and brush thoroughly to produce a clean and sparkling appearance.

AW-6.6 Measurement and Payment

Measurement for payment for **Pebble Washout Finish** will be based on the area in place and accepted by the NPC Representative.

Payment will be made at the corresponding contract unit price per square meter for the pertinent item under Architectural Works in the Bill of Quantities.

Payment shall constitute full compensation for all labor, materials, equipment, tools and all incidentals necessary for the completion of this work.

AW-7.0 PLYWOOD CEILING BOARDS

AW-7.1 General

Consist of furnishing of all labor, materials and other facilities for the satisfactory of all work necessary to complete the marine plywood ceiling.

AW-7.2 Materials

Thickness of plywood boards shall be as indicated on the drawings, marine, rotary cut, tanguile or dao. Sheets shall be nailed to ceiling nailers/joists at 150mm (6") on center.

AW-7.3 Sample

Samples must be submitted to the Contracting Officer for approval as to quality.

AW-7.4 Wood Framing

Framing shall be 50mm x 76mm (2" x 3") tanguile ceiling joists at 1200mm o.c.b.w. and 50mm x 50mm (2" x 2") nailing strip at 400mm o.c.b.w. or as indicated on the drawings.

AW-7.5 Miscellaneous

Fastener shall be smooth shank, zinc - coated, common wire nails of local manufacture.
Glue shall be resorcinol formaldehyde synthetic resin.
Putty shall be of the color to match wood finish where exposed and shall be subject to approval of the Contracting Officer.

AW-7.6 Construction

All rough carpentry work, ground centering, blocking, etc., shall be in accordance with detailed drawings or recognized carpentry standards.
The Contractor shall rigidly construct all wood framing true to lines, levels and dimensions. Nails and other anchorage shall be in accordance with good practice.

Miter external molded members and cope internal corners.
No hammer mark or any other unsightly marks shall be made on any exposed wood face.

All lumbers that will come in contract with concrete and masonry shall be coated with asphalt.

AW-7.7 Protection

The Contractor shall be held accountable for the damaged materials caused by negligence mishandling.

AW-7.8 Measurement and Payment

Measurement and payment for **Plywood Ceiling Boards** will be based on the area installed and accepted by the Contracting Officer.

Payment will be made at the corresponding contract unit price per square meter for the pertinent item under Architectural Works in the Bill of Quantities.

Payment shall constitute full compensation for all labor, materials, equipment, tools and incidentals necessary for the completion of the work.

AW-8.0 SUSPENSION SYSTEM

AW-8.1 General

The Contractor shall furnish all materials, labor and equipment necessary to install complete suspension system for plaster ceiling, acoustic board, perimeter for light diffuser and necessary anchorage.
The Contractor shall submit to the NPC Representative for approval, samples and shop drawings illustrating fully the construction and methods of installation. Work shall be performed only upon written approval of the samples and drawings by the NPC Representative.

AW-8.2 Materials

Components shall be manufactured from prime quality hot-dipped galvanized steel according to BS 2989 and JIS G3302 Standards with Z18 zero spangle zinc coating (180/m^2). The exposed flange is capped with pre-coated metal strip with polyester coating of 20-25 microns dry film thickness.

Main (1-1/4" x 1") and intermediate (1") runners for all suspension system, unless otherwise required, shall be galvanized steel Snap-On T-runners, satin silver color. The runner shall be installed 600mm on centers supported at every 1200mm by wire or steel strap hangers. The grid shall be leveled to within 1/500.

AW-8.3 Workmanship

The installation and workmanship shall be in full accordance with manufacturer's specifications and shall be made by workmen experienced in this kind of work. Acoustical tiles shall be clipped to the ceiling suspension system with galvanized spring clips. Tile shall fit closely to adjoining walled beams, columns, pilasters and cut neatly around all openings in the ceiling.

AW-8.4 Measurement and Payment

Measurement for payment for **Suspension Sys**tem will be based on the area in place and accepted by the NPC Representative.
Payment will be made at the corresponding contract unit price per square meter for the pertinent items under Architectural Works in the Bill of Quantities.

Payment shall constitute full compensation for all labor, materials, equipment, tools and incidentals necessary for the completion of this work.

AW-9.0 DOWNSPOUTS AND ROOF DRAINS

AW-9.1 Scope of Works

a) Downspouts

Downspouts shall be 150 mm diameter unplasticised PVC, or as indicated in the drawings complete with fittings and accessories down to the catch basin and water storage tank.

b) Roof Drain

Roof drain shall be of high grade, strong, stainless. Casting shall be free from blowholes, porosity hard spots, excessive shrinkage, cracks, or other injurious defects shall be smooth and well cleaned both inside and outside and all fin sand roughness removed. Roof drains shall conform to the diameter of downspouts. Roof drains shall be provided at the upper end of all downspouts.

AW-9.2 Measurement and Payment

a) Downspouts

Measurement for payment will be based on the length installed and accepted.

b) Roof Drains

Measurement for payment for Roof Drain will be based on the number of set installed and accepted.

Payment shall constitute full compensation for labor, materials, equipment, tools and incidentals necessary for the completion of the work.

AW-10.0 MOISTURE VAPOR BARRIER

AW-10.1 General

The work to be done under this section includes the furnishing of all labor, materials, equipment, and other facilities required to complete all moisture vapor barrier work as shown in the drawings and as specified.
All concrete floor slabs in direct contact with the ground shall be provided with moisture vapor barrier to stop movement of moisture from the ground through capillary action or osmotic pressure.

AW-10.2 Materials

a) Vapor Barrier – Vapor barrier shall be polyethylene sheeting with thickness as recommended by the manufacturers and as approved by the NPC Representative.

b) Adhesive and/or Tape – Adhesive or tape shall be as recommended by the manufacturers as approved by the NPC Representative.

AW-10.3 Physical Properties

a) Tensile strength (lb/2" width) is 260.

b) Moisture and vapor transmission (ASTM F. 96, Procedure E) Ungreased gm/sq.m/225 hours is 25. Perms shall be 0.125.

c) Greased (ASTM D1027) 6M/sq. meter/24hours is 8. Perms shall be 0.27.

AW-10.4 Application

Prior to placing the concrete, the hard core fill should be compacted to a smooth even surface, eliminating all sharp projections or irregularities which may puncture the moisture and vapor barrier. It is preferable in most cases to bring the fill to grade with a stiff mix of one part Portland cement and three parts sand so placed as to provide a smooth even surface for installing the membrane, or to blind the hard core with a layer of consolidated sand. The net thickness of consolidated sand above the gravel fill shall not be less than 6.3mm. Cover the entire area with a layer of moisture and vapor barrier extending past the perimeter of the slab and turning up against walls for the depth of the concrete. The moisture and vapor barrier shall be lapped and the exposed edges of polyethylene shall be sealed by either of the sealing set out below. Where pipes and conduits must pass through the barrier, the material should be carefully cross slit so that it fits tightly around the pipe, and then taped to the pipe with pressure sensitive tape.

Sealing

a) Tape Sealing - To obtain an effective seal, moisture and vapor barrier should be lapped 25mm (1") at all joints and sealed with 50 mm (2") pressure sensitive tape. A 50mm (2") width of polyethylene film is left exposed on both edges for joining and it is important to ensure that both surfaces are free from moisture and dust, and that the tape is in contact with the polyethylene film on both sheets. If necessary, a firm base such as board can be placed under the joint and the tape applied with firm pressure by hand or by mechanical applicator.

b) Adhesive Sealing - Where adhesive sealing to be used, each alternate sheet must be inverted so that the exposed polyethylene strips of the alternate sheets of the barrier face downwards, ensuring that both surfaces are free from moisture and dust. The sheets shall be lapped 50mm (2") to ensure good adhesion and both surfaces shall then be coated with adhesive and the joint made in accordance with the manufacturer's instructions.

c) End Joint Sealing - End joint sealing should be effected by cutting the ends square, forming a continuous single interlocking fold and sealing on both sides with adhesives.

AW-10.5 Vapor Barriers Under Concrete Slab on the Ground Level

After consolidating the sand bed under concrete floors and edge beams and before placing the reinforcement, the whole of the sand bed shall be covered with a layer of vapor barrier laid in the longest lengths and widest available widths, lapped 25mm at all joints and intersections and sealed with the pressure sensitive tape. A 50mm width of polyethylene film shall be exposed on both edges of the moisture vapor barrier where sealed joints are to be made and the contractor shall ensure that the tape is in contact with a film on both sheets, all in accordance with the manufacturer's instructions. Alternatively, adhesive sealing may be used in which case each alternate

sheet shall be inverted, so that the exposed strips of the sheets are in contact. The sheets shall be lapped 50mm and both polyethylene surfaces coated with the contact adhesive and firmly pressed together to form a moisture proof sealed joint. The moisture vapor barrier shall be carried down into trenches, turned up at the side edge and after concrete has set, turned across on top of concrete slab under cavity flashing.

AW-10.6 Measurement and Payment

Measurement and payment for **Vapor Barrier** shall be based on the area of material installed and accepted by the NPC Representative.

Payment will be made at the corresponding contract unit price per square meter for the pertinent item under Architectural Works in the Bill of Quantities. Payment shall constitute full compensation for all labor, materials, equipment, tools and all incidentals necessary for the completion of this work.

AW-11.0 GLASS AND GLAZING

AW-11.1 General

The work includes the furnishing of all labor and materials required to complete all glass and glazing as shown on the drawings and/or herein specified. Mirrors shall be provided and installed where indicated in plans.
The Contractor is responsible for the correct sizes and grades of glass to be used. Improperly set glass or glasses which does not meet the requirements of its grade and size will not be accepted. Such glass must be replaced to the satisfaction of the NPC Representative.

The size of glass indicated is approximate only and the actual size shall be determined by measuring the frame to receive the glass. Glazing rabbets shall be rigid true, plumb, square, properly primed, clean, dry and dust free, before glazing work is started.

Each piece of glass shall have the manufacturer's label showing the type, thickness and quality of the glass. Putty and glazing compound shall be delivered to the site in unopened containers, plainly labeled with the manufacturer's name and brand.

AW-11.2 Materials

a) Glass of all windows, doors, transoms shall be of the best quality of its respective kind and free from internal or surface defects. Thickness of glass shall be as mentioned in the plans. For other qualities and thickness refer to recognized standards.

b) Mirror. Where required on the drawings for various purposes, public spaces, etc., glass to be selected shall be 6.3mm (1/4") thick, polished plate glass with right of rejection. Silver to be deposited evenly on selected quality polished plate and protected with electro-copper backing, shellac, varnish and paint in an approved standard method.

Each mirror shall bear manufacturer's label guaranteeing quality and compliance with specifications guaranteed for ten (10) years to be free from any defects that impair full and complete reflection or that present on unsightly appearance. Upon receipt of notice from NPC Representative, Contractors shall repair and/or replace without cost to the NPC all defective material and workmanship.

All labor and other incidental materials such as glazing compound, shims, glazing clips, securement devices, felt, etc., not specifically referenced above but required to provide a complete satisfactory and approved installation. Prior to setting of any mirror on masonry or plastered wall surfaces, all such surfaces shall be damp-proofed. Mirror with frames (in toilet rooms) with kinds, quality and finish as specified complete with "theft proof" frames shall be furnished and installed in all toilet rooms as indicated in the drawings. Mirror shall be 6.3mm (1/4") thick with aluminum or stainless steel frame on a 6.3mm (1/4") thick plywood backing. Space behind walls shall be insulated and damp-proofed. Check "flatness of wall plan" prior to setting. Perimeter for frame shall be set closely against wall surface in all cases. Renew plastering or surface back mirrors and report any irregularities to NPC Representative that will prevent mirror frames fitting closely to wall surface.

Note: Guarantee is required for all mirrors.

AW-11.3 Installation

a) The glass shall be prevented from all contact with metal or any hard or sharp metals by using resilient shims placed at quarter points.

b) Resilient sealant shall be used.

c) Use stops in size permitting a "good grip" on the glass.

d) Glass shall be installed only in openings that are rigid, plumb and square.

e) Allow sufficient clearance at edges of glass to compensate for some settlement of the building. Clearance shall be 6.3mm (1/4") from edge to frame and 3.2mm (1/8") for face.

f) Marking, banners, posters and other decor shall not be applied directly to glass surface as these could cause thermal stress.

g) Removal of putty or glazing compound smears from glass shall be performed by the glazing Contractor during the metal work life. Failure to do so may result in damage to the glass.

AW-11.4 Measurement and Payment

No measurement for payment for **Glass and Glazing** of doors and windows, the relevant cost being included in the contract unit price for the pertinent items for Doors and Windows under Architectural Works in the Bill of Quantities.

AW-12.0 GLAZING SEALANT

AW-12.1 General

The work to be done shall consist of furnishing all labor, materials and other facilities for the satisfactory performance of all work necessary to complete all glazing sealant work as shown on the drawings and specified herein.

AW-12.2 Materials

a) Silicone Rubber should comply with Federal Specifications for silicone building sealant and Federal Specifications for one (1) component building sealant. Packaging shall be supplied at least in fl. oz. (325 ml) cartridges and two (2) gallons (7.5 litters), bulk pails, net weight. The joint width shall not be less than 3.2mm. (1/8"). The joint depths shall allow a sealant depth of 3.2mm (1/8") to a maximum of 12.7mm. (1/2"). The silicone sealant bead depth shall be less than the joint width which is about 2.1mm.

b) Masking Tape. Areas adjacent to joint shall be masked to a sure line. Do not allow masking tape to attach clean surface to which the silicone sealant is to be adhere. Tooling shall be completed in one (1) continuous stroke immediately after sealant application and before a skin forms. Masking shall be removed immediately after tooling.

AW-12.3 Method of Application

Sealant shall be applied in a continuous operation. A positive pressure adequate to properly fill and seal the joints width shall be employed. Tool or strike the building sealant with light pressure to spread the material against the back-up material and the joint surfaces such as aluminum (sealant shall be applied above 40 °F). A tool with a concave profile is recommended to keep the building sealant with the joint. The sealant can be applied at outdoor temperature as low as 35 °F provided that surface is clean and dry. Excess sealant shall be cleaned from non-porous surfaces, before curing, before using a commercial solvent. On porous surfaces, excess sealant shall be allowed to cure and them be removed by abrasion or other mechanical means. The sealant shall not be disturbed for at least 48 hours.

AW-12.4 Guarantee

The Contractor shall guarantee the caulking work to be free from defects of materials and workmanship for a period of ten (10 years).

AW-12.5 Measurement and Payment

No measurement for payment will be made for **Glazing Sealant**, the cost of which shall be included in the contract unit price for the pertinent items where Glazing Sealant is required under Architectural Works in the Bill of Quantities.

AW-13.0 WEATHERSTRIPPING

AW-13.1 General

The work to be done shall consist of furnishing materials tools and equipment and perform labor required to complete all types of weather-stripping for all exterior doors and doors noted on the drawings to be light-proof, soundproof or dust-proof, install weather stripping in accordance with manufacturer's instructions. Fit tightly at corners to maintain continuity around periphery of doors.

AW-13.2 Samples

Sample of strips of weather-stripping elements shall be submitted.

AW-13.3 Materials

a) Extruded products shall be of aluminium alloy 6063 T5.

b) Extruded architectural bronze.

c) Flexible metal products shall be of (zinc, aluminium/bronze/ stainless steel).

d) Inserts shall be of vinyl and/or felt.

AW-13.4 Fasteners

All extruded weather-stripping and saddles shall be furnished complete with screws, color-matched to the items.

a) For fastening to wood, screws shall be of aluminium or bronze.

b) For fastening to metal, screws shall be of self- tapping plated steel.

c) For exterior applications to metal, stainless steel self-tapping screws, plated to match the items are recommended.

AW-13.5 Installation

Included products shall be installed level, square and in proper alignment and relationship to work of other trades. Attachments shall be by means of appropriate nails, screws, bolts, and/or anchors of corresponding materials.

AW-13.6 Measurement and Payment

No measurement for payment will be made for **Weather-stripping**, the cost of which shall be included in the contract unit price for the pertinent items for Doors and Windows where weather-stripping is required under Architectural Works in the Bill of Quantities.

AW-14.0 JOINERY AND CARPENTRY WORKS

AW-14.1 General

These regulations shall apply to all parts of work in which joinery (carpentry for permanent features, i.e. excluding formwork or shuttering, wood scaffolding, etc.) will be used.

All services shall comprise labor, equipment and the supply of the appurtenant materials and structural components including off-loading and storage at the site unless otherwise specified.

All materials and structural components to be supplied, erected or installed by the Contractor, and therefore, ultimately incorporated in the structure shall be new and unused unless otherwise specified. They shall be suitable for their intended purpose and appropriately matched to each other.

All materials and structural components covered by standards shall meet the quality and dimensional requirements thereof.

Early enough before the beginning of fabrication, the dimension of non-standardized structural components shall be checked by Contractor on the structure unless it is established, for instance, in the Specifications or by mutual agreement, that such checking can be dispensed with or will be replaced by the statement of specific dimensions, e.g., in drawings explicitly mentioned.

In particular, the Contractor shall verify that such conditions as the following do not exist:

- undue humidity of the structure
- Inadequate painting of the structural components intended to be installed.
- Lack of possibilities for fixing the structural components and sealing them against the respective part of the structure.

Other works which even if not specifically mentioned in the Bill of Quantities or Schedule of Price shall be included in the Contractual Works.

- Protecting the executed Works and the items handed over execution of same from damage and theft up to the time of acceptance.
- Providing small tackle and tools.

- Supplying consumable stores
- Transporting all materials and structural components, from the storing places at the Site to the points of destinations, and return transport if necessary.
- Removal of all contamination (refuse, building, rubbish and the like) arising from or in connection with the Contractor's work.
- Installing and dismantling as well as providing all false work and scaffolds.
- Making holes in masonry and light weight concrete.
- Supplying and fitting dowels.
- Chemical preservation of timber.

Prior to the start of his operations under this item, the Contractor shall verify that all conditions are suitable for the timely and effective carrying out of his work. Where unsuitable conditions are found, they shall be reported in writing to the NPC Representative and under the NPC Representative's direction immediately corrected.

AW-14.2 Quality of Lumber

Lumber indicated and required for various parts of the work shall be of the best grade available. It must be straight, sound, bright, of nature growth, well - seasoned and conditioned to suit the particular purpose for which it is to be used. The material shall be cleanly sawn, square edged, and free from injurious shakes, splits, warps, wanes and knots, soft spots and rot, incipient, decay and all other defects or imperfections impairing its strength, durability or appearance. All structural components shall be made so that when properly treated and used they will not warp or crack under any circumstances including stresses due to temperature humidity that will have to be expected. Their general conditions on lumber when not mentioned in the succeeding particulars are carried and shall apply.

AW-14.3 Fastening

Joints for cabinet work shall be glued aside from nails or other fastening device required. The type and strength of gluing shall suit the site of installation and intended application (of glues) must not cause any discoloration or other damage. Sealing compounds shall be resistant to atmospheric influences, shall not harden, and shall not be aggressive.

All nails on surfaces exposed to view shall have flush heads. They shall be countersunk. The use of nails with notched heads and screw nails in lieu of wood screws shall not be allowed.

All door frames shall be rabbeted and molded. Frames which are in contact with concrete shall be anchored by means of 102 mm (4") common wire nails spaced not more than 204 mm (8") apart the contact surfaces.

Anchors, connectors, fastenings, and any rough hardware necessary for the completion of the work but is not shown or indicated on the drawings and/or specified shall be provided. Such rough hardware shall be of the size and type to suit the conditions encountered. Bolts, nuts, washers, hangers, straps and other rough hardware is embedded in or in contact with exterior wall of concrete masonry or slab or exposed to weather shall be zinc coated unless otherwise specified. Bolts head and nut bearing on wood shall be provided with standard steel washers.

AW-14.4 Wood Preservatives

All lumbers ultimately in contact with the outside air or permanently with particular humid air or connecting to masonry or concrete e.g. windows and doors, including lining and casing, shall before being inserted be treated on all sides with a suitable wood preservative, in the case of lumber sensitive to blue stain, also with a blue stain preventive agent, unless adequately protected in manufacture already, e.g. wood work items.

The Contractor shall in the choice and use of the wood preservative exercise the care required in the handling of poisonous substances. The wood preservative shall also be compatible with the paint and in interior applications the wood preservative shall be colorless.

If the NPC Representative has not specified the wood preservative to be used, the Contractor may make his own choice of a suitable preservative, subject to the NPC Representative's approval. Before leaving the workshop, the lumber components shall receive a coat of paint.

Lumber surfaces in contact with masonry shall be given two (2) brush coats of bituminous paint before installation.

AW-14.5 Materials

Materials for carpentry works shall conform to the following specifications and shall be used whenever indicated in the plans or noted in the Bill of Quantities:

a) Kinds of Lumber

1) S4S Yacal, Molave Guijo or approved equal

i) Door and window jambs, sills and mullions

ii) Any lumber in contact with concrete or masonry, such lumber mentioned above shall be treated with wood preservative treating solution.

2) Apitong or approved equal

i) Ceiling frames and hangers

ii) Wooden frames and shelves, cabinets and closet

3) Tanguile, Red Lauan or approved equal

i) Cabinet and closet framing, kiln-dried with moisture content not more than 10% when tested

ii) All mouldings, base boards and wood slats.

iii) Vertical and horizontal studs for interior partitions

iv) All T & G board, fascia boards, louvers shall be kiln-dried with moisture content not more than 10% when tested.

v) Door and window sash frames

4) Kiln-dried Narra

i) Mouldings and lattice works and base boards.

ii) Wood handrails, door panels and frames with moisture content not more than 10% when treated.

iii) All structural lumber to be used for truss members, purlins, cleats, wood plates, girder and rafters shall be as indicated in the Civil Design drawings.

AW-14.6 Shop Drawings

Shop drawings with essential dimensions and details for construction may be required by the NPC Representative in connection with carpentry and joinery work which will be submitted for approval before proceeding with the work.

AW-14.7 Measurement and Payment

Measurement for payment for **Carpentry Works** will be based on the unit of measure specified in the bill of quantities install and accepted by the NPC Representative.

Payment will be made at the corresponding contract unit price per unit of measure specified in the bill of quantities for the pertinent items under Architectural Works.

Payment shall constitute full compensation for all labor, materials, equipment, tools and incidentals necessary for the completion of this work.

AW-15.0 MILLWORK AND CABINET WORK

AW-15.1 General

The work to be done under this section shall consist of furnishing all labor and materials, and performing all operations temporary and permanent woodworks, finished treatment and building-in of all cabinet type items,

complete in every respect, and incidental associated woodwork appurtenances, the application of all finish hardware in connection with finished woodwork in strict accordance with requirements of drawing and is specified herein subject to the terms and conditions of the Contract Documents.

All woodwork required to be furnished and installed in connection with finish treatment of exposed interior surfaces or spaces, that is cut, fitted, built-in and finished structure is hereby subject to the terms and conditions of the Contract Documents.

All finished millwork that is constructed, assembled and provided with surface finish treatments in a shop outside building structure is hereby classified as "Cabinet Work". Reference to "surface finish treatment" including the filling, staining, shellacking or waxing of all cabinet type woodwork unless noted to contrary.

AW-15.2 Work not Included

Woodwork and equipment items specifically indicated on drawing as being furnished by the Contractor.

AW-15.3 Materials and Workmanship

a) Lumber and Wood (Rough Carpentry Work) shall, unless approved otherwise, be new lumber, well-seasoned, air-dried, first quality or other specie conforming to requirements thereof of equivalent kind and quality. Wood for blocking, grounds nailing strips, and/or other woodwork incident to carpentry and joinery and/or for use of other trades unless specified otherwise, shall be second quality Apitong or approved equal perfectly sound and free from loose knots, cluster knots to surface knots that would interfere with or preclude the sound attachment thereof and/or securement to other work.

b) Wood for shelves and shelving in coat closets, supply closets, etc., shall be of K.D. Tanguile suitable for painting and varnishing, as approved by the NPC Representative.

c) Mill and Cabinet Work
Specie of wood shall be K.D. Tanguile for all items of finished wood and cabinet work required to have a natural wood finish, unless otherwise specified.

Quality and Workmanship. All wood for interior finished mill and cabinet work shall be thoroughly air-cured, kiln-dried stock, satisfactory to NPC Representative. All materials specified herein shall be product of one mill in so far as practicable. Contractor shall submit for approval the name of subcontractor for mill and cabinet work called for on scale drawings. Only first-class cabinet type workmanship will be admissible an execution of this work, performed by artisans skilled in this trade so as to provide cabinet work of the highest trade, finish and installation as specified and required.

Care shall be exercised by careful screening to avoid strong contrast in color and graining of finished woods for all wood surfaces or trim, paneling, wall facing, etc., so that any one room or wall surface will present a reasonably uniform appearance. All cutting, framing and fitting shall be done as required for accommodation of work of other trades. Use of wood chips, shims or other shrinkable materials for leveling of plumbing will not be permitted in any form. Mortise and tendon joints set in an approved type of water and moisture proof glue with wedges and/or pinned. Shop mitres, 102mm (4") or more to be glued and doweled and/or locked with a metal ring. Mitres less than 102mm (4") shall have concealed spline.

No woodwork shall be installed until such time as plastering is entirely dry.

In so far as practicable, all millwork, panelling etc. assembled in shop shall be back-painted and finished throughout before delivery to building.

Running trim (chair rail), etc. of wood shall have minimum number of splices and in each instance bevelled and jointed over a solid bearing ground.

In addition to machine sanding, all interior trim, panelling and woodwork shall be smoothed by hand using "00" sandpaper to give all woodwork the required smooth surface for exposed finished treatment and free from machine and tool marks, abrasion, raised grain and other undesirable defects. All woodwork shall be fitted to plaster or other finished work in careful manner so as not to injure these surfaces in any way. Where plaster or other work is damaged or disturbed, it shall be restored to its original state and/or make good without cost to the NPC at the Contractor's expense.

d) Laminated Plastic Plywood or Particle Board. All horizontal surfaces where laminated plastic covered wood are indicated on drawings shall be cigarette-proof grade. Seconds of the laminate shall be used as a "backing veneer" where concealed.

e) Centring Blocking, Grounds and Furring. Furnished and installed for all above items of woodwork as specified.

f) Wood Finish Materials. In general, conform to minimum standard requirements for kind, quality, functions and characteristics of local standards specifications as approved for use and specified herein.

1) Stains, if required, shall be those approved by NPC Representative for various types of finishes.

2) Linseed Oil shall be pure, thoroughly settled and either raw or boiled as required.

3) White Lead shall be white carbonate of lead ground in pure linseed oil.

4) Beeswax shall be pure, unadulterated and of the highest quality product of approved manufacturers.

AW-15.4 General Construction, Workmanship, etc.

General. Provide all rough carpentry required and/or necessary for any construction works, ladders, staging, scaffolds, and the like. Provide the temporary protection for all masonry and other related items during period of construction, including temporary centres, stairs treads, etc.

Grounds, blocking, cants, nailing strips and other rough woodwork shall be provided for sheet metal work, fabric flashing, and interior woodworks required by drawings.

a) Cutting, Patching and Fitting. Perform all cutting and fitting or work of other trades as required to secure work herein specified including that for any plumbing, heating and electrical work and do all required patching after other trades.

b) Grounds and Blocking. All wood grounds, blocking, centres nailing strips, cants, all wood grids for framing, etc., provided as required to secure carpentry, millwork, acoustical and insulation work and of sizes required.

Grounds shall be sized and dressed to proper dimensions. Ground against masonry units shall be secured in place with expansion bolts. Grounds that are not satisfactory shall be taken down and approved grounds reset at Contractor's expense. Grounds shall be provided behind all wood trim in every instance.

c) Rough Hardware. All nails, bolts, screws and any other rough builder's hardware or securement devices required to securely fasten all work in place shall be furnished and installed for any work herein.

d) Miscellaneous Millwork

The foregoing items are only intended to represent the principal items under this section. The Contractor shall include and furnish all items of Carpentry and Millwork. These are generally indicated on the drawings and shop drawings of all items and shall be prepared and submitted for the NPC Representative's approval as previously specified.

1) Shelving. Generally, 19mm (3/4") plywood with solid stock tongued front edges, all edges, and supported on cleats, of some material secured to walls with expansion bolts in lead sleeves. Where hook strips are required, they shall be of similar materials and as detailed on drawings, with double pronged hooks secured in place by the Contractor.

2) Countertops. Except where metal countertops are required, 19mm (3/4") laminated plywood with 3.32mm (1/8") standard grade linoleum of approved color, cemented down with approved type of linoleum adhesive. Where metal edging is

required, furnished smooth roll edge white metal alloy edging strips secured with oval header non-ferrous screws.

3) Drawers. Shall have metal slides with roller bearings, particle board or plywood bottoms, solid hard wood boxing, dove-tailed and glued. Drawer fronts of solid stock, of selected birch and/or as detailed otherwise on drawings and dove-tailed to slides and bottoms.

4) Cases and cabinet doors. Unless scheduled otherwise, or detailed on drawings, hinged doors for cases and cabinets required under work of this section included and provided with suitable and/or appropriate hardware supplied by the Contractor. Sliding door hardware shall be furnished and installed by the Contractor.

5) Miscellaneous interior cabinet work (cases, counters, equipment fixtures, and the like. The work included herein comprises all items of interior wood cabinet works indicated or required by drawings, including all miscellaneous metal supports, located throughout all public spaces where interior woodwork shall be supplied and built. These shall include all the equipment accessories, supports, draw slides, glass and glazing, shelves, counters, drawers, etc. complete in every respect, provided with beeswax finish and ready to operate.

General construction and quality of workmanship and materials is as specified herein. Office racks, interior cases and/or fixtures, supplied by NPC to be fitted into or between "built-in" case works shall be delivered to Cabinet Carpenter Contractor for in NPC and assembled with his work. In all instances, over-all length of such cabinets, cases, fixtures, shall be verified so as to fit in an approved manner when installed and/or assembled without disfigurement or cutting at job site.

Contractor shall thoroughly examine drawings and Schedules of Work and Finishes and shall be responsible for furnishing, installing and the surface treatment/finishing of all wood items.

AW-15.5 Wood Finish Treatment

The wood finish treatment for all exposed wood surfaces shall conform to the following, except where or when approved otherwise by NPC Representative. Finish treatment in general applies to the finishing of Narra or Tanguile plywood panels. The intent of the surface finish requirements specified hereinafter are to simulate the best grade quality of workmanship and materials in local use, applied by skilled and experienced wood finishers and painters.

All exposed interior woodwork throughout building structure except laminated plastic covered plywood and woodwork specified to be painted shall be carefully prepared to receive the following finish treatments.

Preparation of wood surfaces

Prior to application of any finish treatment, all wood surfaces shall be thoroughly cleaned of all foreign matter, dirt, oil, grease, cement plaster stains, finger marks, and the like. Should badly disfigured or damaged surfaces be encountered that are unsuitable to receive finish treatment, attention shall be called to NPC Representative before proceeding and await his conclusion.

All exposed surfaces of any woodwork, either mill or cabinet shall be entirely smooth and unblemished when erected.

Smooth thoroughly using a fine grade of waterproof sandpaper. Sand a second time with sandpaper moistened with best quality refined linseed oil.

Where crevices, deep open wood pores and any other defective surfaces are present, that are "re-faceable", they shall be filled with "stopping wax", prepared as follows:

i) In an iron pot, put one cupful of common shellac, one teaspoonful of powder resin, one piece of base wax the size of half and average size walnut and a teaspoonful of powdered lemon chrome or other coloring matter to match color of wood.

ii) Heat and stir thoroughly until prepared compound is fully melted and mixed so as to be uniform in texture. Turn portions of melted compound out between two flat boards and roll to form cylindrical sticks while still plastic.

iii) As previously specified, thoroughly and tightly fill all holes, crevices, open pores in wood and minor defective areas in wood surface by first melting sticks on a hot iron or small benzene lamp, as if it were solder.

iv) Defective surfaces, where certain type of natural defects occur in wood that do not provide good seats to receive "stopping wax" shall be enlarged and slightly under-cut around edges so as to assure the forming of a solid key when crevice is filled.

v) To finish surface after stopping, strike off protruding stopping and smooth with glass paper, so as to leave all surface clean, perfectly smooth and ready for final finish treatment.

AW-15.6 Finish Hardware and Show Case Lighting

These items as they relate to all cabinet work, furnished and installed complete by this Contractor. Finish hardware for cabinet work and show case lighting fixtures shall be of the highest quality product as selected by NPC Representative. Contractor shall examine same, determining before

application that items will perform the function and purpose for which they are intended and apply them in an acceptable manner.

When cabinet work shop drawings are submitted for approval by the Contractor, a detailed cabinet hardware schedule will be prepared by the NPC Representative.

AW-15.7 Prime Painting and/or Finishing

Contractor shall have option of finishing any portion of this work either on site and/or on a shop. All priming and back-painting shall be completed by the Contractor.

AW-15.8 Refitting and Checking

Immediately before building is occupied, the Contractor shall examine all doors and other movable part of all case and cabinet work to see that all are in perfect operating condition. Before and after refitting, all edges of doors shall be sealed with approved water resistant materials.

AW-15.9 Protection of Finish Products / Interior Woodwork, etc.

The Contractor shall be held responsible and accountable for the explicit protection of all finish cabinet work, interior trim and decorative treatment until Final Inspection and Acceptance. NPC Representative reserves the right to order replacement at no additional cost to contract sum, for any and all work so injured, and/or damaged as to be unsightly after repairing and/or refinishing. Authorization to repair and/or refinish shall not constitute a waiver of NPC Representative's right to require replacement of any item or work if unsatisfactory to him after such repairing and/or refinishing.

AW-15.10 Measurement and Payment

Measurement for payment for **Cabinet Works** will be based on the unit of measure specified in the bill of quantities install and accepted by the NPC Representative.

Payment will be made at the corresponding contract unit price per unit of measure specified in the bill of quantities for the pertinent items under Architectural Works.

Payment shall constitute full compensation for all labor, materials, equipment, tools and incidentals necessary for the completion of this work.

AW-16.0 WOOD DOORS

AW-16.1 General

The work to be done under this section include the furnishing of materials tools and equipment and performing labor required to complete flush type hollow core doors and other wood doors as shown on the drawings or as specified.

Doors shall be thoroughly seasoned, kiln-dried wood and pressure preservative treated. Wood doors shall be products of reputable, nationally known manufacturers approved by the NPC Representative.

All doors shall be of the type and size indicated in the drawings and as specified herein. The top and bottom edges of all wood doors shall be given a coat of water resistant coating after cutting and fittings, and prior to installation.

AW-16.2 Samples

Sample shall be submitted showing the corner sections of wood doors and jambs.

AW-16.3 Workmanship

The Contractor shall take special care in the manufacturing and assembly process of joint work. All joint works shall be done in accordance with accepted practices and shall be accurate and clean so as the joined elements fit perfectly together.

AW-16.4 Materials

Flush Type - Hollow Core Plywood shall be of first class quality marine plywood and the color shall be approved by the NPC Representative.

Framing shall be kiln-dried treated Tanguile for exterior framing and kiln-dried Tanguile for exposed edge framing.

Panel Type Tanguile, KD shall be used for panel doors, stiles and rails; grain and color suitable for natural finish.

Jambs shall be S4S Yakal, common to all doors.

AW-16.5 Installation

a) Each door shall be accurately cut, trimmed and fitted to its frame and hardware.

b) Allowance shall be given for painter's finish and possible swelling or shrinkage.

c) Clearance shall not exceed 3.2mm (1/8") at lock and hanging stiles and at top; and, 6.3mm (1/4") at bottom.

d) All corners shall be rounded to 0.07mm (1/26") radius. Lock and rail edges shall be slightly bevelled.

e) The screws for hardware shall not be driven, but merely started by driving and then screwed home.

f) All doors shall operate freely and with all hardware properly adjusted and functioning.

g) Doors shall be installed complete with finishing hardware, e.g. doorknob with key, hinges, doorstop, etc.

AW-16.6 Measurement and Payment

Measurement and payment for **Wood Doors** will be based on the number of sets installed and accepted by the NPC Representative.
Payment will be made at the corresponding contract unit price per set for the pertinent item under Architectural Works in the Bill of Quantities.

Payment shall constitute full compensation for all labor, materials, equipment, tools and incidentals necessary for the completion of this work.

No measurement of payment for door jambs, payment being included in set.

AW-17.0 ALUMINUM DOORS AND WINDOWS

AW-17.1 General

The contractor shall furnish and install all aluminum doors and windows in accordance with the applicable drawings specification and manufacture's standards. Samples of aluminum sections shall be submitted by the Contractor to the Contracting Offices for approval before fabrication commences.

AW-17.2 Materials

Aluminum Glass Door

Aluminum glass doors shall be double swing, full glass and floor hinge type complete with transom; hardware and accessories as indicated in the drawings.

Aluminum Glass Windows

Aluminum glass windows shall be a combination of mixed and slide type or as indicated in the drawings.

Color for both doors and windows frames and accessories shall be anodized olive brown, preferably "Analok", "Kalcolor" or approved equal.

Members, sizes, extrusion processes and other characteristics of aluminum shall be referred to "ALUMINUM WORKS" and/or Drawings.

Glass Panels shall be (.006m-0.008mm) thick tinted bronze or as indicated on the drawing.

Aluminum glass doors and windows shall be products of reputable, national known manufacturers approved by the Contracting Officer preferably manufactured by "Hooven Philippines", "Permaline" or approved equal.

AW-17.3 Installation

Doors and windows shall be installed in strict accordance with the accepted manufacturer.

AW-17.4 Measurement and Payment

Measurement and payment for **Aluminum Doors and Windows** will be based on the number of sets installed and accepted by the NPC Representative.

Payment will be based at the corresponding contract unit price per set for the pertinent items under Architectural Works in Bill of Quantities.

Payment shall constitute full compensation for all labor, materials, equipment, tools and incidentals necessary for the completion of this work.

AW-18.0 FINISHING HARDWARE

AW-18.1 General

This section includes furnishing and installing all finishing hardware, complete. The schedules in this section are intended to indicate the various hardware's but are not guaranteed as to quantity. The Contractor shall check the schedule and drawings for count and any item similar location elsewhere in the building.

In order to identify and establish each kind of hardware, genuine American, Japanese & European products shall be used.

AW-18.2 Packaging and Marking

Each item of finishing hardware shall be individually packed and delivered in the manufacturer's original container. Each package or box shall be clearly marked with the manufacturer's name, catalogue number and other markings required for easy identification of the hardware.
A packaging list should be furnished to clearly identify the quantity and type of hardware in every box numbered in accordance with this list.

All hardware shall have the required screws, bolts and fastening necessary for installation packed in the same package with hardware. All packages shall be legibly and adequately labeled indicating the part of the work for which it is intended.

AW-18.3 Qualified Supervision

Materials shall be procured from a source of supply approved by the NPC Representative as competent to correctly evaluate the plans, details, and specifications and be prepared at all times to promptly and satisfactorily service the hardware on the job. This supplier must be an established Contractor for builder's hardware who meets all above requirements and who operates an office in this field.

AW-18.4 Material Specification

a) Butt Hinges shall conform to U.S. Federal Specifications unless otherwise specified.

1) For doors up to 914mm (3' - 0") wide or less, 90mm x 90mm (3-1/2" x 3-1/2") hinges shall be used.

2) For closet doors, use long span hinges.

3) Where the jamb trim projects to such an extent that the width of the leaf of butt hinges will not allow the door (in normal opening) to clear such trim, butt hinges with leaves of sufficient width shall be provided.

4) Finish and Material

i) Hinges used for doors to receive point shall be Bonderized and prime coating for painting.

ii) Hinges used for doors to receive natural finish shall be wrought steel highly finished, polished and plated.

iii) Use only non-ferrous material butt hinges for doors exposed to the weather.

b) Lock-sets shall conform to U.S. Federal Specifications.

c) Hardware Selection and Door Control. To obtain satisfaction and maximum services, consideration should be given to all of the following basic factors:

i) Proper lock selection. Depends on expected usage (lock, series, function), climatic conditions.

ii) Proper installation. The use of right installation tools is recommended.

iii) Proper door control. To protect locks and other hardware items, the use of door closers and other control devices is vital under certain conditions.

d) Keying and Key. Locks shall be keyed in sets and sub-sets to provide maximum expansion. All sets shall be grand master keyed, and all

entrance locks shall be great-master keyed. Designation shall be by the NPC Representative.

Permanent cylinders with construction inserts are to be assembled with all locksets. Change keys are to be packed in cartons marked "packing list". On completion of the job, the NPC Representative will collect all construction keys, remove the construction inserts from the lock cylinders and distribute the lock change keys as directed. Retain Contractor and construction keys for future key system control.

Construction

a) Mechanism. Wrought steel zinc plated and dischromated with coil compression springs.

b) Exposed trim and parts. Wrought brass, bronze, aluminium or stainless.

Installation. For hollow wood doors and frame, uniform application regardless of function completely reversible for R.H. or L.H. doors.

Warranty. Locksets are engineered to meet or exceed applicable government and industry standards for strength, durability and performance. They are fully guaranteed against defects in materials for workmanship.

- Door Closers
- Push/Pull Handles
- Door Stops
- Door Catches

AW-18.5 Installation and Hardware

All hardware shall be installed in a neat, crafts manlike manner following the manufacturer's instruction. Fasteners supplied together with the hardware, shall be used to secure the hardware in place. Wood screws set in expansion shields, shall be used for securing hardware to concrete or masonry surfaces. Through-bolts shall be used where specified or necessary for satisfactory installation. After installation, hardware shall be protected from paint, stains, blemishes and damage until acceptance of the work. All hardware shall be properly adjusted and checked out in the presence of the NPC Representative to see that the hinges, locks, bolts and closers operate properly. Any error in cutting or fitting, or any damage to the adjoining work shall be replaced as directed.

AW-18.6 Measurement and Payment

No measurement for payment will be made for **Hardware**, the cost of which shall be included in the contract unit price for the pertinent items where hardware is required under Architectural Works in the Bill of Quantities.

AW-19.0 PAINTING AND VARNISHING

AW-19.1 General

The work to be executed under this section shall include the furnishing of all materials, labor, tools and ladders, scaffolding and other facilities necessary for the satisfactory performance of all work necessary to complete all painting and finishing of all surfaces throughout the interior and exterior of the building, except as otherwise specified.

The Contractors, providing the labor, materials or both for this project are specifically referred to the General Contract plans, to the General Conditions of the specifications, to all the Sections of the Specifications and to the various other sub-contract documents which may affect the completion of any sub- contract work. In the absence of a complete agreement between sub-contractors, supply dealers or others affected by the construction of this project, the General Contractor shall be held responsible for the co-ordination of all the work.
The Contractor shall examine all sections of this specification and perform all paintings called for therein.
All woodwork in ceiling, partitions, handrails, cabinet work, grill work, mouldings and others as specified by the NPC Representative shall be painted/varnished.

AW-19.2 Inspection of Surfaces

Before starting the work, the Contractor shall inspect all surfaces to be painted. If the surfaces cannot be put in proper condition to receive paint by customary cleaning methods or sanding or sparkling, the Contractor shall notify the NPC Representative in writing. The NPC Representative will cause these defects to be reminded. The commencing of the work by the Contractor indicates his acceptance of the surfaces to be painted and assumes responsibility for the rectification of any unsatisfactory finishing, resulting from his negligence.

AW-19.3 Materials

All paint materials shall meet the requirements of the Philippine National Standard Specifications for Paintings.
Paints shall be brought to the Site in tightly closable, convenient, original containers, if nothing to the contrary is stipulated in the Specifications. The containers shall be marked in a durable manner with the following particulars:

- Maker
- Paint and relevant thinner
- Gross and net weights
- Date of supply by the maker's factory

The openings of the containers shall leave enough room for a stirring appliance.

All containers shall be kept tightly closed until the contents are to be used. Immediately prior to use of the contents and before pouring into smaller

containers for working purposes, any skin shall be removed and the contents stirred thoroughly, if necessary with a stirring appliance.

Paints, thinners and filling cements which are not required for immediate use shall be protected against the action of frost and heat.
Only thinners supplied by the makers of the paint or those described by them as suitable shall be use for adjusting paints to working consistency. The instructions of the maker shall be followed in this respect.

Paint and filling cements shall be used in accordance with the maker's instructions.

The Contractor shall obtain from the manufacturer and shall submit to the NPC Representative a paint manufacturer's guarantee for the quality of each painting material and that each coat of paint is compatible with previous and subsequent coats.

Paints which do not have to be prepared by mixing several constituents just prior to use shall be brought to the Site in such a state of readiness that they need only be adjusted to brushing or spraying consistency to meet the relevant working conditions (e.g., temperature), by adding the particular thinners in accordance with the maker's instructions.
With the exceptions of ready-mixed materials in original containers, all mixing shall be done at the job site. No materials are to be reduced or changed except as specified by the Manufacturer of said materials.

The quality of the paints shall be such that they form no solid sediment and at most a slight skin in unopened original containers within 6 months - calculated from the marker's delivery date. A paint which has formed a solid sediment or more than just a slight skin in the unopened original containers by the time of use or which cannot be processed satisfactorily shall not be used. A sediment shall be regarded as solid if it cannot be dispelled quickly and completely by stirring.

The use of white zinc (lithophones) will not be allowed.

A place will be designated by the NPC Representative for the storage of paint materials and tools. Whenever it may be necessary to change the location of this storage place, the Contractor shall promptly move to the newly designated place. The storage space floor shall be adequately protected from damage and from paint. Paint shall be covered at all times, safeguards taken to prevent fire.

AW-19.4 Colors and Samples

All colors shall be subjected to the approval of the NPC Representative. Tinting of matching colors shall be done under the supervision of the NPC Representative. In all cases, a sample shall be applied on the job and the

NPC Representative must give his approval before work is commenced. If required, three panels, 200 mm x 250 mm (8" x 10") of each color and finish shall be prepared in advance, with the NPC Representative. "Of color selected" shall be understood as all coats specified herein.

AW-19.5 Workmanship

All work shall be done by skilled mechanics with high quality workmanship. All paints shall be evenly applied so as to be free from sags, runs, crawls or other defects. All painting materials shall be meet the requirements of stress and shall be in accordance with the relevant standards. All coatings shall be of proper consistency and well brushed out so as to show the minimum of brush marks, except varnish and enamel which shall be uniformly flowed on. All brushes shall be clean and in good condition, with heavy brushes preferred. Light brushes shall not be permitted.

Paint shall be thoroughly stirred so as to keep the pigment evenly in suspension when paint is being applied.

No painting shall be done under conditions that are unsuitable for the production of good results. No oil painting shall be done in damp weather.

Application of succeeding coats shall strictly follow the over-coating times specified by the paint manufacturer. If no specific data are available, all coats shall be thoroughly dry before painting shall be applied. At least twenty-four (24) hours shall be allowed between coats. Exterior painting under damp/wet conditions is not allowed.
Painting coat as specified are intended to cover the surfaces perfectly, if surfaces are not fully covered, further coat shall be applied to attain the desired evenness of the paint application.

All parts of moldings and ornament shall be left clean and true to details.
All finish shall be uniform as to sheen, color and texture, except when glazing is required.

AW-19.6 Protection

The Contractor shall protect the work of all other trades against damage or injury by his employees, or by his materials, tools or utensils used in connection with this contract. Any damage done by him shall be repaired at his own expense, without additional compensation beyond the contract price.

The Contractor shall note that some damage to paint-work during shipment, storage, and building-in and particularly during grouting of the steel lining is unavoidable and the application of all protective treatment shall be programmed accordingly. Care shall be taken to remove salt crystal liable to become deposited during the sea transport and/or storage at seaport by thorough washing with clean fresh water. Before any coat of paint is applied, the surface shall be prepared as hereunder described, so that it is clean and free from all deleterious matter and completely dry.

The Contractor shall be responsible for the complete shop and field coats. Shop coats shall be checked for good quality and where necessary, before proceeding with the painting or coating operations at Site, the Contractor shall clean and repair, including smooth trowel, all shop coats which are defective or damaged.
Protect all parts of the building from paint drops by using clean drop cloths and remove all paint inadvertently placed or dropped on exposed surfaces

without damage to same. Close various spaces while painting and exclude dust until finish is dry.

Plumbing systems shall not be used to wash paint brushes or containers.

Temporary or permanent welding shall not be permitted on areas where the welding will damage paint or other protective coatings, unless the areas of coatings which would be damaged thereby are accessible for repairing and inspection. Materials which have been painted shall be handled with care and protected as necessary to preserve the coating in good conditions.

AW-19.7 Paint Application

Materials, which are subject to working instructions, shall be treated according to these instructions, unless stipulated differently by the relevant paint manufacturer:

Paint, gloss and coating may be worked manually or by machines, unless a particular execution has been stipulated in the Specifications.

Paint, gloss and coat shall be bond firmly and be of even surface without scars and strips.

The surface shall be smooth, if not otherwise stipulated in the Specifications, such as finely or coarsely granulated.

Any paint, gloss or coating shall be applied without filling to create a uniform surface or, when gloss is being applied, a flowing surface with the required materials according to instruction manuals, of white or light shade, unless otherwise stated in the Specifications.

Top finish shall be high-gloss, unless otherwise stated in the Specifications.

If flat levels are to be formed, the prime coated surfaces shall be completely being covered with suitable undercoat filler ribbed and smoothed.
Primer protective coating shall be applied on woodwork according to manufacturer's instruction. If several coats are requested, the preceding coat shall need to be dried before applying the subsequent one. This does not apply for wet-on-wet techniques.

Drying periods prescribed by the manufacturer shall be observed, for open surfaces, as well as for edges or irregular surfaces. All edges at doors, windows, skirting, sockets, etc., shall be of sharp and straight line.

New concrete and masonry surfaces must be thoroughly naturalized either by brush or spray with a solution of 2 kg. of zinc sulfate to each gallon of water.

Surfaces so treated shall be tested to ascertain that alkalinity is removed; otherwise a second treatment with the same solution shall be applied. Within 24 hours after drying, all crystals on the surface must be brushed off applying the prime coat.

Metal works shall be kept clean and free from corrosion following installation. Abraded surfaces shall be retouched prior to finish painting, using the same

type of paint as prime coat. Galvanized metals shall be weathered or pickled with the approved metal primer in accordance with printed instruction of the manufacturer.

Where components parts of steel or aluminum alloys meat, joints shall be sealed so that no moisture can penetrate between the contact surfaces.

Rivet and bolt heads, protruding corners, sharp section edges and places of difficult access shall be pre-treated.

The paint shall be applied in coats which are as uniform as possible.

The first priming coat shall be applied by brush. Further coats shall be applied by brush if nothing to the contrary is stipulated in the Specifications.

Smaller and specially shaped brushes shall be used for rivet and bolt heads, protruding corners, sharp section edges and places of difficult access.
When applying paints by spray-gun, the object to be sprayed shall not be contaminated by water or oil in the compressed air.

In paint systems involving coats, the various coats of paints shall be distinguishable from each other by their shade.

All coats of print shall be applied only to clean, dry and non-greasy surfaces. In multi-coat paint systems, the coat last applied shall always be sufficient dry, free from any superficial moisture and from dust and dirt before applying the next text coat; only when using the moist oil type of paints may it be necessary for the previous coat to be hard dry.

The Contractor shall inform the NPC Representative in good time before starting to apply the next coat so that the NPC Representative shall have the opportunity of approving the previous coat.
Painting work shall not be carried out at a temperature below +5 °C and above 50 °C. In addition, painting work shall not be carried out on surface affected by the action of rain, fog and moisture or water of condensation; work started on such surfaces may not be continued until the surfaces to be painted are completely dry.

AW-19.8 Painting Systems

All surfaces which are required by the Finish Schedules or specifications to be painted, or otherwise finished, shall be given coats of paints or varnish as specified herein. Individual directions printed on the label of the approved paint and varnish shall be strictly followed. Paint thinner or linseed oil of the same brand as the paint to be thinned shall be used.
All materials, supplies and articles furnished shall be the standard products of superior quality. All constituent materials shall conform to the applicable provisions of the latest edition of ASTM Specifications.

The following list indicates painting materials of special compositions considered suitable for various parts of the works.

Concrete and Plastered Surface

Any concrete, cement plaster exposed to high humidity 3 coats of a highly weather-resistant synthetic resin-based paint. The first coat shall contain from 5% to 20% thinner as the surface requires.

All concrete (walls, foundations, etc.) backfilled with soil or submerged.

- 1 coat of coal-tar epoxy.
- 2 coats of a mineral-filled water resistant coat-tar epoxy.

Concrete, cement plaster, etc. exposed to oil, surface shall be dry, if possible sandblasted, clean and slightly roughened.

- 1 coat with a plastic-modified hydraulic mortar.
- 2 coats of an oil-resistant synthetic resin based paint.

Concrete exposed to Mechanical and Chemical attack.

- 1 coat of colorless 2- pack epoxy based paint; this shall contain from 10% to 20% thinner as the surface requires.
- 2 coats of 2-pack epoxy-based paint.

Concrete flooring exposed to mechanical wear and oil.

- 3 coats of chlorinated rubber-based paint. The first coat shall contain 15% thinner.

Internal concrete, plastered walls exposed to abrasion.

- 3 coats of an oil-free, synthetic resin-based, dust-binding paint.

Concrete flooring subject to minor mechanical wall.

- 2 coats of an oil-free, synthetic resin-based, dust-binding paint.

Internal plastered ceilings and walls.

- 2 coats of a polyvinyl-acetate dispersion type, non-chalking paint. First coat shall contain up to 30% thinner of clean, fresh water as the surface requires.

<u>Wooden Surfaces</u>

a) Exterior Parts –

b) Surface shall be smoothed down with adhesive; if machine sanding is involved, a sanding is involved, a sanding sealer to bind the fibres shall be applied; the surface shall also be dry and free from dust.

- 1 coat of fungicide and bactericide ingredients after first coat.
- 2 coats of synthetic resin-based lacquer with white active pigments.

c) Interior Parts - Application of varnish on wooden interior walls, partitions, T&G ceiling panelling and closets/cabinets.

All materials, supplies and articles furnished shall be the standard products of a known manufacturer approved by the NPC Representative.

1) First Coat. Fill open grained wood with natural wood paste fillers, as is, or mixed with oil-wood stain to obtain desired shade. Apply along the grain within 30 minutes. Let dry overnight and sand lightly.

2) Second Coat. Apply any one (1) of the colors of oil-wood stain: oak, walnut, marble, and mahogany. Dry overnight and sand lightly.

3) Third Coat. Spray required coats of lacquer sanding sealer. Let dry for 30 minutes and sand to smooth.

4) Choice of any of the following topcoats:

- Clear flat lacquer - for standard flat effect.
- Clear dead flat lacquer - for complete flat lacquer.
- Super dead flat lacquer - for complete flat lacquer.
- Clear gloss lacquer - for standard gloss effect.
- Water white gloss lacquer - for brilliant crystal clear effect.
- Versatile spar varnish - for glossy thick coating also applicable for exterior wood surfaces.

When spraying under high humid conditions, add up to ten per cent (10%) by volume of lacquer thinner retarder to prevent blushing of lacquer products.

Steel Surfaces

Details are given General Technical Requirements.

AW-19.9 Measurement and Payment

Measurement of payment for **Painting and Vanishing** will be based on the area applied and accepted by the NPC Representative.

Payment will be made at the corresponding contract unit price per square meter for the pertinent items under Architectural Works in the Bill of Quantities.

Payment shall constitute full compensation for all labor, materials, equipment, tools and incidentals necessary for the completion of this work.

AW-20.0 CONCRETE FLOOR HARDENER

AW-20.1 General

The work under this section shall be undertaken by skilled tradesmen experienced with this kind of work. The work to be done shall consist of furnishing all labor, materials and provision of tools and equipment necessary to complete the application of Floor Hardener.

AW-20.2 Materials

Floor hardener shall be non-metallic a mixture of especially graded mineral aggregates crushed and sieved to produce sharp granules. It should be extremely hard and must be highly resistant to abrasion, impact, chemical and acid, attack and will not oxidize under any circumstances. It should be non-metallic and must be a mixture of graded Silicon Carbide and Aluminum Oxide Aggregates.

AW-20.3 Measurement and Payment

Measurement and payment for **Concrete Floor Hardener** will be based on the area placed and accepted by the NPC representative.

Payment will be made at the corresponding contract unit price per square meter for the pertinent item under Architectural Works in the Bill of Quantities.

Payment shall constitute full compensation for all labor, materials, equipment, tools and incidentals necessary for the completion of this work.

AW-21.0 FIBER CEMENT BOARD

AW-21.1 General

The work to be done under this section includes the furnishing of all labor, materials, equipment, tools and other facilities necessary to complete the work.

Boards for walls of the type and thickness indicated shall be properly installed and coordinated with the work of other trades.

AW-21.2 Materials

Fiber cement board for wall shall be of Portland cement, sand, cellulose fiber and water autoclaved, immune to water damage, fire resistant, durable, rot and termite proof.

AW-21.3 Handling and Storage

Boards shall be stacked on edge or laid flat on a smooth surface. Edges and corners shall be protected from chipping. To ensure optimum performance, store sheets under cover and keep dry prior to fixing.

AW-21.4 Installation

Fiber cement boards shall be fixed by a qualified installer as recommended by the manufacturer.

AW-21.5 Framing

Steel channel shall be used at maximum spacing of 600mm x 600mm O.C. B.W. Six (6) millimeter thick board shall be fixed to
metal frame with 2mm Ø galvanized fiber cement nail.

AW-21.6 Measurement and Payment

Measurement for payment for **Fiber Cement Board** will be based on the area install and accepted by the NPC Representative.

Payment will be made at the corresponding contract unit price per square meter for the pertinent items under Architectural Works in the Bill of Quantities.

Payment shall constitute full compensation for all labor, materials, equipment, tools and incidentals necessary for the completion of this work.

AW-22.0 SOIL TREATMENT

AW-22.1 General

The work to be done under this Section shall include all labor, materials, tools and equipment necessary for soil treatment.

The Contractor shall treat the soil under the building and immediate surroundings to make it impervious and toxic to subterranean termites, often referred to as white ants or "anay" by application of soil poison solutions.

AW-22.2 Material

Material to be used shall be a solution commonly used by licensed companies or entities engaged in pest control or pest eradication. Banned solutions must not be applied.

AW-22.3 Application

The application of solutions follows the sequence of construction and the following are the order treatment:

a) Thoroughly saturate every linear meter of excavation for footings and other cement work.

b) After grading and leveling the soil in the ground and layers of gravel laid preparatory to the pouring of concrete, flood or soak every square floor area.

c) As soon as the building is constructed, just prior to the landscaping of the lawn and garden, saturate every linear meter perimeter of the building, about three (3) meters wide, with the termite proofing solution.

d) Treat earth fills thoroughly as they may carry termite colonies. As soon as the fill is packed and leveled, saturate every one square meter area with 4 litters of the termite-proofing solution.

An ordinary watering can (sprinkling can) can be used to saturate or saturate areas with the termite-proofing solution. However, for convenience and thorough and faster application, use a power sprayer with 3 to 5 gallons per minute capacity.

AW-22.4 Measurement and Payment

Measurement for payment for **Soil Treatment** will be shall be based on the unit of measure specified in the bill of quantities installed and accepted by the NPC Representative

Payment will be made at the corresponding contract unit price per unit of measure specified in the bill of quantities for the pertinent items under Architectural Works.

Payment shall constitute full compensation for all labor, materials, equipment, tools and incidentals necessary for the completion of this work.

AW-23.0 PLUMBING FIXTURES AND FITTINGS

AW-23.1 General

The work covered by this section of the Specifications consists in furnishing all plant, labor, equipment and tools, articles, appliances and materials and in performing all operations in connections with the installation of all plumbing fixtures, fittings and accessories, complete, in strict accord with this section of the Specifications or indicated on the drawings, are included in this work.

AW-23.2 Make

The model numbers herein given are intended to illustrate the quality and design of fixtures that will be required. American standard fixtures specified herein and any substitution made to any item of fixtures specified must first be approved by the NPC Representative.

AW-23.3 Trade Marks

All plumbing fixtures and fittings must bear the trademarks of the manufacturer.

Maintenance Manual shall be submitted including complete instructions for replacing valve washers and strainers and give manufacturer's recommendations as to cleaning finish fixture surfaces.

Submit samples of valves, faucets, trims and others for approval of the NPC Representative.

AW-23.4 Fixtures

a) Water Closet – as shown in the drawings or as specified in the Bill of Quantities

b) Lavatory – as shown in the drawings or as specified in the Bill of Quantities

c) Urinal – as specified in the Bill of Quantities

d) Double Tub – Stainless steel sink

e) Bibbs – Nickel Plated Copper or Brass Alloy

f) Shower Heads – Nickel Plated Copper

g) Plated clips and 19mm (3/4") caps on wall or as indicated on the drawings.

h) Floor Drain – Stainless or Brass Alloy

i) Clean-outs – Brass alloy

AW-23.5 Installation

Plumbing fixtures shall be installed free and open in a manner to afford access for cleaning. All brackets, cleat, plates and anchors required to support the fixtures shall be furnished in a rigidly manner. Water closets shall be sat on Boll-Wax.

Installed plumbing fixtures shall be kept clean and in working order for adequate protection so as not be used by anybody until issuance of Certificate of Completion.

All fixtures shall be provided with individual control stop so that each fixture may be separately controlled without affecting any other fixture.

All flush valves shall be equipped with vacuum breaking devices.

AW-23.6 Toilet Accessories

a) Soap Holders – white, vitreous China to match fixtures quality, brand and wainscoting color.

b) Tissue/Toilet Paper Holder - colored, to follow Water Closet brand and quality. Provide and fit, ready for use, on most convenient side of wall inside each water closet compartment, 750mm (30") above the finish floor.

c) Urinal and Toilet Partition and Cubicle Doors- Hard wood laminate

phenolic boards. Provide polyester coated extruded aluminium framing, non-rusting connection accessories, door hinges and lock sets, toilet paper holder, grab handle and accessory hook, signage.

d) Towel Holder-stainless

e) Liquid Soap Dispenser

AW-23.7 Measurement and Payment

Measurement and payment for **Plumbing Fixtures** will be based on the number of sets/pieces installed and accepted by the NPC Representative.

Payment will be made at the corresponding contract unit price per set/piece for the pertinent item under Architectural Works in the Bill of Quantities.
Payment shall constitute full compensation for all labor, materials, equipment, tools and incidentals necessary for the completion of this work.

AW-24.0 WATERPROOFING

AW-24.1 General

The work includes the laying/ installation of waterproofing membrane at the roof deck of the building.

Waterproofing materials shall be delivered to the site in their original sealed containers or packages bearing manufacturer's name and brand designation.

The work shall be performed by the manufacturer's certified applicators and only the best quality of materials and workmanship shall be used in strict accordance with the standard practice for this type of work.

AW-24.2 Materials

The waterproofing material shall be a complete system of bitumen layers supplied by a manufacturer of reputable corporate existence.
Waterproofing materials shall be heat resistant preformed reinforced bituminous membrane which has good elongation and recovery characteristic when subjected to expansion and contraction movements.

AW-24.3 Surface Preparation

All concrete or masonry surfaces shall be cured for minimum of seven (7) days. It must be wood-trawled, smooth, firm, dry, clean and free from rubbish, lose or foreign materials and imperfections.

Installation of metal fittings and similar works shall be completed before application of waterproofing is done.

Surfaces shall be properly graded to drain water freely into drain lines. Drainage connections shall be set up to permit free flow of water. There shall be provisions for mortar cants in the angle formed by the area. If required,

reglets of about 40mm deep and 40mm wide at 250mm above floor finish shall be provided along walls or parapet walls for the waterproofing system.

AW-24.4 Execution of Work

The waterproofing membrane shall be installed according to the manufacturer's instruction. Apply material "patching compound" reinforced with "patching fabric" on cracks and other surface imperfections.
The membrane application shall be commenced from the lowest point when applied on a surface to fall line to ensure weathered overlaps.

After installation of membrane, careful inspection shall be made for accidental damage. Damaged area shall be cleaned and patched with fresh membrane waterproofing (minimum patching material of 152mm x 152mm).
Prior to acceptance of the job, all waterproofed surfaces shall be given a 48-hour flooding and the Contractor shall remedy at once any evidence of leakage. Flooding test shall be done by plugging all drains, building temporary dams at opening so that water will be 25.4mm (1") deep at high point of waterproofing.

Concrete topping to be used shall be 20.70MPa as per ACI specifications and 50mm (2") thick (minimum) excluding the finish and reinforced with welded steel wire fabric as per ASTM A185-73 specifications.

In particular, the Contractor shall verify conditions such as the following do no exist:

- extensive unevenness of the bed
- too rough, too porous, too smooth surfaces
- sharp edges of boarding and ridges
- variation from the horizontal or fall stipulated in the Specifications or dictated by circumstances
- incorrect level of the surface of the bed
- non-rounded corners, edges and channeling
- stress and settlement cracks, holes
- too moist surface
- non-sealing of voids (e.g. in concrete)
- inadequate firmness of the bed
- oily surface
- unsuitable type or portion of penetrating structural members
- lack of parts for connecting structural members which penetrate the waterproofing

AW-24.5 Guarantee

The Contractor shall guaranty that the work specified in this section will be free from defects of materials, workmanship and leakage for a period of five

(5) years from the date of final acceptance. This obliges the Contractor to make good the defective work.

AW-24.6 Measurement and Payment

Measurement of payment for **Membrane Waterproofing** will be based on the area applied and accepted by the NPC Representative.

Payment will be made at the corresponding contract unit price per square meter for the pertinent items under Architectural Works in the Bill of Quantities.

Payment shall constitute full compensation for all labor, materials, equipment, tools and incidentals necessary for the completion of this work.

TECHNICAL SPECIFICATIONS

(MECHANICAL WORKS)

PART 1 - TECHNICAL SPECIFICATIONS

MW - MECHANICAL WORKS

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MW - MECHANICAL WORKS

MW-1.0 GENERAL

The work to be done under this section shall include the furnishing of all labor, materials, equipment, tools and other incidentals for all mechanical works enumerated hereunder or as shown on the accompanying drawings and installation manuals or as otherwise directed by NPC.

The work shall be performed and completed with high quality workmanship, in accordance with generally accepted modern practice in installation/erection works of Mechanical Equipment for the Uprating of Virac (Marinawa) Substation from 10MVA to 20MVA.

All equipment and materials which the Supplier shall supply and install shall be new and unused. They shall be suitable for their intended purpose and shall comply with all applicable regulations, quality and dimension standards.

The Supplier shall closely coordinate with other disciplines to avoid interference with other works specified in the relevant sections of this specification.

MW-2.0 SCOPE OF WORK

It is not the intent of this specification to specify all technical requirements or to set forth those requirements covered by applicable codes and standards. The Supplier shall furnish high quality work, materials and equipment meeting the requirements of this specification and industry standards.

The Supplier shall also be responsible to assess and determine all and every work and service although not specifically detailed but are deemed required to fully complete the work and smooth execution of the project. Relative costs of any additional works or materials which the Supplier deemed required or necessary to complete the works shall be included in the bid proposal.

The work to be done under this section shall comprise the furnishing of all labor, tools, equipment, supply of appurtenant materials and other incidentals including installation/erection and test of all mechanical works enumerated hereunder in accordance with the Specifications contained herein and as shown in the drawings or otherwise directed by the NPC, which shall consist of but not limited to the following:

a) One (1) lot of Domestic Water Supply System consisting of pipes, valves, pipe fittings, gaskets, flanges, bolts and nuts, pipe supports including the required excavation and backfilling of embedded pipes and other incidentals to complete the domestic water supply piping system;

b) One (1) unit of Inverter-Window Type Air Conditioner of 10,000 kJ/hr minimum cooling capacity for proposed extension office, complete with its mounting accessories and controls;

c) One (1) unit of Wall Mounted Exhaust Fan, 100 m^3/hr minimum capacity for Comfort Room, complete with its mounting accessories and control;

d) One (1) unit of Portable Type Fire Extinguisher, Clean Agent (HCFC or Halotron I Type), 7.1 kg. (15.5 lbs), non-expiry, multi-shots, wall-hung type and UL/FM approved;

e) Relocation of one (1) unit of floor-mounted air-conditioning unit to the proposed expansion of control room and;

f) All other works and services required to complete the project.

MW-3.0 MATERIALS AND EQUIPMENT

MW-3.1 General

All materials, equipment, devices and accessories shall be new and unused, free from all defects and imperfections, and best suited for the purpose intended. Materials used in the manufacture and installation of all equipment to be furnished shall be of the required quality used in commercial products of reputable manufacturers. All equipment or substitute materials to be used shall conform to the latest specifications and provisions of approved standards of engineering societies or other equivalent standards approved by NPC.

All materials, parts, and assemblies to be used shall be tested conforming to the latest specifications and provisions of approved Standards of Testing Materials. Results of the test shall be made to provide means of determining compliance with the applicable specifications. When requested, all tests or trials shall be made in the presence of NPC's duly authorized representative.

If the equipment fails to meet the guaranteed performance as determined by the test, the Supplier shall promptly make the necessary modifications at no cost to NPC.

Brochures, catalogs and other related technical data of materials and equipment to be supplied by the Supplier under this contract shall be submitted by the Supplier for NPC's review and approval prior to fabrication. Equipment or articles installed or used without such approval shall be at the Supplier's risk of subsequent rejections.

MW-3.2 Applicable Codes and Standards

The design, materials, equipment, manufacturing, construction, installation, and testing of all works under this contract shall be in strict accordance with the latest edition of all applicable codes and standards, national and local laws, codes and regulations, statutes and ordinances.

The latest edition of each standard shall mean the latest edition available at the date of contract signing.

All units, dimensions and calculations shall be in metric system.

MW-3.3 Test of Materials

All materials, parts and assemblies to be used shall be tested conforming to the latest specifications and provisions of approved Standards of Testing Materials. Results of the test shall be made to provide means of determining compliance with the applicable specifications. When requested, all tests or trials shall be made in the presence of NPC's duly authorized representative.

If the equipment fails to meet the guaranteed performance as determined by the test, the Supplier shall promptly make the necessary modifications at no cost to NPC.

MW-3.4 Submittals

The Supplier shall submit the technical specifications/data and brochures/catalogs of all equipment and materials to be supplied for NPC's review and approval prior to purchase and/or implementation including other necessary documents as required or specified in the relevant sections of this specification. Equipment or materials installed or used without such approval shall be at the Supplier's risk of subsequent rejections.

MW-4.0 DOMESTIC WATER SUPPLY SYSTEM

MW-4.1 General

This section provides the essential information for the design, supply, installation, construction and test of the Domestic Water Supply System to provide the water requirements of the proposed extension office included in the uprating of virac (marinawa) substation from 10MVA to 20 MVA including all required excavation and backfilling works for the piping system.

The water supply shall be sourced and interconnected from the existing water supply line. Interconnection point shall be as directed by NPC representative/s.

MW-4.2 Domestic Water Supply Piping System

The Supplier shall supply, install and test the Domestic Water Supply and Distribution Piping System including piping supports, fittings, all required excavation and backfill of pipe trenches.

The work shall include the installation of valves, valve boxes if necessary, and other accessories to complete and make ready for safe and reliable operation of the system, but not limited to the following:

a) One (1) unit of 20 mm Ø Gate Valve;

b) One (1) unit of 20 mm Ø Hose Bibb;

c) One (1) lot of domestic water piping, pipe fittings and other necessary accessories.

MW-4.2.1 Pipe, Fittings and Accessories

Domestic water piping shall be constructed from Unplasticized Polyvinyl Chloride (*uPVC*) pipe schedule 80 or class 150, conforming to ASTM D-1784 or approved equivalent.

Unplasticized PVC pipe connection joints 80 mm (3") Ø and above shall be joined by rubber ring or solvent cement type connection. Smaller sizes shall be of solvent cement type connection.

Flanged connections may be used for connecting to flanged surfaces and shall be of the same material with the connected pipe with a rating of class 150 or ANSI 150. Flanged joints may use flat gaskets with serrated flange faces or 0-rings with corresponding grooves. Gaskets and 0-rings shall not be fabricated from plasticized PVC.

Union joints shall not be used with pipe diameters of more than 63 mm O.D. (2"). Joints between metal pipes and PVC pipes should be flanged type using a PVC flange on the PVC pipe and full face gasket.

Flange bolts shall be hexagonal head machine bolts with heavy semi-finished head nuts having dimensions in accordance with ANSI B18.2.

PVC pipe installed aboveground shall be properly supported to avoid pipe sagging. Pipe covering made of steel or metal shall be provided in case there is high risk of damaging the pipe during normal operation and maintenance.

All trench excavation and backfill works shall be done in accordance with pertinent provisions specified in the Civil Works Specifications.

MW-4.2.2 Valves and Accessories

All gate and globe valves, 65mm and over shall be of OS & Y with rising stem, solid wedge type disc for gate valves and plug type disc for globe valves, bolted, bonnet, bolted gland and have flanged ends with the following materials of components:

a)	Body & bonnet	-	Cast iron
b)	Stem	-	Bronze or brass
c)	Seat ring & seat	-	Bronze or bronze faced
d)	Wedge or disc	-	Bronze or bronze faced

Gate and globe valves, 50mm and smaller shall be made of bronze material, rising stem, union bonnet, inside screw, solid wedge or plug type disc, and screwed ends. Valves installed in valve boxes shall have flanged ends for easy replacement or if valves with screwed ends are used, appropriate unions shall be installed.

Valves of all sizes shall have a rating of not less than Class 150.

Garden hose connection valves or hose bibbs shall be of bronze material, 20mm size and outfitted with male thread hose connections.

Strainers, if required, shall be of Y-type with cast iron or PVC body material and flanged or screwed ends. Screen elements shall be of stainless steel construction with minimum of 40-mesh size.

MW-4.3 Installation

The Supplier shall install the piping system in a thorough manner and with good workmanship in accordance with the construction drawings and specification or as directed by NPC. No installation work for underground pipe shall commence unless trench excavation has been approved by NPC.

All pipes, fittings, valves and appurtenances shall be free from dirt or other foreign matters before laying. In the installation of the pipes, care shall be taken to prevent the pipes from becoming clogged during the progress of the work. Should any pipe become either partially or wholly clogged before final completion of the work, it shall be cleaned out by the Supplier in a manner satisfactory to NPC or shall be replaced by and at the expense of the Supplier. Open ends shall be temporarily plugged, otherwise suitably closed when necessary.

Special care shall be taken in carrying out the installation of joints, branches, valves and other fittings.

All piping works shall be coordinated with any other work at site and with existing installation so that interference between piping and other structural features will be avoided. In case interferences occur, NPC will decide which work is to be relocated.

Where pipeline are laid, the trench shall be provided with a cushion pad of at least 100 mm sand and sandy soil bedding materials.

Embedded water supply pipes in open areas shall be laid not less than 300mm from the ground surface to the bottom of pipe.

All pipeline excavation shall be backfilled up to the level of the finished grade surface in layers of 150 mm and thoroughly compacted. Backfill materials shall be compactable soil taken from trench excavation and approved by NPC. Trench excavation and backfilling works shall be done in accordance with the pertinent provisions of the Civil Works Technical Specifications.

PVC pipe installed aboveground shall be properly supported to avoid pipe sagging. Pipe covering made of steel or metal shall be provided in case there is high risk of damaging the pipe during normal operation and maintenance.

All existing facilities affected and damaged during the installation of piping shall be replaced and/or restored to its original appearance by the Supplier at his own expense.

Transportation, storage and erection shall be in strict accordance with manufacturer's recommendations. Erection shall be such as to prevent stress in the piping.

All trench excavation and backfill works shall be done in accordance with pertinent provisions specified in the Civil Works Specifications.

MW-4.4 Testing, Cleaning and Disinfection

The piping system shall be hydrostatically tested at a pressure 1.5 times the design pressure or maximum working pressure of the system for a period of not less than 30 minutes.

Before any test is made, the Supplier shall notify NPC in advance so that such test may be witnessed. All expenses that may be incurred during the tests shall be borne by the Supplier.

If applicable, test shall also include visual check on joints or welded parts, as applicable, during actual operation of each system to ensure that no leakage is observed on the joints.

Before starting the test procedure, the piping shall be flushed and cleaned thoroughly. When filling the line with water, all air shall be removed.

Tests may be applied to sections or the entire system. The test shall be made between valves and sections of not more than 305m (1000 ft) in accordance with the American Water Works Association (AWWA).

There shall be no leakage whatsoever from the pipes, fittings and connections for each section tested while the system is under the test pressure for the period of not less than thirty (30) minutes of the total time to inspect all portions of the waterline under test, whichever is longer.

During the test, valves shall be opened and closed. Any leakage or any defect disclosed by the tests prior to the acceptance shall be corrected and repaired by the Supplier at his own expense to the satisfaction of NPC.

The water piping system shall be disinfected after testing and before being put into use. Before disinfections, the piping should be drained, flushed, re-drained and refilled. In refilling, care must be taken to avoid entraining or entrapping air in the piping. The Supplier may use any of the methods of disinfections as recommended by the American Water Works Association (AWWA) or any of the following kinds of treatment:

a) Chlorine Gas-Water Mixture;

b) Calcium-Hypochlorite or equal; or

c) Dry Calcium Hypochlorite or Chlorinated Lime and Water Mixture.

Retention period shall be at least 24 hours and shall produce not less than 10 ppm at extreme end of the lines at the end of the retention period. After flushing, residual chlorine must be reduced to less than 1 ppm.

The Supplier shall submit the following for review and/or approval by NPC:

a) Test procedures prior to test; and

b) Test and inspection reports.

MW-4.5 Submittal

The following documents shall be submitted by the Supplier for NPC's review and approval prior to procurement and installation:

a) Complete data, specifications and catalogues;
b) Outline and assembly drawings;
c) Test procedures;
d) Field test reports; and
e) Operation and Maintenance Manuals.

MW-5.0 AIRCONDITIONING AND VENTILATION SYSTEM

MW-5.1 General

This section provides the essential information for the Air Conditioning and Ventilation System equipment to be supplied, installed and tested by the Supplier.

All air-conditioning equipment and Ventilation System shall preferably have one Brand name and shall be the standard product of a reputable A/C manufacturer. In case other brand of A/C and Ventilation equipment are to be used to meet with the specific requirements in the bid document, catalogues and other supporting documents shall be submitted for NPC's review and approval.

Power supply for the ventilation and air-conditioning equipment shall be 230V, single phase, 60 hz.

Refrigerant to be used shall be environment-friendly.

All necessary transformers and electrical materials shall be included in the Supplier's supply if power ratings provided are other than the one's specified above.

MW-5.2 Design Conditions

a) Outdoor Conditions:

Dry Bulb Temperature	:	35°C
Wet Bulb Temperature	:	27°C
Relative Humidity	:	80% to 100%

b) Indoor Conditions (for air-conditioned areas):

Dry Bulb Temperature	:	24°C ± 3°C
Relative Humidity	:	50% ± 5%

c) Area to be air-conditioned shall be:

c.1) Proposed Extension Office

d) Area to be ventilated shall be:

d.1) Comfort Room (proposed extension office) - 10 changes per hour

MW-5.3 Schedule of Equipment

a) Air-Conditioning Unit

Location	Quantity	Cooling Load/Unit	Type
a.1) Proposed Extension Office	One (1) unit	10,000 kJ/hr	Inverter Window Type

b) Ventilation Unit

Location	Quantity	Rating/Unit	Type
b.1) Comfort Room	One (1) unit	100 m^3/hr	Wall Mounted Exhaust Fan

MW-5.4 Air-Conditioning System

MW-5.4.1 Scope of Works

The Work called for in this specification includes the design, furnishing, delivering, installing and testing of window type air conditioners (inverter type) to provide a fully ventilated and air conditioned rooms. The work shall include other accessories even though not specifically mentioned in this specification but are necessary to obtain a complete set for the safe and reliable operation of the system as a whole.

All electrical materials such as circuit breakers, automatic controls, including all power and control wires, supervision, electrical outlets and fittings shall be included and provided by the Supplier including complete system of automatic temperature controls.

The type and quantity of air conditioning equipment to be supplied shall be as specified in Clause 5.3 (Bill of Quantities) or shown on the drawings.

All air conditioning units (split type) to be supplied and installed shall have the following features/accessories but not limited to:

- With Remote Controller and Holder
- With automatic and manual swing louver control
- With control switch
- Cool Mode
- Fan Mode
- Automatic Mode

MW-5.4.2 Window Type Air-Conditioning Systems

The Window Type Air Conditioning Units to be supplied and installed for specific areas in the building are as specified in the schedule of equipment or shown on the drawings.

The units shall be wall mounted room (inverter-window type) air conditioner and shall be provided with a room thermostat and sensing element which detect changes in room temperature and adjust it to desired cooling by automatic actuation of the compressor. Compressor shall be provided with thermal overload device that automatically shuts off the compressor during overheating.

Fan motor shall be permanently lubricated. The unit shall operate on a 230 V AC, single phase and 60 Hz power supply.

Mounting brackets which are properly fixed on the concrete wall or structure shall be provided to support the suspended portion of the air conditioner unit. Weather seals shall be provided on the area between the air conditioner and wall opening.

Provision of wall opening for the installation of the window type air conditioning units shall be closely coordinated with the civil works.

MW-5.5 Ventilation Units

MW-5.5.1 General

The Supplier shall furnish, deliver, install and test the ventilation system equipment complete with all the necessary appurtenances for its efficient operation. The scope of supply shall include all mounting supports and fixing materials required to complete the installation and ready for operation.

The unit shall be properly sized to conform to the required air changes per hour at free air for this particular application but in no case be less than those specified elsewhere in this specification. It shall be designed to continuously or intermittently operate on a 230 V, single phase, 60 Hz power supply, otherwise specified.

MW-5.5.2 Wall Mounted Exhaust Fans

Thru-the-wall propeller exhaust fans shall be provided at the area as specified in the schedule of equipment.

Each unit shall be properly sized to conform with the required air changes per hour at free air for this particular application but in no case be less than those specified elsewhere in this specification. Unit installed/mounted on the wall and directly discharges exhaust outside the building shall be provided with automatic shutter. It shall be of the direct driven type and corrosion resistant to operate on a 230 V, single phase, 60 Hz.

MW-5.6 Installation and Painting

The Air-Conditioning and Ventilation Units shall be installed as indicated in the drawings or as directed by NPC. After installation, all exposed and unfinished surfaces shall be thoroughly cleaned and washed possibly by chemical of all rust, oil and other foreign matters and shall be repainted in accordance with the manufacturer's standard or as approved by NPC.

Likewise, all surfaces and supports shall be thoroughly cleaned of rust, oil and other foreign matters and shall be painted with epoxy primer and two (2) coats of finish paint.

Painted surfaces of all equipment which are damaged during transport and installation shall be repaired or touched-up as necessary to prevent rusting, corrosion, etc. until the final finish painting application is made.

MW-5.7 Spare Parts and Tools

The Supplier shall supply the standard spare parts for one (1) year operation as recommended by the equipment manufacturer. Spare parts required during the warranty period shall be supplied by the Supplier at no Cost to NPC.

Special tools for normal operation and maintenance and are not usually available in a standard machine shop or retailing store shall also be provided as recommended by the manufacturer.

MW-5.8 Acceptance Test

Prior to acceptance of the Works, the equipment shall be tested in the presence of NPC to determine whether the requirements of the specifications have been met. Any defects found that are inherent in the equipment shall be remedied at the expense of the Supplier.

MW-5.9 Submittal

Prior to purchase and implementation of the works, the Supplier shall prepare and submit five (5) copies of the following drawings/documents for review/approval of NPC:

a) Dimensional layout drawings of mechanical equipment and associated devices.

b) Manufacturer's catalog sheets, marked as necessary, to indicate materials or equipment being furnished including instruments for control system;

c) Complete control schematic and wiring diagrams for all equipment to be furnished;

d) List of recommended Spare Parts and Special Tools; and

e) Operation and Maintenance Manuals.

MW-6.0 FIRE FIGHTING SYSTEM

MW-6.1 General

This section provides the essential information for the design, manufacture, fabrication, supply, installation, delivery to site and test of the specified Fire Fighting System.

All equipment and materials necessary for the complete installation shall be furnished complete, even though not necessarily mentioned in this specification but are necessary for the safe and reliable operation of the Fire Fighting System.

All the Fire Fighting System equipment shall be supplied by the Supplier complete with their corresponding technical brochures written in English that would aid in the installation, operation and maintenance of the equipment.

The Fire Fighting System shall be designed, installed and tested in accordance with the requirements of National Fire Protection Association (NFPA) Standards.

The Supplier shall design, furnish, install and test all the equipment specified below.

MW-6.2 Portable Fire Extinguishers

MW-6.2.1 Scope of Work

The Supplier shall supply the specified number of UL/FM approved Portable Type Fire Extinguishers complete and ready for operation and shall be installed at their corresponding place of use as specified below and shown on the drawings.

a) One (1) unit of Portable Type Fire Extinguisher, Clean Agent (HCFC or Halotron I Type), 7.1 kg. (15.5 lbs), non-expiry, multi-shots, wall-hung type and UL/FM approved.

MW-6.2.2 Fire Extinguishers

Fire extinguishers shall be Underwriter Laboratories and/or Factory Mutual Approved and of rechargeable cylinder with five (5) years guarantee against leak. Each fire extinguisher cylinder shall be complete with release valve, dial gauge indicator, appropriate length of hose with nozzle and locking pin.

The 7.1 kg (15.5 lbs.) capacity wall-hung type fire extinguishers shall be complete with carrying handle and wall-mounting bracket.

Portable fire extinguishers shall be suitable for the protection against class ABC fires using Clean Agent (HydroChloroFluoroCarbon or Halotron I Type) that is environmentally safe and leaves no residue.

The fire extinguishers shall be check-weighed at interval of six (6) months from the date of delivery for a period of one (1) year and if found to be undercharged (unless used by an NPC personnel) shall be filled and recharged by the Supplier at no expense to NPC.

MW-6.2.3 Submittal

The Supplier shall submit the type and model of the fire extinguishers for the approval of NPC prior to purchase.

MW-7.0 DRAWINGS

Prior to procurement of all materials, equipment and auxiliaries to be supplied by the Supplier under this contract, the Supplier shall submit for NPC's review, approval, and/or reference, five (5) copies of prints of technical specifications/data and/or brochures/catalogues. NPC shall review, comment or note corrections to be made and return two (2) copies to the Supplier within twenty (20) calendar days after receipt of the drawing. If corrections are required, the Supplier shall make all necessary corrections and re-submit such within fourteen (14) calendar days for NPC's review and approval.

Prints marked "Approved" or "Approved with Corrections Indicated" authorize the Supplier to proceed with the procurement of materials or equipment or construction/fabrication of the work shown on the drawings, with corrections, if any, indicated thereon. When prints of drawings are marked "Approved with Corrections Indicated" or "Returned for Corrections", the Supplier shall finalize the drawings and re-submit same in five (5) copies each for final approval. Every revision shall be shown by number, date and subject in a revision block.

Drawings approved by NPC shall in no way relieve the Supplier from entire responsibility for engineering, design, workmanship, material and all other liabilities under the Contract.

NPC reserves the right to reproduce any drawings or prints received from the Supplier as may be required despite any notice prohibiting the same appearing on the drawing or the print.

The Supplier shall submit construction and detailed drawings as may deemed necessary, as-built drawings and other documents for NPC's review, approval, information and reference as specified in the relevant specifications.

Any supply of materials/equipment or construction of any particular structure or portion thereof prior to the approval of drawings pertinent thereto shall be at the Supplier's risk. The Supplier shall be responsible for any extra cost that may arise in correcting the work already done to conform with the drawings as revised and approved.

Should an error be found in the Supplier's drawings during construction/erection, the correction including any field change considered necessary shall be noted on the drawings and shall be resubmitted for approval.

All data and information to be submitted shall be in the English language and all drawings shall be drawn using the metric system as unit of measurement.

The Supplier shall address all communications pertaining to Supplier's Drawings or otherwise agreed to:

The Manager, Design and Development Department
National Power Corporation
BIR Road corner Quezon Avenue,
Diliman, Quezon City 1100

All drawings and documents to be submitted by the Supplier for NPC's review and approval shall be on A4 size or A3 size folded to A4.

MW-8.0 GUARANTEE

The Supplier shall guarantee the replacement of the supplied equipment or components at his own expense against defect in design, workmanship and materials for a period of twelve (12) months after the equipment has been installed, tested and accepted. However, the warranty coverage for the compressor of the air-conditioning units shall be five (5) years. The Supplier guarantees that the equipment will perform in the manner as set forth in the equipment's manual and the Contract.

The Supplier shall submit a Warranty Certificate effective from the date of acceptance by NPC.

After the lapse of the warranty period, provided that there are no defects found and/or pending repair works, NPC shall release the warranty security/certificate.

MW-9.0 MEASUREMENT OF PAYMENT

Measurement for payment for all works shall be based on the bid price of each item as shown in the Bill of Quantities. The cost shall cover all works required and described in the pertinent provisions of the specifications.

Measurement for payment for pipes shall be based on the bid price of actual length of pipe installed as shown in the Bill of Quantities. The cost shall cover all works required including excavation, sand bedding, backfilling, testing, painting and other works and services described in the pertinent provisions of the specifications.

SECTION VI

PART II

TECHNICAL DATA SHEETS

SECTION VI – TECHNICAL SPECIFICATIONS
PART II – TECHNICAL DATA SHEETS

ANNEX "A" – TO BE SUBMITTED WITH THE BID PROPOSAL
- E.1.1: GENERAL TECHNICAL REQUIREMENTS
- E.1.2: POWER TRANSFORMER

ANNEX "B" – TO BE SUBMITTED DURING POST QUALIFICATION
- E.1.2: POWER TRANSFORMER
- E.1.9: POWER, CONTROL AND INSTRUMENTATION CABLES

E.1.1: GENERAL TECHNICAL REQUIREMENTS

ANNEX "A"

A. Project Requirements

A.1 All standard accessories, including those not indicated in this Specification, shall be furnished.

A.2 The detailed work to be performed by NPC or Contractor for the Project shall be as follows:

	NPC	Contractor
Design & Engineering		X
Fabrication & Manufacture of Substation Equipment and its accessories per specification		X
Factory Tests (Design & Routine)	X*	X
Packing and Delivery to Port of Loading		X
Delivery from Port of Loading (FOB) to Port of Entry (CIF Port of Entry)		X
Loading/Unloading		X
Delivery from Port of Entry to Site		X
Unloading at Site or NPC Stockyard		X
Storage, Moving and Care of Goods		X
Checking All Parts (at Delivery Port or Site)**	X**	X
Unpacking (at Site)		X
Foundations		X
Foundation Piers		X

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

	NPC	Contractor
Interconnecting Shipping Sections		X
Tools for Installation and Testing		X
Installation		X
Tools for Maintenance		X
Spare Parts		X
Cable and Wire Connections		X
Cable Schedule		X
Oil Filling and Treatment of Oil (for transformers, reactors)		X
Field Testing (Pre-Commissioning)***	X***	X
Calibration of Instrument & Controls		X
Quality Assurance Control	X	X
Touch-up Paint		X
Commissioning***	X***	X

* NPC representative(s) to witness Factory Routine Tests, if required in the Technical Data Sheets of every equipment.

** To be done by both NPC and Contractor or their representative

*** NPC representative to approve and witness every field testing and commissioning to be conducted for each of the substation equipment.

A.3 The services of a competent field service engineer or technician is required under this contract

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

A.4 Site Conditions and Environment

A.4.1 The expected environmental and meteorological conditions for the location of the equipment installation are as follows:

	Description	NPC Requirements
a.	Elevation above sea level	Not higher than 1000m
b.	Equipment location (indoor, outdoor)	Outdoor
c.	Ambient conditions at equipment location	
	1. Temperature range °C	0 – 40
	2. Relative humidity %	75 –95 non-condensing
d.	Maximum outdoor daily average temperature, °C	28.8
e.	Outdoor air conditions:	
	1. Tropical (Yes, No)	Yes
	2 Dust or Salt Laden (Yes, No)	Yes
f.	Degree of Contamination (specify light, medium, heavy, or very heavy per IEC Std.)	Very Heavy
g.	Maximum design wind velocity, kph	300
h.	Required creepage distance, mm/kV (Based on max. phase to phase voltage)	31
i.	Flood level above equipment pedestal, mm	300
j.	Other outdoor abnormal conditions: (Yes, No)	
	1. hurricane (typhoon)	Yes
	2. tornado	No
	3. chemical pollution sources	No
	4. H_2S gas	No

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

		NPC Requirements
A.5	Design for seismic load (Yes, No): If Yes, refer to Paragraph 1.1.9	Yes
	Acceleration Factor (horizontal)	
	1. Seismic zone factor, Z	0.4G
A.6	Equipment shall be shipped, prepared and protected for outdoor storage for period of: year	One (1)
A.7	Other General Requirements	
A. 7.1		
	a. Documentary film to be provided for the Project	Yes
	b. Type	Per Specifications
	c. No. of copies to be furnished	Six (6)
	d. Hardware and Software to be provided as a complement for the submission of Final/As-Built Drawings	Yes
	1. Type	PC compatible Laptop
	2. Processor	Latest available on time of award
	3. Clock Frequency	Fastest available
	4. RAM capacity, G bytes	128 min.
	5. Hard disk capacity, G bytes	2 TB min.
	6. Sound card	64-bit Stereo
	7. Video card capacity	Largest available
	8. Monitor	14" LED SVGA / color monitor
	Software:	
	1. Operating System	Latest Microsoft Windows with Hardcopy and CD
	2. Microsoft Office	Yes, Professional Edition Latest Version to be provided with hardcopy and CD

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

	NPC Requirements
Peripheral Connectivity:	
1. Communication Interface	RS 232-C and USB Ports
2. Fax Modem Provided	Yes, 56 k voice, fax, data
3. CD ROM / WRITE	Yes, latest version
4. DVD ROM Drive provided	Yes, latest speed
5. Portable mouse provided	Yes
6. Built-in i.Link (IEEE 1394) port	Yes
7. 10/100/1000 Mbps RJ-45 PCI based with Wake-on LAN, DMI Capable	Yes
Power Supply:	
1. Voltage	100-240 VAC, 1-Φ, 60 Hz
Units to be provided	
1. Laptop	Four (4)[1]

A.8 The Equipment Manufacturer shall acknowledge to have read understand and will comply with all the technical requirements stated in the TDS for the following equipment:

a. Power Transformer
b. Power, Control & Instrumentation Cable

[1] For used by Design and Development Department (2 units), SPUG-Catanduanes (1 unit) and Project Management Department (1 unit) shall be included in the cost for Substation Equipment.

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

E.1.2: POWER TRANSFORMER

ANNEX "A"

B.1 Technical Features and Requirements

B.1.1 Transformer Description

		NPC Requirement	Contractor's Data
a.	Number of phase	3-phase	
b.	Insulation	Mineral oil	
c.	Application	Substation transformer	
d.	Class *(Outdoor, indoor)*	Outdoor	
e.	Continuous rated output at 65°C temp. rise (80°C hot spot), MVA	20	
f.	Self-cooled rating (ONAN)	20	
g.	Cooling Rating		
	1. 1st stage cooling rating	N/A	
	2. 2nd stage cooling rating	N/A	
h.	Percent overload, %	20 %	
i.	Type of overload capability (specific cyclic or short time emergency loading)	According to IEC 60354 normal cyclic loading	
j.	Duration of cycle at 1.2 x p.u load and not exceeding hot spot temperature of 120°C after 100% continuous full-load at ambient temperature of 40 °C, hrs	4	
k.	Magnetic flux density	Max. 1.7	
l.	Type	Three-winding Transformer	

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

	NPC Requirement	Contractor's Data
m. Insulation level: Nominal operating voltage level for equipment		
1. H-winding, kV	69	
2. X-winding, kV	13.8	
3. Y-winding, kV	13.8	
Rated Voltage for equipment:		
1. H-winding, kV	72.5	
2. X-winding, kV	15	
3. Y-winding, kV	15	
4. H/Y-winding, neutral terminal, kV	25/15	
n. Basic Impulse Level:		
1. H-winding, kV	350	
2. X-winding, kV	110	
3. Y-winding, kV	110	
4. H/X-winding, neutral terminal, kV	150/110	
o. Basic Switching Impulse Withstand Level		
1. H-winding, kV	N/A	
2. X-winding, kV	N/A	
3. Y-winding, kV	N/A	
p. Exciting current at rated voltage and frequency and based on maximum MVA rating of high voltage winding not more than	1.5%	

B.1.2 Capitalized Cost for Transformer Losses

When comparing between tenders, the capitalized cost for transformer losses will be used:

1. No load loss at 100% of rated voltage on mid-tap, (N_{L-L})	$4,500/kW
2. Load loss related to 85°C, (L_L)	$3,200/kW
3. Auxiliary Loss for Stage 1 Cooling, (Aux_{L1})	N/A
4. Auxiliary Loss for Stage 2 Cooling, (Aux_{L2})	N/A

In the bid evaluation, the figure listed above will be multiplied by its respective guaranteed loss value in kilowatts, and the resulting figures will be added to the bid price to give total evaluated price to bid comparison.

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

B.1.3 Transformer Guaranteed Losses

Transformer Guaranteed Losses at Rated MVA, frequency, voltage & temperature.

		Contractor's Data
a.	No-Load Losses, kW	
b.	Load Losses, kW	
c.	Stage 1 Cooling Losses, kW	N/A
d.	Stage 2 Cooling Losses, kW	N/A
e	Total Losses, kW (a+b+c+d)	

Note: Other transformer technical description shall be refer to Annex "B" and shall be submitted during the Post Qualification

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

E.1.2: POWER TRANSFORMER

ANNEX "B"

B.1 Technical Features and Requirements

B.1.1 Transformer Description (Cont'd...)

		NPC Requirement	Contractor's Data
B.1.2	Angular displacement for three-phase transformers (specify ANSI Std. or vector group symbol if IEC Std. is applied)	Ynyn0d1	
B.1.3	Stabilizing winding *		
	a. To be provided (Yes, No)	No	
	b. Capacity Rating	5MVA	
B.1.4	Winding material shall be:		
	a. "H"	copper	
	b. "X"	copper	
	c. "Y"	copper	

B.1.5 Capacity Ratings

The maximum simultaneous continuous loading, in windings without exceeding the temperature rise limitations, under each cooling condition, shall be as follows:

a.	Winding	H, X, Y	
b.	MVA Rating, per phase		
	1. H-winding	20	
	2. X-winding	20	
	3. Y-winding	5	
c.	PF (lead/lag)	0.85 lag	
d.	Type of cooling	ONAN	

Note: *

In addition to the required load rating, the tertiary winding shall be sized to withstand the effects of the full rated short circuit and to circulate the system harmonic currents of up to 2% of the transformer rating.

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

	NPC Requirement	Contractor's Data
e. Temperature Rise top oil, °C/Average Winding Temperature, °C	65/65	

B.1.6 Impedance

1. Impedance (Percent/MVA Base) at 85°C		
a. H-X winding at 20 MVA	Manufacturer's Data	
b. H-Y winding at 20 MVA	Manufacturer's Data	
c. X-Y winding at 5 MVA	Manufacturer's Data	

B.1.7 Audible Sound

a. Average audio sound level not more than, dB	≤ 74	
when measured at the factory, in accordance with (specify applied Standard)	ANSI/IEEE C57.12.90 or IEC 60076-10	
and with excitation of	100%	

B.1.8 Short Circuit Capability

B.1.8.1 Short Circuit Current Magnitude - System Data

a. H-Terminals		
Short circuit power	According to ANSI C57.12 -2000 Paragraph 7.1.5.3 Table 16	
Ratio of zero to positive sequence impedance	According to ANSI C57.12-2000 Paragraph 7.1.5.3	
b. X-Terminals		
Short circuit power	According to ANSI C57.12 -2000 Paragraph 7.1.5.3 Table 16	

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

	NPC Requirement	Contractor's Data
Ratio of zero to positive sequence impedance	According to ANSI C57.12 -2000 Paragraph 7.1.5.3	
c. Y-Terminals		
Short circuit power	According to ANSI C57.12 -2000 Paragraph 7.1.5.3 Table 16	
Ratio of zero to positive sequence impedance	According to ANSI C57.12 -2000 Paragraph 7.1.5.3	

If the mentioned data is not filled in, the NPC will presume that the data used is from ANSI C57.12.00-2000 Paragraph 7.1.5.3.

B.1.9 Bushings

The Contractor shall provide bushings as follows:

a. Bushing class and standard:		
HV terminals (H):		
1. Rated current, A	≥ 800	
2. Insulation Class	72.5	
3. BIL in kV	350	
4. Creepage length, mm	2247.5	
LV terminals (X):		
1. Rated current, A	≥ 1200	
2. Insulation Class	15	
3. BIL in kV	110	
4. Creepage length, mm	465	
LV terminals (Y)		
1. Rated current, A	≥ 800	
2. Insulation Class	15	
3. BIL in kV	110	
4. Creepage length, mm	465	
LV terminals (Z)		
1. Rated current, A	N/A	
2. Insulation Class	N/A	

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

	NPC Requirement	Contractor's Data
3. BIL in kV	N/A	
HV/LV neutral terminal, (H_o/X_o)		
1. Rated current, A	≥ 800/1200	
2. Insulation Class	15	
3. BIL in kV	110	
4. Creepage length, mm	465	
LV neutral terminal, (Y_o)		
1. Rated current, A	N/A	
2. Insulation Class	N/A	
3. BIL in kV	N/A	
4. Creepage length, mm	N/A	
b. Color of bushing shall be	Brown	
c. Provision for potential taps on the condenser bushings		
H-terminal bushings	Yes	
X-terminal bushings	No	
Y-terminal bushings	N/A	
d. Provision for test taps on the condenser bushings		
H-terminal bushings	Yes	
X-terminal bushings	No	
Y-terminal bushings	N/A	
e. If a terminal is not brought out through a bushing initially, provision: (shall, shall not) be made in the overall design, including the cover operating for the future installation of bushings, having an insulation class matching that of the associated winding.	N/A	

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

	NPC Requirement	Contractor's Data

f. Terminal connectors shall be provided as listed below. Each terminal shall have a maximum RIV level of 10 microvolts when energized at 125 percent of the rating of the associated winding.

Terminal	Description of Connector	
(H)	Manufacturer's std.	
(X)	Manufacturer's std.	
(Y)	Manufacturer's std.	
(H_oX_o)	Manufacturer's std.	
(Y_o)	-	
(Other)	-	

B.1.10 Cooling

a. Cooling medium will be (air, water, oil)	Air and Oil	
b. Temperature		
1. Temperature of cooling air, not to exceed	40°C	
2. Average temperature of the cooling air for any 24 h period, not to exceed	30°C	
3. Temperature of cooling water, not to exceed	N/A	
4. Average temperature of cooling water for any 24 h period, not to exceed	N/A	
5. Water will be supplied at:	N/A	
and:	N/A	
c. Conduit connections to the weatherproof control cabinets shall be:	from bottom	
d. Cooler arrangement (separately mounted or transformer mounted)	Transformer mounted	

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

		NPC Requirement	Contractor's Data
e.	Coolers	Radiator fin type	
f.	Steps of forced cooling	N/A	
g.	Fan motor supply voltage, V	N/A	
h.	Cooling fan control including selection and display of "Auto-Manual" mode, selection and display of "Fan Group", control and display "ON" fan groups of transformer shall be:		
	1. Integrated in the Transformer Monitoring and Control System	N/A	
	2. Interfaced to the MBSC	N/A	

B.1.11 Surge Arrester Mounted on Transformer

a.	Type	Station	
b.	Discharge counter provided	Yes	
c.	Leakage current monitor provided	Yes	
d.	Mounting Provisions provided	Yes	
e.	Surge arresters shall be supplied for terminals as follows and they shall be solidly grounded to the transformer pad:		
	1. Terminals H1, H2 & H3 Surge arrester Type & Rating, kV	N/A	
	2. Terminals X1, X2 & X3 Surge arrester Type & Rating, kV	Station / 12	
	3. Terminals Y1, Y2 & Y3 Surge arrester Type & Rating, kV	Station / 15	

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

	NPC Requirement	Contractor's Data
f. Remote indication of discharge counter registers and leakage current to be provided thru:		
1. Transformer Control Board (Control Room)	Yes	
2. MBSC System	N/A	

B.1.12 Spill Gaps

B.1.12.1 Spill gaps shall be provided and set on the basis of winding insulation class, listed in Paragraph 1.2.2.5.2.1, for the following terminals:

a. HV terminals	N/A	
b. LV terminals	N/A	
c. Y terminals	N/A	
d. Z terminals	N/A	

B.1.13 Continuous Gas Monitoring System (Not Used)

a. Supply of intelligent on-line continuous gas-in-oil incipient fault detection system, including full bore gate valve, transmitter with sensor, communication controller, alarm indicator, continuous ppm display, software and calibrator suitable for tropical climate use (Yes, No)	N/A	
b. Type		
1. Hardware	N/A	
2. Software	N/A	
c. Location of gas-in-oil sensor	N/A	
d. Having the following functions:		
1. Gas level indication	N/A	

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

	NPC Requirement	Contractor's Data
2. Gas trends (hourly and daily trends)	N/A	
3. Faulty annunciation, alarm indication and status indication	N/A	
4. History logging	N/A	
5. Configuration and self-test	N/A	
6. Remote software upgrading possible	N/A	
e. Display range	N/A	
f. Continuous Gas gas-in-oil Monitoring System of the Transformers shall be:		
1. Integrated in the Transformer monitoring and control system (Local & Remote)	N/A	
2. Interfaced to the MBSC System for the substation	N/A	
g. Degree of protection of panel enclosures	N/A	
h. Provide Notebook computer for retrieval of information and data [1]	N/A	

B.1.14 Temperature Indicator

a. Supply of dial-type winding temperature indicators mounted on the transformer for top oil and hot spot temperatures mounted side by side with each other approximately 1500 mm above ground level	Yes	
b. Monitoring Equipment for Remote Temperature Indication shall be provided (Yes, No)	Yes [2]	
1. Type	Microprocessor based	

[1] Refer to paragraph A_7 (a) for features of Notebook computer to be provided
[2] Can be installed in the same rack for Transformer Operation Control System

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

	NPC Requirement	Contractor's Data
2. Resistance Coil Hot Spot Temperature Indicator (Specify quantity/phase)	1/phase	
3. Transfer Switch (With, Without)	With	
4. Instrument for Panel Mounting (size)	19" rack	
5. Required points for remote digital temperature recorder	2	
c. Equipment for Data Logging to be provided*	Yes	
1. Number or Number Per Phase	1/phase	
2. Type: (Resistance Coil, Thermocouple, RTD, etc.)	RTD	

* Note: These functions shall be integrated in the Transformer monitoring and control system.

B.1.15 Sudden Pressure Relay

a. Sudden pressure relay, required (Yes, No)	Yes	
b. Type	Manufacturer's Data	
Sudden Pressure Relay alarm/ trip of the Transformers shall be integrated in the :		
1. Transformer monitoring and control system	---	
2. Shall be interfaced to the MBSC System for the substation	---	
3. Existing Main Control Switchboard	Yes	

B.1.16 Annunciator

a. Local outdoor annunciator panel to be provided located at the transformer outdoor cubicle (Yes, No)	No	

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

	NPC Requirement	Contractor's Data
b. Annunciator to be provided in the remote transformer control cubicle (Yes, No)	Yes	

B.1.17 Transformer Taps

a. The taps specified in Paragraph 1.18 shall be full capacity taps and shall be connected as described therein.		
1. The taps, upon which all ratings shall be based, shall be for the: High Voltage Winding, kV	69 ± 10% at 0.625 steps for the on-load tap changer	
"X" low voltage wind, kV	-	
"Y" low voltage wind, kV	-	
2. The transformer shall be shipped with a: (specify on-load, no-load) tap changers set at these taps	on-load	

B.1.18 Tap Changer

a. No-Load Tap Changer (Not Applicable)		
1. A no-load tap changer shall be furnished and provided for the transformer:	No	
2. Tap changer rated current, A	N/A	
3. Power supply for motor, V	N/A	
4. Power requirement, motor, kW	N/A	
5. Operation and Control	N/A	
b. On-Load Tap Changing Mechanism		
1. A load tap changing mechanism shall be furnished and provided for the transformer:	Yes	
2. Taps above rating shall be (percent steps/number)	0.625%/16	
3. Taps below rating shall be (percent steps/number)	0.625%/16	

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

	NPC Requirement	Contractor's Data
4. Operation and Control (auto., remote, manual)	Yes	
5. Full kVA rating is required on all taps except: (tap no/s.)	N/A	
6. Tap changer rated current, A	By Contractor	
7. Power supply for motor, V	By Contractor	
8. Power requirement, motor, kW	By Contractor	
9. Provision in the design of the LTC control circuit for future-present operation with another transformer (Yes, No)	No	
10. A complete indoor transformer control system panel shall be provided in accordance with paragraph E.1.2.2.5.4.12 of the Technical Specification	Yes	
11. Paralleling of transformer shall follow the principle of: (state whether master follower or minimum circulating reactive current principle)	---	
12. Degree of protection of transformer control system panel	IP 50	
c. A protective relay (oil-flow operated) and a sudden-pressure operated protection relay with trip contact shall be provided for the conservator of LTC	Yes	
d. All tap changer functions, including tap changer position sensing, selection and display of "Auto-Manual" mode, oil-flow and sudden pressure operated relays (analog output=4-20 mA) shall be integrated in the Transformer monitoring and control system	Yes	

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

B.1.19 Bushing Current Transformer and Potential Devices (If Required)

B.1.19.1 Bushing Current Transformer

	NPC Requirement	Contractor's Data
a. Bushing current transformers with multi-ratios shall be supplied at the following terminals:	H & X (where applicable) & neutral	
b. Rated primary current, A:		
1. H-bushing	By Manufacturer	
2. X-bushing	By Manufacturer	
3. Y-bushing	By Manufacturer	
4. Neutral	To be based on the design requirements of the protection system by the supplier	
c. Rated secondary current, A:		
1. H-bushing	1	
2. X-bushing	1	
3. Y-bushing	1	
4. Neutral	1	
d. No. of Cores:		
1. H-bushing	2	
2. X-bushing	2	
3. Y-bushing	2	
4. Neutral	1	
e. Core Assignment:		
1. H-bushing:		
Core 1	Metering	
Core 2	Relaying	
Core 3	N/A	
Core 4	N/A	
2. X-bushing:		
Core 1	Metering	
Core 2	Relaying	
Core 3	N/A	
Core 4	N/A	

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

	NPC Requirement	Contractor's Data
3. Y-bushing:		
Core 1	Metering	
Core 2	Relaying	
Core 3	N/A	
4. Neutral bushing:		
Core 1	Relaying	
Core 2	---	
Core 3	---	
f. Accuracy class:		
1. Metering Core	0.3B2.0	
2. Relaying cores	C400	

B. 1.19.2 Bushing Potential Device

a. Bushing potential devices with space heaters shall be provided on the following terminals:	N/A	
b. Burden for rated accuracy		
1. Main	N/A	
2. Auxiliary	N/A	
3. Accuracy Class (per ANSI)	N/A	
4. Secondary voltage (with nominal system voltage / √3 and specified ratio)	N/A	
5. Ratio	N/A	

B.1.20 Auxiliary Power Supply

a. 460 VAC		
1. No. of phase	N/A	
2. No. of wire	N/A	
3. Frequency, Hz	N/A	
4. Short Circuit Capability, kA	N/A	
5. System	N/A	
6. No. of set	N/A	

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

	NPC Requirement	Contractor's Data
7. Automatic power supply transfer switch [3]	N/A	
b. 230 VAC		
1. No. of phase	1-phase	
2. No. of wire	2-wire	
3. Frequency, Hz	60	
4. Short Circuit Capability, kA	50	
5. System	Ungrounded	
6. No. of set	1	
c. DC supply voltage		
1. Voltage	125	
2. No. of set	1	
3. Short Circuit Capability, kA	25	
4. System	Ungrounded	

B.1.21 Oil Preservation System

a. The conservator type of oil preservation system of the transformer shall be of the: (specify diaphragm, nitrogen gas sealed, etc.)	Diaphragm	
b. A single-float Buchholz relay shall be provided for each main conservator connected as leakage detector for the diaphragm of the air-bag type (Yes, No)	Yes	
c. A non-return valve with trip contact and automatic closing action for each main conservator, isolating the conservator when back-flow to the transformer corresponding to the breathing action is exceeded shall be provided (Yes, No)	Yes	

[3] The transfer switch shall be mounted in a separate control cabinet, or within the main control compartment but equipped with a fire barrier between power and control wiring. Cables to the transfer switch shall be physically separated and not terminated on adjacent terminal points. Contractor shall submit wiring diagrams for NPC review and acceptance.

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

B.1.22 Insulating Oil

	NPC Requirement	Contractor's Data
a. Insulating oil shall be mineral oil in accordance with ASTM D3487 (Type I, Type II)	Per Manufacturer recommendation	
b. Additional Properties:		
1. Min. Flash Point, °C (ASTM D92)	145	
2. Pour Point, max. °C (not higher than)	-40	
3. Kinematic, Viscosity at 40°C	Max 12	
4. Electrical Breakdown limits (IEC 60156 Sphe. Electr.)	Min 30	
c. Shipment Samples	Required	

B.1.23 The following shall be provided to facilitate handling the transformer:

a. Standard Skid Base of Heavy Steel		
1. Without Wheels	Yes	
2. With Wheels	No	
b. Wheels shall be removable type (specify uni-directional, bi-directional)	N/A	
c. Rail gage	N/A	
d. Transformer rails to be provided	No	

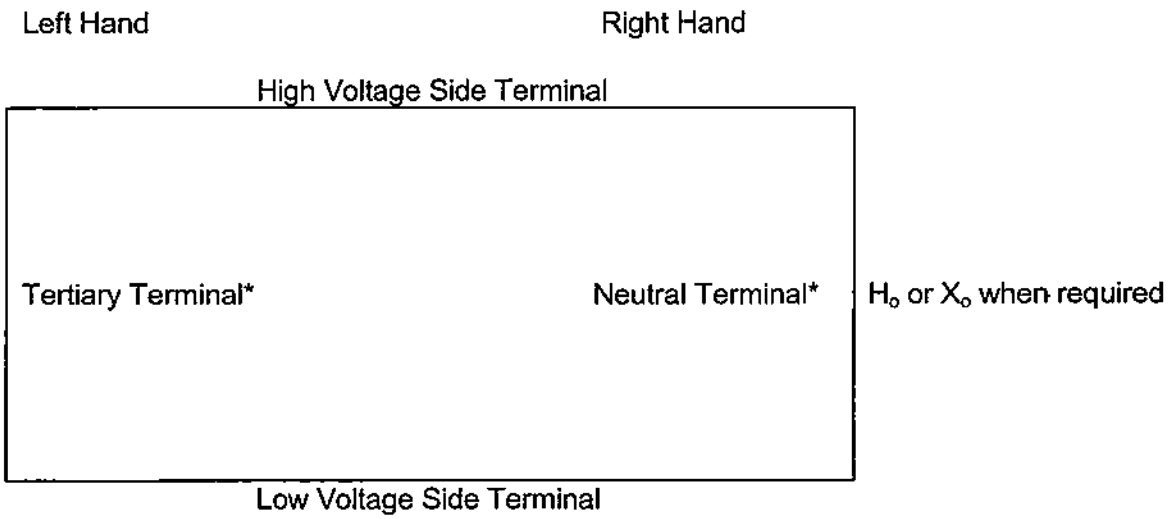
Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

B.1.24 Bushing Location

B.1.24.1 The location of the bushings of the transformer shall be as shown below:



NOTE: * Location of the tertiary and the neutral terminal are tentative. Final arrangement shall depend on the final layout of the substation and the substation equipment.

B.1.25 Special Features

B.1.25.1 Four (4) copies of photographs (8-1/2 x 11 in) with binding edge on 11 in. dimension, shall be furnished at or before the time of shipment for the following views:

View (side, top)	Facing Terminals (H, X, Y)	Tanked or Untanked	Fully Assembled (Yes, No)
Side	H, X, Y	Tanked	Yes
Side	H, X, Y	Untanked	Yes
Top	H, X, Y	Tanked	Yes
Top	H, X, Y	Untanked	Yes

B.1.26 Contractor's coordination with other equipment (If Applicable)

B.1.26.1 On transformers where flanges are supplied for bus ducts, the bushings are to be located to provide ground clearance, as stated below, between bus enclosure and live parts of bushings to which bus duct is connected and to other bushings not connected to the bus

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

duct. Contractor shall cooperate with the Contractors of the following equipment for the coordination of the power transformer terminals:

B.1.26.2 Isolated phase bus duct requires line to bus duct enclosure (ground) clearance from H, X, and Y terminals N/A, N/A, by Contractor, mm, respectively.

B.1.26.3 Non-segregated phase bus duct requires line to bus duct enclosure (ground) clearance from H, X, and Y terminals, N/A, N/A, N/A mm, respectively. [4]

B.1.26.4 Transformer tank design shall be such that no additional heating will result from induction or conduction from the bus ducts connected to it at rated load within its normal service condition.

B.1.26.5 Contractor shall inform the NPC of his coordination activities with vendors of connected or associated equipment by forwarding copies of correspondence.

B.1.27 Fire Prevention/Extinguishing Measures (Not Used)

	NPC Requirement	Contractor's Data
a. Transformer Explosion and Fire Prevention and Extinguishing Measures to be provided for the Transformer	No	
1. Type	N/A	
2. To include		
a. Main Tank	N/A	
b. OLTC	N/A	
c. Oil Bushing on Oil Cable Boxes	N/A	
d. Oil Filter Units	N/A	
b. The Transformer Explosion and Fire Prevention System to be provided with a back-up system known as Drain and Stir System	N/A	

[4] To be coordinated with the Manufacturer of the Metalclad Switchgear.

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

B.1.28 Oil Filter Units

a.	Oil Filter Units to be provided for each OLTC tank	Yes	
b.	Type	Outdoor stationary type mounted on transformer tank	
c.	Flow rate capacity	To be coordinated with the requirement of OLTC	
d.	Filter Accuracy	10 mm or better	
e.	Residual water content in oil after filter	Less than 10 ppm	

B.2 Tests and Experience Requirements

B.2.1 Normal Tests

	Description	NPC Requirement	Contractor's Data
a.	Is transformer design new or of previous design with the same rating and voltage level?	By Contractor	
	1. If new, design (type) tests and reports are required	Yes	
	2. If previous design of same rating and voltage, certified type test reports of duplicate production type are acceptable	Yes	
b.	Routine tests to be performed on all the transformers whether new or of previous design	Yes	
c.	Certified Routine test reports to be submitted (Yes, No)	Yes	
d.	Additional tests are required (Yes/No). If Yes, see Paragraph B.2.2	Yes	

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

	Description	NPC Requirement	Contractor's Data
e.	Test reports of licenser instead of his own (Contractor) is (acceptable, not acceptable)	Not acceptable	
f.	Test frequency requirement (Power)	60 Hz	
g.	Factory Acceptance Tests (Routine) to be witnessed by NPC representative (Yes, No)	Yes	
h.	Required no. of personnel to witness Factory Acceptance Tests	Three (3)	

B.2.2 Additional Tests

B.2.2.1 If additional tests are required (see Paragraph B.2.1.d). They shall be as follows:

a. All the special tests mentioned in IEC 60076-1 Sub-clause 10.1.3 except for the short circuit withstand test.

b. One-hour low frequency induced dielectric tests which is required on all terminals.

B.2.3 Equipment and Manufacturer's Experience

		NPC Requirement	Contractor's Data
a.	The manufacturer should have been in the business of manufacturing power transformers of the same voltage level or greater for not less than: years	10	
b.	The manufacturer must have a reference overseas (outside country of origin) supply record of the type of power transformer being offered: units	20	

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

c.	The reference power transformers being offered at least from three (3) different power utilities at tropical countries or countries having the same climatic conditions as that of the Phils. should have been in the actual service and operating satisfactorily for not less than: years	3	

B.2.3.1 Experience less than what is required will be ground for rejection of bids offered. Proof of satisfactory performance from at least three (3) different power utilities shall be submitted as compliance with the requirements and for NPC reference. Non-submission of the requirement shall also be considered as a disqualification of the bid being offered.

B.3 Auxiliary Power Supply

B.3.1 The items listed below shall be designed to receive the following voltage source:

		NPC Requirement	Contractor's Data
a.	Space heaters for the transformer control cubicle, VAC	230, 1- ϕ, 60 Hz	
b.	Internal lights and convenience outlets, VAC	230, 1- ϕ, 60 Hz	
c.	Motors, VAC	230, 1 -ϕ, 60 Hz	
d.	Annunciator source, VDC	125, +10%, - 15%	
e.	Indicating lights for position indicator of operating mechanism, VDC	125, +10%, - 15%	

B.4 Contractor's Field Service Representative

B.4.1 Contractor Shall provide the services of a testing engineer at the job site for the Main Transformer and all its accessories and associated equipment.

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

B.5 Shipping and Packing

B.5.1 Shipping Limitations

B.5.1.1 The maximum permitted shipping weight and dimensions shall be:

Weight, kg	*	
Height, mm	*	
Length, mm	*	
Width, mm	*	

Note: * Refer to Provisions on the Specific General Technical Requirements for the Substation Equipment and the Detailed Scope of Work for the Substation.

B.5.2 Packing

Refer to Provisions on the Specific General Technical Requirements for the Substation Equipment and the Detailed Scope of Work for the Substations.

B.6 Spares and Spare Parts

B.6.1 The following spares and spare parts aside from those Contractor's recommended spare parts shall be furnished for the transformer for Virac (Marinawa) Substation.

	NPC Requirement	Contractor's Data
a. Bushings for the high voltage terminals complete w/ gaskets and oil, if oil-filled:		
"H" terminals	1 unit	
"X" terminals	1 unit	
"Y" terminals	1 unit	
"Ho"terminals	1 unit	
"Xo"terminals	1 unit	
b. Set(s) of Bushing CTs, of each type and voltage rating used	--	
c. Set(s) of gauges and thermometers of each type used	1 each	

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

		NPC Requirement	Contractor's Data
d.	Fan motor set(s)	--	
e.	Set(s) of gaskets for cover, manhole, hand-holes and piping connections	1	
f.	A complete set of spare parts for the tap changing equipment, consisting of, but not limited to the following:		
	1. set(s) of diverter switch assembly	--	
	2. set(s) of stationary contacts for one phase	--	
	3. set(s) of moving arcing contacts for one phase		
	4. kits for repairing seal between motor drive and tap-changer compartment		
g.	Bucholz, single-float Bucholz, sudden pressure and winding temperature relay of each type used	1	
h.	Amount of silica gel in container (25 kg) enough to refill the dehydrating breaker	1 can	
i.	Set of silica gel container	--	
j.	Set(s) of bursting plate	--	
k.	Transformer Main Tank Rupture Disk Bursting set.	1 set	
l.	OLTC Rupture Disk Bursting Set	1 set	
m.	Paper filter insert for the Oil Filter Unit	--	
n.	Temperature switch for the Oil Filter Unit	--	
o.	Oil Bushing Rupture Disk Bursting Set	--	

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

	NPC Requirement	Contractor's Data
p. Oil filter unit Rupture Disk Bursting Set	--	
q. Nitrogen cylinder equipped with Manometer		
1. 50 liters	--	
2. 5 liters	--	
r. Fragment disk for nitrogen re-filling type	--	
s. Tool for nitrogen cylinder re-filling	--	
t. Low pressure flexible hose	--	

B.6.2 All spare parts subject to damage or deterioration by moisture shall be packed in moisture-proof material. All spare parts shall be interchangeable with and identical in all respect to the original parts.

B.6.3 All transformer of one size and type and all transformer components of the same rating shall be fully interchangeable.

B.7 Tools and Appliances

B.7.1 In addition to those tools and appliances recommended by the Contractor for the transformer, the following tools and appliances shall be supplied for the transformer for Virac (Marinawa) Substation.

	NPC Requirement	Contractor's Data
a. Manually operated jacks of ample capacity for lifting the transformer to place or position steel rollers during installation at job site (number of set/s)	1 set (4 units)	
b. Set of any special tools, wrenches and equipment that may be necessary or convenient for assembling/ disassembling the transformer (number of set/s)	1	

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

	NPC Requirement	Contractor's Data
c. Set of slings enough to lift 105% of the transport weight of the transformer	1 set	
d. Electronic calibrator for gas monitoring device, similar or equivalent to H200i Electronic Calculator	--	
e. Automatic Insulating Oil Test Set used for determining the dielectric strength of insulating oils, both new and in-service oils, used in transformer, complete with the required accessories and devices similar or equivalent to FOSTER OTS 60AF Model. The set shall also be provided with the following accessories in addition to the standard accessories:		
i. transportation trolley	--	
ii. oil test vessel fitted with cylindrical electrodes, 1 in (2.5 mm) dia	--	
iii. oil test vessel for the ASTM D1816 specification with motarized stirrer	--	
iv. two years supply of paper for the built-in printer	--	

B.8 Other Technical Requirements for the Transformer

Refer to the Provisions for the Specific Technical Requirements for the Substation Equipment and the Detailed Scope of Work or the Substation.

C. Other Technical Data to be Filled-in by Contractor

C.1 The Contractor furnished data and information are included in this Specification to indicate the guaranteed performance data, predicted performance, interface requirements and construction features of all Contractor furnished equipment. The accuracy of such information and the compatibility of such information with overall performance requirements specified by NPC are the sole responsibility of the Contractor.

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

C.2 Environmental Considerations

C.2.1 In accordance with Paragraph 1.1.8 of the General Technical Requirements and the Technical Data Sheets of Section E.1.1, the operating environment for this installation (will ☐, will not☐) affect the life expectancy of the components used in this equipment. If there will be an effect, the following components will be affected as follows:

Component	Effect

C.3 Other Technical Data by Manufacturer/Contractor

	Contractor's Data
a. Manufacturer	
1. Transformer	
Type and Designation	
Country of Origin	
2. Bushings	
a) H-Terminal	
Type and Designation	
Country of Origin	
b) X-Terminal	
Type and Designation	
Country of Origin	
c) Y-Terminal	
Type and Designation	
Country of Origin	
d) Neutral	
Type and Designation	
Country of Origin	
3. No-Load Tap Changer	
Type and Designation	
Country of Origin	
4. Transformer Control System	
b. Winding Construction	(layer, disc, etc.)
1. Volts per turn, V	
a. H	
b. X	
c. Y	

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

Contractor's Data

c. Core Construction _____ (core, shell)

1. Area per limb, cm^2 _____

d. Exciting Current
1. at rated voltage _____
2. at 100% voltage _____

e. Resistance per phase, ohm
1. H-winding _____
2. X-winding _____
3. Y-winding _____

f. Winding Distributed Capacitance per Phase (microfarad)
1. Winding to Ground
   a. H _____
   b. X _____
   c. Y _____

2. Between Winding
   a. H-X _____
   b. H-Y _____
   c. X-Y _____

g. Bushing Capacitance (stud to tap/tap to flange), pf
   a. H _____
   b. X _____
   c. Y _____
   d. Z _____

h. CT Capacitance to Ground, pf _____

i. Estimated Natural Resonant Frequency _____

j. Cooling Power Required
1. First step cooling, kW _____
2. Second step cooling, kW _____

k. Coolers

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

Contractor's Data

1. Quantity _____
2. Surface area, each (cm^2) _____
3. Winding Hot Spot Temperature Setting, °C
   a. High Temperature Alarm _____
   b. High Temperature Trip _____
   c. First Step Cooling (ON) _____
   d. Second Step Cooling (ON) _____

l. Fans
1. Type _____
2. Quantity _____
3. Motor size, hp _____
4. Motor speed, rpm _____
5. Capacity, cfm _____
6. Locked rotor, A _____
7. Normal load, kW _____

m. Pumps
1. Type _____
2. Quantity _____
3. Motor size, hp _____
4. Motor speed, rpm _____
5. Capacity, cfm _____
6. Locked rotor, A _____
7. Normal load, kW _____

n. Weights
1. Weight of core, kg _____
2. Weight of winding, kg (total) _____
3. Untanking weight, kg _____
4. Oil-weight _____
5. Total weight with oil, kg _____

o. Dimension
1. Completely assembled
   a) Overall height, mm _____
   b) Height over tank, mm _____
   c) Untanking weight, mm _____
2. Dimension (accessories removed)
   a) Overall height, mm _____
   b) Height over tank, mm _____

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

	Contractor's Data
c) Untanking weight, mm	

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

E.1.9: POWER, CONTROL AND INSTRUMENTATION CABLES

ANNEX "B"

B.1 Technical Characteristics and Requirements

B.1.1 15 kV Power Cable

B.1.1.1 Cable Design Data

	NPC Requirements	Contractor's Data
a. Type of cable	Single core	
b. Conductor cross section	Refer to Single Line Diagram	
c. Conductor diameter, mm	Manufacturer's Data	
d. Conductor material	Annealed Copper	
e. No. of wires, pcs. / Cross section of wire,mm^2	Manufacturer's Data	
f. Longitudinal water sealing system for the conductor		
1. Required (Yes, No)	Yes	
2. Type/description	Manufacturer's Std.	
3. Material	Manufacturer's Std.	
g. Conductor screen		
1. Material	Semi-conductive compound	
2. Nominal thickness, mm	Manufacturer's Data	
3. Minimum thickness, mm	Manufacturer's Data	
h. Insulation		
1. Material	Cross-linked polyethylene (XLPE)	

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

	NPC Requirements	Contractor's Data
2. Nominal thickness, mm	Manufacturer's Data	
3. Minimum thickness at any point, mm	Manufacturer's Data	
i. Insulation Screen		
1. Material	Strippable extruded	
2. Nominal thickness, mm	Manufacturer's Data	
3. Minimum Thickness, mm	Manufacturer's Data	
j. Screen bedding		
1. Type and material	Extruded layer of black PVC compound	
2. Thickness, mm	Manufacturer's Std.	
k. Metallic Screen		
1. Material	Annealed copper wires	
2. Total screen area, mm^2	Manufacturer's Data	
3. Number of wires, pcs.	Manufacturer's Data	
l. Outer Covering/Jacket		
1. Material	Extruded Black PE	
2. Density, kg/dm^3	0.92-0.93	
3. Nominal thickness, mm	Manufacturer's Data	
4. Min. thickness at any point, mm	Manufacturer's Data	
5. Termite protection required	Yes	
- Type/material of termite protection	Manufacturer's Std.	
6. Type/material of fire protection ***)	Manufacturer's Std.	

***) When laid inside the cable trench it shall be flame protected in accordance with IEC 60332-3-22

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

	NPC Requirements	Contractor's Data
m. Overall diameter of completed cable (nominal), mm	Manufacturer's Data	
n. Maximum pulling tension, N	Manufacturer's Data	

B.1.1.2 Electrical and Thermal Data for the 15 kV Power Cable

a. Rated voltage, kV	13.8	
b. Maximum voltage, kV	15	
c. Lightning impulse voltage withstand level, kV	≥ 95	
d. Rated power frequency withstand voltage, kV	≥ 34	
e. Frequency, Hz	60	
f. Max. d.c. resistance of conductor per meter of cable at 20 °C, $\mu\Omega$/m	Accord. to IEC 60228	
g. Maximum operating temperature, °C	90	
h. Max. continuous current carrying capacity per conductor At 90°C temperature	Manufacturer's Data	
i. Max. conductor short circuit current permissible when short circuit occurs at a conductor temperature of 90°C	Manufacturer's Data	
j. Max. continuous current carrying capacity per conductor when laid in air at an ambient temperature of 40 °C and conductor temperature of 90°C.		
1. One circuit laid in trefoil formation, A	Manufacturer's Data	

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

	NPC Requirements	Contractor's Data
2. Two circuit laid in trefoil formation, A	Manufacturer's Data	
k. Continuous conductor temperature at max. continuous current carrying capacity stated above, °C	≤ 90	
l. Maximum allowable conductor temperature at Maximum continuous rating (100% load factor), °C	Manufacturer's Data	
m. Maximum conductor temperature under emergency condition, °C	Manufacturer's Data	
n. Maximum metallic screen short circuit temperature, °C	Manufacturer's Data	
o. Duration at which the cable can be sustained at maximum conductor temperature under emergency situation, hr.	Not less than 2 hrs.	
B.1.2 600V Power Cable		
a. No. of Conductors/ Cable and Size	By Contractor [1]	
b. Conductor Metal	Tin-annealed copper stranded wire	
c. Conductor Shape	Circular stranded for all conductors	
d. Type of insulation	PVC for all conductors	

[1] Contractor to give full description of various number of conductor/ cable and sizes.

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

		NPC Requirements	Contractor's Data
e.	Thickness of insulation	Manufacturer's std.[2]	
f.	Type of jacket (cable sheath)	PVC Jacketed for all cables	
g.	Thickness of jacket (cable sheath)	Manufacturer's std.[2]	
h.	Provided with filler and binder tape	Yes for all cables	
i.	Maximum outside diameter (mm)	Manufacturer's std.[2]	
j.	Weight, kg/km (approximate)	Manufacturer's std.[2]	
k.	Reel length	not less than 500 m per reel	
l.	Max. operating temperature, C	75	
m.	Max. continuous current carrying capacity at 75°C conductor temperature	Manufacturer's Std.	

B.1.3 600V Control and Instrumentation Cable

a.	No. of Conductors / Cable and Size	By Contractor [1]	
b.	Conductor Metal	Tin annealed copper stranded wire for all conductors	

[2] Contractor to give description for each of the sizes/ types of conductors used.

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

		NPC Requirements	Contractor's Data
c.	Conductor Shape	circular for all conductors	
d.	Type of insulation	PVC insulation	
e.	Thickness of insulation of conductors not less than, mm	Manufacturer's Std.[2]	
f.	Type of jacket	PVC Jacketed for all cables	
g.	Thickness of jacket/outer sheath not less than, mm	1.8 for all cables	
h.	Provided with filler and binder tape	Yes for all cables	
i.	Maximum outside diameter (mm)	Manufacturer's Std.[2]	
j.	Weight, kg/km (approximate)	Manufacturer's Std.[2]	
k.	Overall shield required, *(Yes, No)*	Yes	
l.	Type of shielding	annealed copper type with minimum thickness of 0.5mm applied helically over the binder tape	
m.	Reel length	not less than 500 m	
n.	Max. operating temperature, C	75	
o.	Max. continuous current carrying capacity at 75°C conductor temperature.	Manufacturer's Std.	

[1] Contractor to give full description of various number of conductor/ cable and sizes.
[2] Contractor to give description for each of the sizes/ types of conductors used.

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

B.1.4 600V Analog/Measuring (CT/PT) Cables

	NPC Requirements	Contractor's Data
a. No. of Conductors/Cable and Size [1]	4c x 4.0mm^2 for 1A	
b. Conductor material	Annealed copper stranded wire	
c. Conductor shape	Circular (for all conductors)	
d. Conductor cross-section, (mm^2) [2]	Manufacturer's data	
e. Maximum outside diameter, (mm) [2]	Manufacturer's data	
f. Type of insulation [2]	PVC	
g. Thickness of insulation, not less than, (mm^2) [2]	Manufacturer's standard	
h. Type of jacket	PVC jacketed for all cables	
i. Thickness of jacket/outer sheath, not less than, (mm) [2]	1.8 for all cables	
j. Provided with filler and binder tape	Yes for all cables	
k. Maximum outside diameter, (mm^2) [2]	Manufacturer's data	
l. Overall shield required	Yes	
m. Type of shielding	Annealed copper tape with min. thickness of 0.5mm applied helically over the binder tape	
n. Reel length	Not less than 500 meters	
o. Cable entry to panels shall be secured with cable glands	Yes	
p. Spare/loose cables shall be covered with wire-end caps and laced into bundle	Yes	
q. Weight, (kg/km) [2]	Manufacturer's data	
r. Maximum operating temperature, °C	75	

[1] Contractor to give full description of various number of conductor/cable, sizes and ampacities.
[2] Contractor to fill-up the required data.

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

B.1.5 Cable Reel

	NPC Requirements	Contractor's Data
a. Material	Wood	
b. Returnable *(Yes, No)*	No	
c. If Yes, return within no. of month after installation	N/A	

B.2 Test and Experience Requirements

B.2.1 Test Requirements

a. Design test in accordance with applicable standards and reports required *(Yes, No)*	Yes	
b. Certified Design Test Reports of previous tests conducted for same cables are acceptable: *(Yes, No)*	Yes	
c. Additional tests are required *(Yes, No)* If yes, see Paragraph B.2.2.1	Yes	
d. Test frequency requirements	60 Hz	
e. Factory Acceptance Tests (Routine) to be witnessed by NPC	No	
f. Required No. of Personnel to Witness Factory Acceptance Test	N/A	

B.2.2 Additional Tests

B.2.2.1 If additional tests are required (see Paragraph B.2.1.c) they shall be as follows:

Manufacturer's tests standards not within the specified tests of ANSI or IEC Standards

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

B.2.3 Equipment and Manufacturer's Experience

	NPC Requirements	Contractor's Data
a. The manufacturer should have been in the business of manufacturing power and control cables of not less than : Years	10	

B.3 Auxiliary Power Supply Requirement (Not Applicable)

B.4 Contractor's Field Service Representative

B.4.1 Contractor ___shall___ provide the services of a testing engineer at the job site.
(shall, shall not)

B.5 Shipping and Packing

B.5.1 Shipping Limitations

B.5.1.1 The maximum permitted shipping weight and dimensions shall be:

	NPC Requirement	Contractor's Data
Weight, kg	*	
Height, mm	*	
Length, mm	*	
Width, mm	*	

* ***Note:***

Refer to Provision on the Specific General Technical Requirements for the Substation Equipment and the Detailed Scope of Work for the Substation.

B.5.2 Packing

Refer to Provision on the Specific General Technical Requirements for the Substation Equipment and the Detailed Scope of Work for the Substation.

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

B.6 Spares and Tools

	NPC Requirement	Contractor's Data
a. Spare cable for each type and size supplied[1]	N/A	

B.7 Other Technical Requirements for the Power, Control and Instrumentation Cables

Refer to Provision on the Specific General Technical Requirements for the Substation Equipment and the Detailed Scope of Work for the Substation.

C. Other Technical Data to be Filled-in by Contractor

C.1 The Contractor furnished data and information are included in this Specification to indicate the guaranteed performance data, predicted performance, interface requirements and construction features of all Contractor furnished equipment. The accuracy of such information and the compatibility of such information with overall performance requirements specified by NPC are the sole responsibility of the Contractor.

C.2 Environmental Considerations

C.2.1 In accordance with Paragraph 1.1.8 of the General Technical Requirements and the Technical Data Sheets of Section E.1.1, the operating environment for this installation (will ☐, will not ☐) affect the life expectancy of the components used in this equipment. If there will be an effect, the following components will be affected as follows:

Component	Effect

[1] Spare cables should be in metal reels.

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

C.3 Other Technical Data by Manufacturer/Contractor

a. Country of Origin
   1. 15 kV XLPE cable _____
   2. Power, Control and Instrumentation Cable _____

b. Manufacturer
   1. 15 kV XLPE Cable _____
   2. Power, Control and Instrumentation Cable _____

c. Weight of Cable w/o reel structure, kg *
   1. Power Cable (15 kV) _____
   2. Power, Control and Instrumentation Cable (600 V) _____

d. Estimated weight of reel, kg *
   1. Power Cable (15 kV) _____
   2. Power, Control and Instrumentation Cable (600V) _____

e. Total Estimated Weight of cable per reel (including reel), kg
   1. Power Cable (15 kV) _____
   2. Power, Control and Instrumentation Cable (600V) _____

f. Size of largest piece (diameter and depth) mm x mm, Di x D _____

* Contractor to give description of each type and size of cable to be used.

Name of Bidder: _____

Name & Signature of Bidder's Representative: _____

Designation: _____

SECTION VII

BILL OF QUANTITIES

(ELECTRICAL WORKS)

(CIVIL WORKS)

(ARCHITECTURAL WORKS)

(MECHANICAL WORKS)

BILL OF QUANTITIES

(ELECTRICAL WORKS)

BILL OF QUANTITIES
ELECTRICAL WORKS

Item No.	Description of Work or Materials	Work to Be Done	Reference	Unit	Estimated Quantity	Unit Price in Pesos (Words and Figures)	Total Amount (In Figures)
1.0	20/20/5MVA, 69/13.8kV, 3-Ph, 60Hz Three-Winding Transformer complete with the required accessories, appurtenances, spare parts and tools in accordance with the drawings and technical specifications	Supply & Install Test	Refer to NPC TS & Drawing	set	1	_____ _____(P_____)	(P_____)
2.0	Existing 10/10/10MVA, 69/13.8kV, 3-Ph, 60Hz Three-Winding Transformer including its existing accessories, appurtenances parts, control cables, on-load tap changer inside the control room, etc	Dismantle & Haul	Refer to NPC TS & Drawing	set	1	_____ _____(P_____)	(P_____)
3.0	Existing 69kV Bare Aluminum Conductor (connecting the transformer to the main 69kV tubular bus) in accordance with the drawings and technical specifications.	Dismantle, reterminate & test to the new 20MVA Transformer	Refer to NPC TS & Drawing	lot	1	_____ _____(P_____)	(P_____)
4.0	Existing 15kV XLPE Power Cable, 500mm² (feeder supplying switchgear no.2) including termination kits/lugs, etc in accordance with the drawings and technical specifications	Dismantle, recoil & haul	Refer to NPC TS & Drawing	lot	1	_____ _____(P_____)	(P_____)
5.0	Existing 15kV XLPE Power Cable, 500mm² (feeder supplying switchgear no.1) including termination kits/lugs, etc in accordance with the drawings and technical specifications	Dismantle, reterminate & test to the new 20MVA Transformer	Refer to NPC TS & Drawing	lot	1	_____ _____(P_____)	(P_____)
6.0	15kV XLPE Power Cable, 300mm² single-core complete with the required termination kit, terminal lugs, accessories, appurtenances, etc in accordance with the bid drawings and technical specifications	Supply, Install & test	Refer to NPC TS & Drawing	lot	1	_____ _____(P_____)	(P_____)

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BILL OF QUANTITIES
ELECTRICAL WORKS

Item No.	Description of Work or Materials	Work to Be Done	Reference	Unit	Estimated Quantity	Unit Price in Pesos (Words and Figures)	Total Amount (In Figures)
7.0	15kV XLPE Power Cable, 125mm² single-core complete with the required termination kit, lugs, accessories, appurtenances, etc in accordance with the bid drawings and technical specifications	Supply, Install & test	Refer to NPC TS & Drawing	lot	1	_____ _____(P_____)	(P_____)
8.0	LV power, instrumentation and control cables in accordance with the bid drawings and technical specifications	Supply, install & test	Refer to NPC TS & Drawing	lot	1	_____ _____(P_____)	(P_____)
9.0	Existing substation protection system in accordance with the bid drawings and technical specifications	Dismantle, reterminate & test to the new 20MVA Transformer	Refer to NPC TS & Drawing	lot	1	_____ _____(P_____)	(P_____)
10.0	Grounding system including grounding mat and rods, exothermic connection, riser connection to power transformer, control room, etc in accordance with the bid drawings and technical specifications	Supply, install & test	Refer to NPC TS & Drawing	lot	1	_____ _____(P_____)	(P_____)
11.0	Lighting and power system complete with the required outlets, utility boxes, energy meter, switches, lighting fixtures, panelboard, conduit, fittings, accessories, appurtenances, etc including tapping to existing power supply in accordance with the bid drawing and technical specifications	Supply, install, tap & test	Refer to NPC TS & Drawing	lot	1	_____ _____(P_____)	(P_____)
	TOTAL ELECTRICAL WORKS (EW)					_____ _____(P_____)	(P_____)

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_____ Name and Signature of Authorized Representative

_____ Designation

BILL OF QUANTITIES

(CIVIL WORKS)

BILL OF QUANTITIES
CIVIL WORKS

Item No.	Description of Work or Materials	Work to Be Done	Reference	Unit	Estimated Quantity	Unit Price in Pesos (Words and Figures)	Total Amount
1.0	**SITE DEVELOPMENT**						
1.1	Gravel Surfacing (100 mm thk.)	furnish, place, spread & compact	Refer to NPC TS & Drawing	cu.m	120	_____ (₱ _____)	₱ _____
2.0	**EXPANSION OF CONTROL ROOM AND OFFICE**						
2.1	Demolition and restoration of affected structure (Including concrete chipping to connect the proposed beam and folding gate to be transferred , etc.,)	demolish & reconstruct	Refer to NPC TS & Drawing	lot	1	_____ (₱ _____)	₱ _____
2.2	Wall to be Demolished	demolish and dispose	Refer to NPC TS & Drawing	lot	1	_____ (₱ _____)	₱ _____
2.3	Structural Excavation	excavate, stockpile and dispose	Refer to NPC TS & Drawing	cu.m.	15	_____ (₱ _____)	₱ _____
2.4	Structural Backfill	furnish, place, level and compact	Refer to NPC TS & Drawing	cu.m.	9	_____ (₱ _____)	₱ _____
2.5	Structural Fill	furnish, place, spread & compact	Refer to NPC TS & Drawing	cu.m	15	_____ (₱ _____)	₱ _____
2.6	Sand and Gravel Bedding	furnish, spread and level	Refer to NPC TS & Drawing	cu.m.	2	_____ (₱ _____)	₱ _____

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BILL OF QUANTITIES
CIVIL WORKS

Item No.	Description of Work or Materials	Work to Be Done	Reference	Unit	Estimated Quantity	Unit Price in Pesos (Words and Figures)	Total Amount
2.7	Concrete (20.7 MPa)	furnish and place	Refer to NPC TS & Drawing	cu.m.	14	_____ (₱ _____)	₱ _____
2.8	Reinforcing Steel Bars (Gr. 275)	furnish, cut, bend schedule and install	Refer to NPC TS & Drawing	kgs.	1160	_____ (₱ _____)	₱ _____
2.9	Structural Steel	furnish, fabricate and install	Refer to NPC TS & Drawing	kgs.	970	_____ (₱ _____)	₱ _____
2.10	Concrete Walk	furnish and place	Refer to NPC TS & Drawing	cu.m	2	_____ (₱ _____)	₱ _____
3.0	**DRAINAGE APPURTENANCE**						
3.1	100 mm Ø uPVC waste Pipe	furnish and install	Refer to NPC TS & Drawing	l.m.	8	_____ (₱ _____)	₱ _____
3.2	Catch Basin	furnish and install	Refer to NPC TS & Drawing	pcs	4	_____ (₱ _____)	₱ _____
4.0	**TRANSFORMER PAD TO BE MODIFIED**	furnish and construct	Refer to NPC TS & Drawing	lot	1	_____ (₱ _____)	₱ _____
5.0	**CABLE TRENCH**	furnish and construct	Refer to NPC TS & Drawing	l.m	6	_____ (₱ _____)	₱ _____

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Name of Firm

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Designation

BILL OF QUANTITIES
CIVIL WORKS

Item No.	Description of Work or Materials	Work to Be Done	Reference	Unit	Estimated Quantity	Unit Price in Pesos (Words and Figures)	Total Amount
6.0	**REPAINTING** (For Corroded Metalclad Switch Gear)	furnish & apply	Refer to NPC TS & Drawing	sq.m	23	_____ (₱ _____)	₱ _____
7.0	**CHB Perimeter Fence** (To be Demolished and Reconstruct)	demolish & reconstruct	Refer to NPC TS & Drawing	l.m	14	_____ (₱ _____)	₱ _____
	TOTAL CIVIL WORKS (CW)					_____ (₱ _____)	₱ _____

Name of Firm

Name and Signature of Authorized Representative

Designation

BILL OF QUANTITIES

(ARCHITECTURAL WORKS)

BILL OF QUANTITIES
ARCHITECTURAL WORKS

Item No.	Description of Work or Materials	Work to Be Done	Reference	Unit	Estimated Quantity	Unit Price in Pesos (Words and Figures)	Total Amount
1.0	**WALL SYSTEM AND FINISHES**						
1.1	150mm thick (6") CHB Wall including mortars and reinforcing bars.	furnish and lay	Refer to NPC TS & Drawing	sq.m.	75	_____ (₱ _____)	₱ _____
1.2	100mm thick (4") CHB Wall including mortars and reinforcing bars.	furnish and lay	Refer to NPC TS & Drawing	sq.m.	26	_____ (₱ _____)	₱ _____
1.3	Plain cement plaster wall finish	furnish and apply	Refer to NPC TS & Drawing	sq.m.	208	_____ (₱ _____)	₱ _____
1.4	Vitrified glazed wall tiles 200mm x 200mm including bonding materials for toilet walls	furnish and install	Refer to NPC TS & Drawing	sq.m.	6	_____ (₱ _____)	₱ _____
2.0	**FLOOR FINISHES**						
2.1	Vitrified unglazed floor tiles 200mm x 200mm including bonding materials for toilet floor	furnish and install	Refer to NPC TS & Drawing	sq.m.	2	_____ (₱ _____)	₱ _____
2.2	Porcelain Tiles	furnish and apply	Refer to NPC TS & Drawing	sq.m	25	_____ (₱ _____)	₱ _____
2.3	Pebble Washout	furnish and apply	Refer to NPC TS & Drawing	sq.m	6	_____ (₱ _____)	₱ _____

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Name of Firm

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BILL OF QUANTITIES
ARCHITECTURAL WORKS

Item No.	Description of Work or Materials	Work to Be Done	Reference	Unit	Estimated Quantity	Unit Price in Pesos (Words and Figures)	Total Amount
3.0	**ROOFING SYSTEM**						
3.1	Roofings: 2.0mm thk Metallic Plastic long span corrugated roofing sheet, including stainless steel fasteners sealants and 2.0mm thk. Metallic plastic end flashing.	furnish and install	Refer to NPC TS & Drawing	sq.m.	32	_____ (₱ _____)	₱ _____
3.2	Water Proofing for Concrete Gutter:	furnish and apply	Refer to NPC TS & Drawing	lot	1	_____ (₱ _____)	₱ _____
3.3	Ridge Roll: 2.0mm thick Metallic Plastic Ridge Roll including fasteners, sealant, hardware and accessories	furnish and install	Refer to NPC TS & Drawing	l.m.	3	_____ (₱ _____)	₱ _____
3.4	End Flashing: 2.0mm thick Metallic End Flashing including fasteners, sealant, hardware and accessories	furnish and install	Refer to NPC TS & Drawing	l.m.	21	_____ (₱ _____)	₱ _____
3.5	Downspout: 4" Ø uPVC pipe series 1000 downspout including joint fittings, solvents and brackets	furnish and install	Refer to NPC TS & Drawing	l.m.	35	_____ (₱ _____)	₱ _____
3.6	Roof Drain: Removable stianless wire basket strainer	furnish and install	Refer to NPC TS & Drawing	pcs	5	_____ (₱ _____)	₱ _____

_____
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Designation

BILL OF QUANTITIES
ARCHITECTURAL WORKS

Item No.	Description of Work or Materials	Work to Be Done	Reference	Unit	Estimated Quantity	Unit Price in Pesos (Words and Figures)	Total Amount
4.0	**CEILING SYSTEM**						
4.1	6mm thick marine plywood on standard metal furring spaced @ 0.40 O.C.B.W. and metal hangers spaced 0.80 O.C.B.W.	furnish and install	Refer to NPC TS & Drawing	sq.m.	32	_____ (₱ _____)	₱ _____
5.0	**FENESTRATION**						
5.1	Doors:						
	a. D - 1 (900mm x 2100mm) Panel type wood door 2x5 hard wood jamb 3 pieces of heavy duty loose pin hinges One set door knob, weatherproof Glazed lacquer paint finish on door and jamb	furnish and install	Refer to NPC TS & Drawing	set	1	_____ (₱ _____)	₱ _____
	b. D - 2 (600mm x 2100mm) Flush type wood door Marine plywood both sides 2x5 hard wood jamb 3 pieces of heavy duty loose pin hinges One set door knob, weatherproof Glazed lacquer paint finish on door and jamb	furnish and install	Refer to NPC TS & Drawing	set	1	_____ (₱ _____)	₱ _____

_____
Name of Firm

_____
Name and Signature of Authorized Representative

_____
Designation

BILL OF QUANTITIES
ARCHITECTURAL WORKS

Item No.	Description of Work or Materials	Work to Be Done	Reference	Unit	Estimated Quantity	Unit Price in Pesos (Words and Figures)	Total Amount
5.2	Windows:						
	a. W - 1 (1600 x 1100m) Glass and aluminum sliding window 6mm thk. Clear glass one whole piece panel Heavy gage extruded, dark color 50x100mm anodized aluminum frame Heavy duty mechanism	furnish and install	Refer to NPC TS & Drawing	set	2	_____ (₱ _____)	₱ _____
	b. W - 2 (3500m x 1200m) 1/8" x 7/8" Zee bars 5.6mm clear glass Awning and Fix Type	furnish and install	Refer to NPC TS & Drawing	set	1	_____ (₱ _____)	₱ _____
	c. W - 3 (1800m x 1200m) 1/8" x 7/8" Zee bars 5.6mm clear glass Awning and Fix Type	furnish and install	Refer to NPC TS & Drawing	set	1	_____ (₱ _____)	₱ _____
	d. W - 4 (0.60m x 0.60m) Glass and aluminum awning window 6mm thk. Clear glass one whole piece panel Heavy gage extruded 50 x 100mm anodized aluminum frame Heavy duty mechanism	furnish and install	Refer to NPC TS & Drawing	set	1	_____ (₱ _____)	₱ _____
	e. Window Typoon Guard (To all windows)	furnish and install	Refer to NPC TS & Drawing	lot	1	_____ (₱ _____)	₱ _____

_____
Name of Firm

_____
Name and Signature of Authorized Representative

_____
Designation

BILL OF QUANTITIES
ARCHITECTURAL WORKS

Item No.	Description of Work or Materials	Work to Be Done	Reference	Unit	Estimated Quantity	Unit Price in Pesos (Words and Figures)	Total Amount
6.0	**PLUMBING SYSTEM**						
	a. Water closet, white	furnish and install	Refer to NPC TS & Drawing	set	1	_____ (₱ _____)	₱ _____
	b. Lavatory: Wall mounted with pedestal, colored,	furnish and install	Refer to NPC TS & Drawing	set	1	_____ (₱ _____)	₱ _____
	c. Soap holder, white	furnish and install	Refer to NPC TS & Drawing	pc	1	_____ (₱ _____)	₱ _____
	d. Toilet paper holder	furnish and install	Refer to NPC TS & Drawing	pc	1	_____ (₱ _____)	₱ _____
	e. Towel holder	furnish and install	Refer to NPC TS & Drawing	pc	1	_____ (₱ _____)	₱ _____
	f. Floor drain stainless 100mm x 100mm	furnish and install	Refer to NPC TS & Drawing	pc	1	_____ (₱ _____)	₱ _____
7.0	**PAINTING**						
	a. All Concrete Surfaces	furnish and apply	Refer to NPC TS & Drawing	sq. m.	208	_____ (₱ _____)	₱ _____

_____
Name of Firm

_____
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_____
Designation

BILL OF QUANTITIES
ARCHITECTURAL WORKS

Item No.	Description of Work or Materials	Work to Be Done	Reference	Unit	Estimated Quantity	Unit Price in Pesos (Words and Figures)	Total Amount
8.0	**MISCELLANEOUS**						
	a. Soil poisoning; authorized anti-termite liquid concentrate	furnish and apply	Refer to NPC TS & Drawing	sq.m	56	_____ (₱ _____)	₱ _____
	TOTAL ARCHITECTURAL WORKS (AW)					_____ (₱ _____)	₱ _____

_____
Name of Firm

_____
Name and Signature of Authorized Representative

_____
Designation

BILL OF QUANTITIES

(MECHANICAL WORKS)

BILL OF QUANTITIES
MECHANICAL WORKS

Item No.	Description of Work or Materials	Work to Be Done	Reference	Unit	Estimated Quantity	Unit Price in Pesos (Words and Figures)	Total Amount (In Figures)
1.0	**DOMESTIC WATER SUPPLY PIPING SYSTEM**		MW-4.0				
1.1	Gate Valve, 20mm ϕ, rising stem, cast bronze, screwed ends, Class 150	Supply, Install and Test		set	1	_____ _____(P_____)	(P_____)
1.2	Hose Bibb, 20mm ϕ, bronze body, screwed ends, Class 150	Supply, Install and Test		set	1	_____ _____(P_____)	(P_____)
1.3	Water Pipe, 20mm O.D. (1/2" N.D.), uPVC pipe, sch. 80 or Class 150, and its associated fittings, pipe supports and other accessories	Supply, Excavate, Install, Backfill, Test & Disinfection		lm	6	_____ _____(P_____)	(P_____)
1.4	Water Pipe, 25mm O.D. (3/4" N.D.), uPVC pipe, sch. 80 or Class 150, and its associated fittings, pipe supports and other accessories	Supply, Excavate, Install, Backfill, Test & Disinfection		lm	18	_____ _____(P_____)	(P_____)
2.0	**AIR CONDITIONING & VENTILATION SYSTEM**		MW-5.0				
2.1	**Air-Conditioning System**						
2.1.1	Air conditioning units for Office, 10,000 kJ/hr minimum cooling capacity, window type, inverter type, complete with necessary mounting accessories and controls (infrared remote) and other necessary accessories as described in the technical specifications	Supply, Install and Test		set	1	_____ _____(P_____)	(P_____)

_____ Name of Firm

_____ Name and Signature of Authorized Representative

_____ Designation

BILL OF QUANTITIES
MECHANICAL WORKS

Item No.	Description of Work or Materials	Work to Be Done	Reference	Unit	Estimated Quantity	Unit Price in Pesos (Words and Figures)	Total Amount (In Figures)
2.2	**Ventilation System**						
2.2.1	Exhaust fans for comfort room, 100m³/h wall mounted, propeller type, direct driven, complete with automatic shutter, mounting accessories and controls	Supply, Install and Test		set	1	_____ _____(P_____)	(P_____)
3.0	**FIRE FIGHTING SYSTEM**		MW-6.0				
3.1	Portable Fire Extinguishers, HCFC or Halotron I, 7.1kg (15.5lbs), non-expiry, multi-shots, wall hung type with bracket and mounting accessories, UL/FM approved	Supply and Install		unit	1	_____ _____(P_____)	(P_____)
	TOTAL MECHANICAL WORKS (MW)					_____ _____(P_____)	(P_____)

_____ Name of Firm

_____ Name and Signature of Authorized Representative

_____ Designation

SECTION VIII

BIDDING FORMS

SECTION VIII – BIDDING FORMS

TABLE OF CONTENTS

Standard Form No: NPCSF-INFR-01

Checklist of Technical & Financial Envelope Requirements for Bidders

A. THE 1ST ENVELOPE (TECHNICAL COMPONENT) SHALL CONTAIN THE FOLLOWING:

1. ELIGIBILITY DOCUMENTS

a. (CLASS A)

- PhilGEPs Certificate of Registration and Membership under Platinum Category (all pages) in accordance with Section 8.5.2 of the Revised IRR of RA. 9184;

  Note: The failure by the prospective bidder to update its Certificate with the current and updated Class "A" eligibility documents shall result in the automatic suspension of the validity of its Certificate until such time that all of the expired Class "A" eligibility documents has been updated

- Special PCAB License in case of Joint Ventures; and registration for the type and cost of the contract to be bid

- Statement of all its ongoing government and private contracts if any, whether similar or not similar in nature and complexity to the contract to be bid *(NPCSF-INFR-02)*

- The Statement of the bidder's Single Largest Completed Contract (SLCC) similar to the contract to be bid, and whose value, adjusted to current prices using the Philippine Statistics Authority (PSA) consumer price index, must be at least 50% of the ABC *(NPCSF-INFR-03)* complete with the following supporting documents:

  - Contract/Purchase Order
  - Owner's Certificate of Final Acceptance issued by the project owner other than the contractor or a final rating of at least Satisfactory in the Constructors Performance Evaluation System (CPES). In case of contracts with the private sector, an equivalent document (Ex. Official Receipt or Sales Invoice) shall be submitted

  (The Single Largest Completed Contract (SLCC) as declared by the bidder shall be verified and validated to ascertain such completed contract. Hence, bidders must ensure access to sites of such projects/equipment to NPC representatives for verification and validation purposes during post-qualification process.

  It shall be a ground for disqualification, if verification and validation cannot be conducted due to inaccessibility of the site for whatever reason or fault of the bidder.)

- Duly signed computation of its Net Financial Contracting Capacity (NFCC) at least equal to the ABC *(NPCSF-INFR-04)*;

b. (CLASS B)

- Valid Joint Venture Agreement, if applicable *(NPCSF-INFR-05)*

2. *Technical Documents*

- Bid Security, any one of the following:
  - Bid Securing Declaration (*NPCSF-INFR-06c*)

    OR
  - Cash or Cashier's/Manager's check issued by a Universal or Commercial Bank – 2% of ABC;

    OR
  - Bank draft/guarantee or irrevocable letter of credit issued by a Universal or Commercial Bank: *(NPCSF-INFR-06a) - 2% of ABC;*

    OR
  - Surety Bond callable upon demand issued by a reputable surety or insurance company *(NPCSF-INFR-06b) - 5% of ABC, with*
    - Certification from the Insurance Commission as authorized company to issue surety
- Duly signed, completely filled-out and notarized Omnibus Sworn statement (Revised) (NPCSF-INFR-07), complete with the following attachments:
  - For Sole Proprietorship:
    - Special Power of Attorney
  - For Partnership/Corporation/Cooperative/Joint Venture:
    - Document showing proof of authorization (e.g., duly notarized Secretary's Certificate, Board/Partnership Resolution, or Special Power of Attorney, whichever is applicable)
- Organization Chart for the project *(NPCSF-INFR-08)*
- Duly Signed and completely filled-out List of Contractor's Key Personnel (based on the minimum key personnel) *(NPCSF-INFR-09)*
- Duly Signed List of Contractor's Equipment (owned, leased or under purchase agreement (*NPCSF-INFR-12), with*
  - Proof of ownership and/or certificate of availability issued by Equipment Lessors
- Documents to be submitted with the Bid Proposal as specified in Annex A of Section VI – Part II, Technical Data Sheet (Electrical Works)
- Complete eligibility documents of proposed sub-contractor, if applicable

B. THE 2ND ENVELOPE (FINANCIAL COMPONENT) SHALL CONTAIN THE FOLLOWING:

- Duly signed Bid Letter indicating the total bid amount in accordance with the prescribed form (*NPCSF-INFR-13)*
- Duly signed and completely filled-out Bill of Quantities *(Section VII)* indicating the unit and total prices per item and the total amount in the prescribed Bill of Quantities form.
- Duly Signed Detailed Estimates for each items of work showing the computations in arriving at each item's unit prices used in coming up with the bid (*NPCSF-INFR-14)*
- Summary sheets indicating the direct unit prices of construction materials, labor rates and equipment rental rates used in coming up with the bid (*NPCSF-INFR-15)*

CONDITIONS:

1. *Each Bidder shall submit Two (2) copies of the first and second components of its Bid, marked Original and photocopy. Only the original copy will be read and considered for the bid. Any misplaced document outside of the Original copy will not be considered. The photocopy is ONLY FOR REFERENCE. NPC may request additional hard copies and/or electronic copies of the Bid. However, failure of the Bidders to comply with the said request shall not be a ground for disqualification.*
2. *A Bidder not submitting bid for reason that his cost estimate is higher than the ABC, is required to submit his letter of non-participation/regret supported by corresponding detailed estimates. Failure to submit the two (2) documents shall be understood as acts that tend to defeat the purpose of public bidding without valid reason as stated under Section 69.1.(i) of the revised IRR of R.A. 9184.*

Standard Form Number: NPCSF-INFR-02

List of All Ongoing Government and Private Contracts Including Contract Awarded But Not Yet Started

Business Name : _____

Business Address : _____

Name of Contract/Location/ Project Cost	a. Owner's Name b. Address c. Telephone Nos.	Nature of Work	Contractor's Role		a. Date Awarded b. Date Started c. Date of Completion or Estimated Completion Time	Value of Outstanding Works
			Description	%		
Government						
Private						
					Total Cost	

The bidder shall declare in this form all his on-going government and private contracts including contracts where the bidder (either as individual or as a Joint Venture) is a partner in a Joint Venture agreement other than his current joint venture where he is a partner. Non declaration will be a ground for disqualification of bid.

Note : This statement shall be supported with the following documents for all the contract(s) stated above which shall be submitted during Post-qualification:

1. Contract/Purchase Order and/or Notice of Award
2. Certification coming from the project owner/client that the performance is satisfactory as of the bidding date.

Submitted by : _____
(Printed Name & Signature)

Designation : _____

Date : _____

Standard Form Number: NPCSF-INFR-03

The Statement of the bidder's Single Largest Completed Contract (SLCC) similar to the contract to be bid

Business Name : _____
Business Address : _____

Name of Contract	a. Owner's Name b. Address c. Telephone Nos.	Nature of Work	Contractor's Role		a. Amount at Award b. Amount at Completion c. Duration	a. Date Awarded b. Contract Effectivity c. Date Completed
			Description	%		

Notes:
1. The bidder must state only one (1) Single Largest Completed Contract (SLCC) similar to the contract to be bid.
2. Supporting documents such as Contract/Purchase Order and any of the following: Owner's Certificate of Final Acceptance issued by the project owner other than the contractor; *or* A final rating of at least Satisfactory in the Constructors Performance Evaluation System (CPES); *or* Official Receipt (O.R); *or* Sales Invoice for the contract stated above shall be submitted during Bid Opening.

Submitted by _____
(Printed Name & Signature)
Designation : _____
Date : _____

Standard Form Number: NPCSF-INFR-04

NET FINANCIAL CONTRACTING CAPACITY (NFCC)

A. Summary of the Bidder's/Contractor's assets and liabilities on the basis of the income tax return and audited financial statement for the immediately preceding calendar year are:

		Year 20__
1.	Total Assets	
2.	Current Assets	
3.	Total Liabilities	
4.	Current Liabilities	
5.	Net Worth (1-3)	
6.	Net Working Capital (2-4)	

B. The Net Financial Contracting Capacity (NFCC) based on the above data is computed as follows:

NFCC = [(Current assets minus current liabilities) x 15] minus the value of all outstanding or uncompleted portions of the projects under ongoing contracts, including awarded contracts yet to be started coinciding with the contract for this Project.

NFCC = P _____

Herewith attached is certified true copy of the audited financial statement, stamped "RECEIVED" by the BIR or BIR authorized collecting agent for the immediately preceding calendar year.

Submitted by:

_____
Name of Bidder/Contractor

_____
Signature of Authorized Representative

Date : _____

Standard Form Number: NPCSF-INFR-05

JOINT VENTURE AGREEMENT

KNOW ALL MEN BY THESE PRESENTS:

That this JOINT VENTURE AGREEMENT is entered into by and between: _____, of legal age, *(civil status)* _____, authorized representative of _____ and a resident of _____.

- and –

_____, of legal age, *(civil status)* _____, authorized representative of _____ a resident of _____.

That both parties agree to join together their capital, manpower, equipment, and other resources and efforts to enable the Joint Venture to participate in the Bidding and Undertaking of the hereunder stated Contract of the **National Power Corporation.**

NAME OF PROJECT	**CONTRACT AMOUNT**
_____	_____

That the capital contribution of each member firm:

NAME OF FIRM	CAPITAL CONTRIBUTION
1.	₱
2.	₱

That both parties agree to be jointly and severally liable for their participation in the Bidding and Undertaking of the said contract.

That both parties agree that _____ and/or _____ shall be the Official Representative/s of the Joint Venture, and are granted full power and authority to do, execute and perform any and all acts necessary and/or to represent the Joint Venture in the Bidding and Undertaking of the said contract, as fully and effectively and the Joint Venture may do and if personally present with full power of substitution and revocation.

That this Joint Venture Agreement shall remain in effect only for the above stated Contract until terminated by both parties.

_____
Name & Signature of Authorized Representative

_____
Official Designation

_____
Name of Firm

_____
Name & Signature of Authorized Representative

_____
Official Designation

_____
Name of Firm

Witnesses

1. _____ 2. _____

[Jurat]

[Format shall be based on the latest Rules on Notarial Practice]

If the bidder is a joint venture, one of the requirements is the submission of a valid joint venture agreement.

Standard Form Number: NPCSF-INFR-06a

FORM OF BID SECURITY (BANK GUARANTEE)

WHEREAS, *(Name of Bidder)*_____ (hereinafter called "the Bidder") has submitted his bid dated *(Date)*_____ for the *[name of project]* (hereinafter called "the Bid").

KNOW ALL MEN by these presents that We *(Name of Bank)*_____ of *(Name of Country)*_____ having our registered office at _____ (hereinafter called "the Bank" are bound unto National Power Corporation (hereinafter called "the Entity") in the sum of *[amount in words & figures as prescribed in the bidding documents]* for which payment well and truly to be made to the said Entity the Bank binds himself, his successors and assigns by these presents.

SEALED with the Common Seal of the said Bank this ____ day of _____ 20___.

THE CONDITIONS of this obligation are that:

1) if the Bidder withdraws his Bid during the period of bid validity specified in the Bidding Documents; or

2) if the Bidder does not accept the correction of arithmetical errors of his bid price in accordance with the Instructions to Bidder; or

3) if the Bidder, having determined as the LCB, fails or refuses to submit the required tax clearance, latest income and business tax returns and PhilGEPs registration certificate within the prescribed period; or

4) if the Bidder having been notified of the acceptance of his bid and award of contract to him by the Entity during the period of bid validity:

   a) fails or refuses to execute the Contract; or

   b) fails or refuses to submit the required valid JVA, if applicable; or

   c) fails or refuses to furnish the Performance Security in accordance with the Instructions to Bidders;

we undertake to pay to the Entity up to the above amount upon receipt of his first written demand, without the Entity having to substantiate its demand, provided that in his demand the Entity will note that the amount claimed by it is due to the occurrence of any one or combination of the four (4) conditions stated above.

The Guarantee will remain in force up to 120 days after the opening of bids or as it may be extended by the Entity, notice of which extension(s) to the Bank is hereby waived. Any demand in respect of this Guarantee should reach the Bank not later than the above date.

DATE _____ SIGNATURE OF THE BANK _____

WITNESS _____ SEAL _____

_____
(Signature, Name and Address)

Standard Form Number: NPCSF-INFR-06b

FORM OF BID SECURITY (SURETY BOND)

BOND NO.: _____ DATE BOND EXECUTED: _____

By this bond, We (*Name of Bidder*) _____ (hereinafter called "the Principal") and (*Name of Surety*) _____ of (*Name of Country of Surety*) _____, authorized to transact business in the Philippines (hereinafter called "the Surety") are held and firmly bound unto National Power Corporation (hereinafter called "the Employer") as Obligee, in the sum of (*amount in words & figures as prescribed in the bidding documents*), callable on demand, for the payment of which sum, well and truly to be made, we, the said Principal and Surety bind ourselves, our successors and assigns, jointly and severally, firmly by these presents.

SEALED with our seals and dated this _____ day of _____ 20 _____

WHEREAS, the Principal has submitted a written Bid to the Employer dated the _____ day of _____ 20 _____, for the _____ (hereinafter called "the Bid").

NOW, THEREFORE, the conditions of this obligation are:

1) if the Bidder withdraws his Bid during the period of bid validity specified in the Bidding Documents; or

2) if the Bidder does not accept the correction of arithmetical errors of his bid price in accordance with the Instructions to Bidder; or

3) if the Bidder, having determined as the LCB, fails or refuses to submit the required tax clearance, latest income and business tax returns and PhilGEPs registration certificate within the prescribed period; or

4) if the Bidder having been notified of the acceptance of his bid and award of contract to him by the Entity during the period of bid validity:

    d) fails or refuses to execute the Contract; or

    e) fails or refuses to submit the required valid JVA, if applicable; or

    f) fails or refuses to furnish the Performance Security in accordance with the Instructions to Bidders;

then this obligation shall remain in full force and effect, otherwise it shall be null and void.

PROVIDED HOWEVER, that the Surety shall not be:

a) liable for a greater sum than the specified penalty of this bond, nor

b) liable for a greater sum that the difference between the amount of the said Principal's Bid and the amount of the Bid that is accepted by the Employer.

Standard Form Number: NPCSF-INFR-06b
Page 2 of 2

This Surety executing this instrument hereby agrees that its obligation shall be valid for 120 calendar days after the deadline for submission of Bids as such deadline is stated in the Instructions to Bidders or as it may be extended by the Employer, notice of which extension(s) to the Surety is hereby waived.

PRINCIPAL _____	SURETY _____
SIGNATURE(S) _____	SIGNATURES(S) _____
NAME(S) AND TITLE(S) _____	NAME(S) _____
SEAL _____	SEAL _____

Standard Form No: NPCSF-INFR-06c

REPUBLIC OF THE PHILIPPINES)
CITY OF _____) S.S.

BID-SECURING DECLARATION
UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA
LuzP22Z1448Se

To: **National Power Corporation**
BIR Road cor. Quezon Ave.
Diliman, Quezon City

I/We[1], the undersigned, declare that:

1. *I/We* understand that, according to your conditions, bids must be supported by a Bid Security, which may be in the form of a Bid-Securing Declaration.
2. *I/We* accept that: (a) *I/we* will be automatically disqualified from bidding for any contract with any procuring entity for a period of two (2) years upon receipt of your Blacklisting Order; and, (b) *I/we* will pay the applicable fine provided under Section 6 of the Guidelines on the Use of Bid Securing Declaration, within fifteen (15) days from receipt of the written demand by the Procuring Entity for the commission of acts resulting to the enforcement of the Bid Securing Declaration under Sections 23.1 (b), 34.2, 40.1 and 69.1, except 69.1 (f) of the IRR of R.A. 9184; without prejudice to other legal action the government may undertake.
3. *I/We* understand that this Bid-Securing Declaration shall cease to be valid on the following circumstances:
   (a) Upon expiration of the bid validity period, or any extension thereof pursuant to your request;
   (b) *I am/we are* declared ineligible or post-disqualified upon receipt of your notice to such effect, and (i) *I/we* failed to timely file a request for reconsideration or (ii) *I/we* filed a waiver to avail of said right;
   (c) *I am/we are* declared as the bidder with the Lowest Calculated and Responsive Bid, and *I/we* have furnished the performance security and signed the Contract.

IN WITNESS WHEREOF, *I/we* have hereunto set my hand this ____ day of ____ 20____ at _____, Philippines.

_____
[Name and Signature of Bidder's Representative/ Authorized Signatory] [Signatory's legal capacity]
Affiant

[Jurat]
[Format shall be based on the latest Rules on Notarial Practice]

---

[1] *Select one and delete the other. Adopt same instruction for similar terms throughout the document.*

Standard Form No: NPCSF-INFR-07

Omnibus Sworn Statement (Revised)

REPUBLIC OF THE PHILIPPINES)
CITY/MUNICIPALITY OF _____) S.S.

AFFIDAVIT

I, [Name of Affiant], of legal age, [Civil Status], [Nationality], and residing at [Address of Affiant], after having been duly sworn in accordance with law, do hereby depose and state that:

1. *[Select one, delete the other:]*

   [If a sole proprietorship:] I am the sole proprietor or authorized representative of [Name of Bidder] with office address at [address of Bidder];

   [If a partnership, corporation, cooperative, or joint venture:] I am the duly authorized and designated representative of [Name of Bidder] with office address at [address of Bidder];

2. *[Select one, delete the other:]*

   [If a sole proprietorship:] As the owner and sole proprietor, or authorized representative of [Name of Bidder], I have full power and authority to do, execute and perform any and all acts necessary to participate, submit the bid, and to sign and execute the ensuing contract for [Name of the Project] of the [Name of the Procuring Entity], as shown in the attached duly notarized Special Power of Attorney;

   [If a partnership, corporation, cooperative, or joint venture:] I am granted full power and authority to do, execute and perform any and all acts necessary to participate, submit the bid, and to sign and execute the ensuing contract for [Name of the Project] of the [Name of the Procuring Entity], as shown in the attached [state title of attached document showing proof of authorization (e.g., duly notarized Secretary's Certificate, Board/Partnership Resolution, or Special Power of Attorney, whichever is applicable;)];

3. [Name of Bidder] is not "blacklisted" or barred from bidding by the Government of the Philippines or any of its agencies, offices, corporations, or Local Government Units, foreign government/foreign or international financing institution whose blacklisting rules have been recognized by the Government Procurement Policy Board, by itself or by relation, membership, association, affiliation, or controlling interest with another blacklisted person or entity as defined and provided for in the Uniform Guidelines on Blacklisting;

4. Each of the documents submitted in satisfaction of the bidding requirements is an authentic copy of the original, complete, and all statements and information provided therein are true and correct;

5. [Name of Bidder] is authorizing the Head of the Procuring Entity or its duly authorized representative(s) to verify all the documents submitted;

6. *[Select one, delete the rest:]*

   [If a sole proprietorship:] The owner or sole proprietor is not related to the Head of the Procuring Entity, members of the Bids and Awards Committee (BAC), the Technical Working Group, and the BAC Secretariat, the head of the Project Management Office or the end-user unit, and the project consultants by consanguinity or affinity up to the third civil degree;

   [If a partnership or cooperative:] None of the officers and members of *[Name of Bidder]* is related to the Head of the Procuring Entity, members of the Bids and Awards Committee (BAC), the Technical Working Group, and the BAC Secretariat, the head of the Project

Management Office or the end-user unit, and the project consultants by consanguinity or affinity up to the third civil degree;

[If a corporation or joint venture:] None of the officers, directors, and controlling stockholders of *[Name of Bidder]* is related to the Head of the Procuring Entity, members of the Bids and Awards Committee (BAC), the Technical Working Group, and the BAC Secretariat, the head of the Project Management Office or the end-user unit, and the project consultants by consanguinity or affinity up to the third civil degree;

7. *[Name of Bidder]* complies with existing labor laws and standards; and

8. *[Name of Bidder]* is aware of and has undertaken the responsibilities as a Bidder in compliance with the Philippine Bidding Documents, which includes:

   a. Carefully examining all of the Bidding Documents;

   b. Acknowledging all conditions, local or otherwise, affecting the implementation of the Contract;

   c. Making an estimate of the facilities available and needed for the contract to be bid, if any; and

   d. Inquiring or securing Supplemental/Bid Bulletin(s) issued for the *[Name of the Project]*.

9. *[Name of Bidder]* did not give or pay directly or indirectly, any commission, amount, fee, or any form of consideration, pecuniary or otherwise, to any person or official, personnel or representative of the government in relation to any procurement project or activity.

10. In case advance payment was made or given, failure to perform or deliver any of the obligations and undertakings in the contract shall be sufficient grounds to constitute criminal liability for Swindling (Estafa) or the commission of fraud with unfaithfulness or abuse of confidence through misappropriating or converting any payment received by a person or entity under an obligation involving the duty to deliver certain goods or services, to the prejudice of the public and the government of the Philippines pursuant to Article 315 of Act No. 3815 s. 1930, as amended, or the Revised Penal Code.

IN WITNESS WHEREOF, I have hereunto set my hand this __ day of ___, 20__ at _____, Philippines.

[Insert NAME OF BIDDER OR ITS AUTHORIZED REPRESENTATIVE]
[Insert signatory's legal capacity]
Affiant

[Jurat]
[Format shall be based on the latest Rules on Notarial Practice]

Standard Form Number: NPCSF-INFR-08

CONTRACTOR'S ORGANIZATIONAL CHART FOR THE CONTRACT

Submit Copy of the Organizational Chart that the Contractor intends to use to execute the Contract if awarded to him. Indicate in the chart the names of the Project Manager, Project Engineer, Foreman and other Key Engineering Personnel.

Attach the required Proposed Organizational Chart for the Contract as stated above

NOTES:

1. *This organization chart should represent the "Contractor's Organization" required for the Project, and not the organizational chart of the entire firm.*
2. *Each such nominated engineer/key personnel shall comply with and submit duly accomplished forms NPCSF-INFR-10a, NPCSF-INFR-10b and NPCSF-INFR-11, which shall be submitted during post-qualification.*
3. *All these are required to be in the Technical Envelope of the Bidder.*

Standard Form Number: NPCSF-INFR-09

LIST OF KEY PERSONNEL PROPOSED TO BE ASSIGNED TO THE CONTRACT

(Based on the Minimum Key Personnel Required in the Bidding Documents)

Business Name: _____

Business: _____

_____

Particulars	Project Manager (if applicable)	Project Engineer	Materials Engineer (if applicable)	Safety Officer	
1 Name					
2 Address					
3 Date of Birth					
4 Education					
5 License/Qualification Details:					
a. Profession/Specialization					
b. Registration Number					
c. Registration Date					
d. Valid Until					
6 Experience Data:					
a. Years employed by the Bidder					
b. General Experience (yrs.)					
c. Professional Experience on similar project (yrs.)					

Submitted by: _____

(Printed Name & Signature)

Designation: _____

Date: _____

One of the requirements from the bidder to be included in its Technical Envelope is a list of contractor's key personnel (based on the minimum key personnel required in the bidding documents) to be assigned to the contract to be bid, with their complete qualification and experience data.

Standard Form Number: NPCSF-INFR-10a

NOTE: THIS FORM SHALL BE SUBMITTED DURING POST-QUALIFICATION

KEY PERSONNEL'S CERTIFICATE OF EMPLOYMENT
(PROFESSIONAL PERSONNEL)

_____
Issuance Date

THE PRESIDENT
National Power Corporation
BIR Road cor. Quezon Ave.
Diliman, Quezon City

Dear Sir:

I am *(Name of Nominee)*_____ a Licensed _____ Engineer with Professional License No. _____ issued on *(date of issuance)*_____ at *(place of issuance)*_____.

I hereby certify that *(Name of Bidder)*_____ has engaged my services as *(Designation)*_____ for the *(Name of Project)*_____, if awarded to it.

As *(Designation)*_____, I supervised the following completed projects similar to the contract under bidding:

NAME OF PROJECT	OWNER	COST	DATE COMPLETED

At present, I am supervising the following projects:

NAME OF PROJECT	OWNER	COST	DATE COMPLETED

In case of my separation for any reason whatsoever from the above-mentioned Contractor, I shall notify the National Power Corporation at least twenty one (21) days before the effective date of my separation.

As *(Designation)*_____, I know I will have to stay in the job site all the time to supervise and manage the Contract works to the best of my ability, and aware that I am authorized to handle only one (1) contract at a time.

I do not allow the use of my name for the purpose of enabling the above-mentioned Contractor to qualify for the Contract without any firm commitment on my part to assume the post of *(Designation)*_____ therefor, if the contract is awarded to him since I understand that to do so will be a sufficient ground for my disqualification as *(Designation)*_____ in any future National Power Corporation bidding or employment with any Contractor doing business with the National Power Corporation.

_____
(Name and Signature)
AFFIANT

[Jurat]
[Format shall be based on the latest Rules on Notarial Practice]

One of the requirements from the bidder is a list of contractor's key personnel (viz. Project Manager, Project Engineer, Construction Safety Officer, Foremen, etc), to be assigned to the contract to be bid, with their complete qualification and experience data (including the key personnel's signed written commitment to work for the project once awarded the contract).

Standard Form Number: NPCSF-INFR-10b

NOTE: THIS FORM SHALL BE SUBMITTED DURING POST-QUALIFICATION

KEY PERSONNEL'S CERTIFICATE OF EMPLOYMENT
(CONSTRUCTION SAFETY AND HEALTH OFFICER)

_____
Issuance Date

THE PRESIDENT
National Power Corporation
BIR Road cor. Quezon Ave.
Diliman, Quezon City

Dear Sir:

I am *(Name of Nominee)* _____ an Construction Safety & Health Officer with Certificate No. _____ issued on *(date of issuance)* _____ at *(place of issuance)* _____.

I hereby certify that *(Name of Bidder)* _____ has engaged my services as Construction Safety & Health Officer for the *(Name of Project)* _____, if awarded to it.

I am the Construction Safety & Health Officer of the following completed projects similar to the contract under bidding:

NAME OF PROJECT	OWNER	COST	DATE COMPLETED

At present, I am the Construction Safety & Health Officer of the following projects:

NAME OF PROJECT	OWNER	COST	DATE COMPLETED

In case of my separation for any reason whatsoever from the above-mentioned Contractor, I shall notify the National Power Corporation at least twenty one (21) days before the effective date of my separation.

As Construction Safety & Health Officer, I know I will have to stay in the job site all the time and aware that I am authorized to handle only one (1) contract at a time.

I do not allow the use of my name for the purpose of enabling the above-mentioned Contractor to qualify for the Contract without any firm commitment on my part to assume the post of Construction Safety & Health Officer, if the contract is awarded to him since I understand that to do so will be a sufficient ground for my disqualification as Construction Safety & Health Officer in any future National Power Corporation bidding or employment with any Contractor doing business with the National Power Corporation.

_____
(Name and Signature)
AFFIANT

[Jurat]
[Format shall be based on the latest Rules on Notarial Practice]

One of the requirements from the bidder is a list of contractor's key personnel (viz. Project Manager, Project Engineer, Construction Safety Officer, Foremen, etc), to be assigned to the contract to be bid, with their complete qualification and experience data (including the key personnel's signed written commitment to work for the project once awarded the contract).

Standard Form Number: NPCSF-INFR-11

NOTE: THIS FORM SHALL BE SUBMITTED DURING POST-QUALIFICATION

KEY PERSONNEL
(FORMAT OF BIO-DATA)

Give the detailed information of the following personnel who are scheduled to be assigned as full-time field staff for the project. Fill up a form for each person.

1. Name : _____
2. Date of Birth : _____
3. Nationality : _____
4. Education and Degrees : _____
5. Specialty : _____
6. Registration : _____
7. Length of Service with the Firm : _____ Year from _____ (months) _____ (year)
   To _____ (months) _____ (year)
8. Years of Experience : _____
9. If Item 7 is less than ten (10) years, give name and length of service with previous employers for a ten (10)-year period (attached additional sheet/s), if necessary:

Name and Address of Employer	Length of Service
_____	_____ year(s) from _____ to _____
_____	_____ year(s) from _____ to _____
_____	_____ year(s) from _____ to _____

10. Experience:

    This should cover the past ten (10) years of experience. (Attached as many pages as necessary to show involvement of personnel in projects using the format below).

One of the requirements from the bidder is a list of contractor's key personnel (viz. Project Manager, Project Engineer, Construction Safety Officer, Foremen, etc), to be assigned to the contract to be bid, with their complete qualification and experience data (including the key personnel's signed written commitment to work for the project once awarded the contract).

1. Name : _____

2. Name and Address of Owner : _____

3. Name and Address of the Owner's Engineer (Consultant) : _____

4. Indicate the Features of Project (particulars of the project components and any other particular interest connected with the project): _____

5. Contract Amount Expressed in Philippine Currency : _____

6. Position : _____

7. Structures for which the employee was responsible : _____

8. Assignment Period : from _____ (months) _____ (years)
: to _____ (months) _____ (years)

_____
Name and Signature of Employee

It is hereby certified that the above personnel can be assigned to this project, if the contract is awarded to our company.

_____ _____
(Place and Date) (The Authorized Representative)

One of the requirements from the bidder is a list of contractor's key personnel (viz. Project Manager, Project Engineer, Construction Safety Officer, Foremen, etc), to be assigned to the contract to be bid, with their complete qualification and experience data (including the key personnel's signed written commitment to work for the project once awarded the contract).

Standard Form Number: NPCSF-INFR-12

LIST OF EQUIPMENT, OWNED OR LEASED AND/OR UNDER PURCHASE AGREEMENTS

(Based on the Minimum Equipment Required in the Bidding Documents)

Business Name: _____

Business: _____

_____

Description	Model/Year	Capacity / Performance / Size	Plate No.	Motor No. / Body No.	Location	Condition	Proof of Ownership / Lessor or Vendor
A. Owned							
i.							
ii.							
iii.							
iv.							
v.							
B. Leased							
i.							
ii.							
iii.							
iv.							
v.							
C. Under Purchase Agreements							
i.							
ii.							
iii.							
iv.							
v.							

Submitted by: _____

(Printed Name & Signature)

Designation: _____

Date: _____

One of the requirements from the bidder to be included in its Technical Envelope is the list of its equipment units pledged for the contract to be bid, based on minimum equipment required in the bidding docs. which are owned (supported by proof/s of ownership), leased, and/or under purchase agreements (with corresponding engine numbers, chassis numbers and/or serial numbers), supported by certification of availability of equipment from the equipment lessor/vendor for the duration of the project

Standard Form No. : NPCSF-INFR-13

BID LETTER

Date: _____

To: **THE PRESIDENT**
National Power Corporation
BIR Road cor. Quezon Ave.
Diliman, Quezon City

We, the undersigned, declare that:

(a) We have examined and have no reservation to the Bidding Documents, including Addenda, for the Contract **UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA (LuzP22Z1448Se).**

(b) We offer to execute the Works for this Contract in accordance with the Bid Documents, Technical Specifications, General and Special Conditions of Contract accompanying this Bid;

The total price of our Bid, excluding any discounts offered below is: *[insert information]* _____;

The discounts offered and the methodology for their application are: *[insert information]* _____;

(c) Our Bid shall be valid for a period of *[insert number]* _____ days from the date fixed for the Bid submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

(d) If our Bid is accepted, we commit to obtain a Performance Security in the amount of *[insert percentage amount]* _____ percent of the Contract Price for the due performance of the Contract;

(e) Our firm, including any subcontractors or suppliers for any part of the Contract, have nationalities from the following eligible countries: *[insert information]* _____;

(f) We are not participating, as Bidders, in more than one Bid in this bidding process, other than alternative offers in accordance with the Bidding Documents;

(g) Our firm, its affiliates or subsidiaries, including any subcontractors or suppliers for any part of the Contract, has not been declared ineligible by the Funding Source;

(h) We understand that this Bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal Contract is prepared and executed; and

(i) We understand that you are not bound to accept the Lowest Calculated Bid or any other Bid that you may receive.

(j) We likewise certify/confirm that the undersigned, is the duly authorized representative of the bidder, and granted full power and authority to do, execute and perform any and all acts necessary to participate, submit the bid, and to sign and execute the ensuing contract for the **UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA (LuzP22Z1448Se)** of the National Power Corporation.

(k) We acknowledge that failure to sign each and every page of this Bid Letter, including the Bill of Quantities, shall be a ground for the rejection of our bid.

Name: _____

In the capacity of: _____

Signed: _____

Duly authorized to sign the Bid for and on behalf of: _____

Date: _____

Standard Form No. : NPCSF-INFR-14

DETAILED COST ESTIMATE FORM

Name of Bidder : _____

_____

Item No.	Item Description	Unit of Measure	Direct Cost			Mark-Up		VAT	Unit Cost	Total Price
			Materials	Labor	Equipment	OCM	Profit			

_____

Name, Signature of Authorized Representative

_____

Designation

Standard Form No. : NPCSF-INFR-15

SUMMARY SHEETS OF MATERIALS PRICES, LABOR RATES AND EQUIPMENT RENTAL RATES

Name of Bidder : _____

I. Unit Prices of Materials

Materials Description	Unit	Unit Price
1.		
2.		
3.		
4.		
5.		
6.		
7.		

II. Manpower Hourly Rates

Designation	Rate/Hr.
1.	
2.	
3.	
4.	
5.	
6.	
7.	

III. Equipment Hourly Rental Rates

Equipment Description	Rental Rate/Hr.
1.	
2.	
3.	
4.	
5.	
6.	
7.	

Name, Signature of Authorized Representative

Designation

SECTION IX

BID DRAWINGS

SECTION IX - BID DRAWINGS

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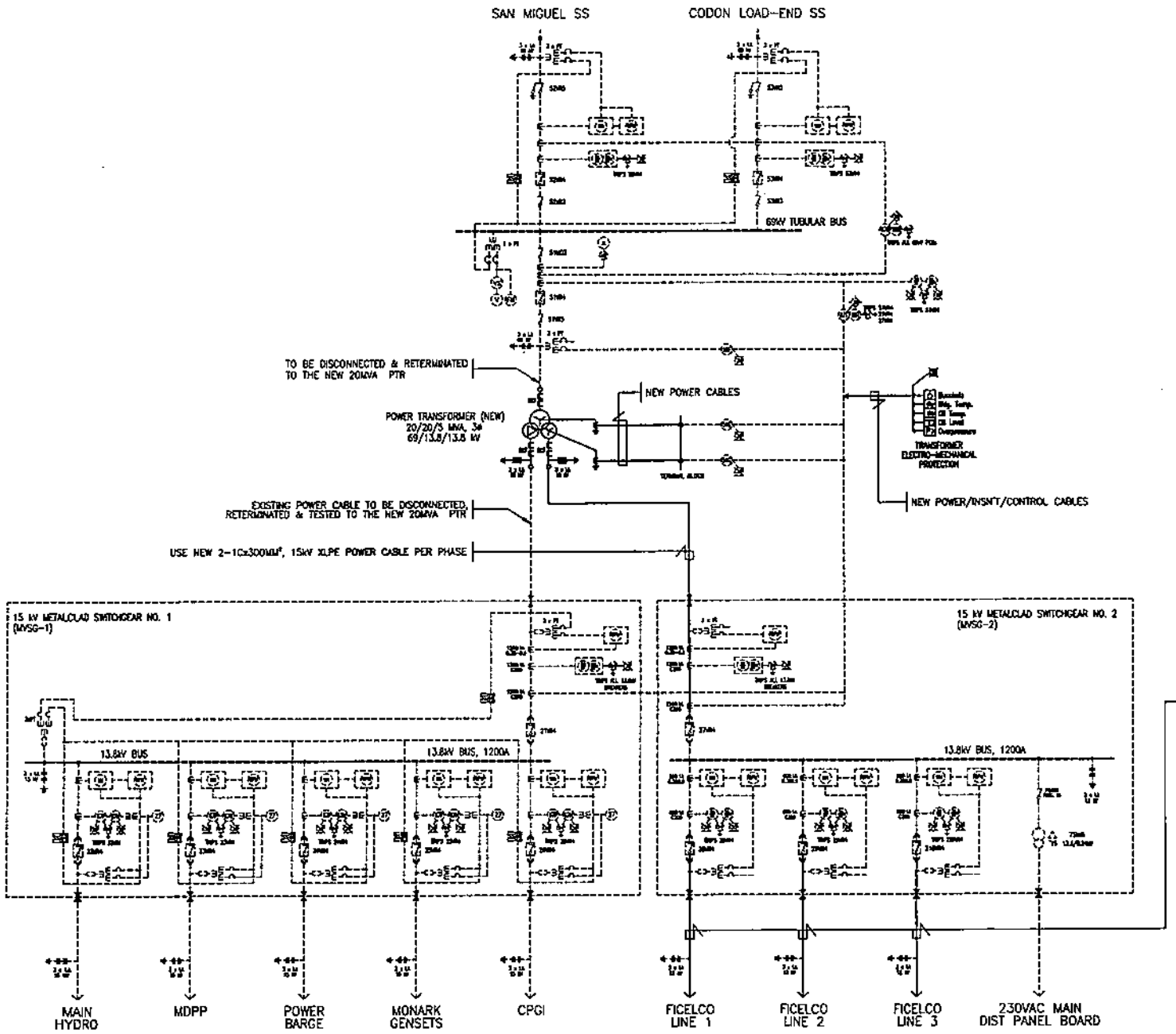


NOTES:

1. ALL EQUIPMENT SHOWN IN SOLID LINES SHALL BE SUPPLIED, INSTALLED AND TESTED UNDER THIS PROJECT. ALL NECESSARY EQUIPMENT, APPURTENANT/ACCESSORIES, TOOLS, MATERIALS, WORKS, ETC. THAT ARE NEEDED TO COMPLETE THE PROJECT PROPERLY SHALL BE PROVIDED BY THE CONTRACTOR AT NO ADDITIONAL COST TO NPC.
2. NEW TERMINAL CONNECTORS SHALL BE PROVIDED FOR HIGH & MEDIUM VOLTAGE CONDUCTOR/CABLES SUITABLE FOR THE RECONNECTION WORKS TO THE NEW POWER TRANSFORMER.
3. THE CONTRACTOR IS REQUIRED TO CONDUCT SITE INSPECTION TO DETERMINE THE EXTENT OF WORK NEEDED FOR THIS PROJECT.
4. ALL EXISTING POWER CABLES TO BE DISMANTLED SHALL BE HAULED TO NPC'S DESIGNATED WAREHOUSE/STOCKYARD OR AS PER INSTRUCTION OF NPC'S AUTHORIZED PERSONNEL.

LEGENDS:

87T	—	TRANSFORMER DIFFERENTIAL RELAY
87B	—	BUS DIFFERENTIAL RELAY
86T	—	TRANSFORMER LOCK-OUT RELAY
86B	—	BUS LOCK-OUT RELAY
50/51	—	PHASE OVERCURRENT RELAY
50/51N	—	RESIDUAL OVERCURRENT RELAY
51G	—	GROUND OVERCURRENT RELAY
59F	—	OVER-FLUXING RELAY
94	—	AUXILIARY TRIPPING RELAY
30	—	ANNUNCIATOR/ALARM
BCT	—	BUSHING CURRENT TRANSFORMER
LA		LIGHTNING ARRESTER

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

OWNER: **NATIONAL POWER CORPORATION**
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: **UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA**

LOCATION: MARINAWA, BATO, CATANDUANES

TITLE: **SINGLE LINE DIAGRAM**

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENGR. / ARCHT.		
CIVIL/ARCHT			
ELEC.			
MECH.			

SUBMITTED: R. P. VERAR, Division Engineer A, DED

RECOMMENDED: E. Z. C. LUGOD, JR., Manager, DED

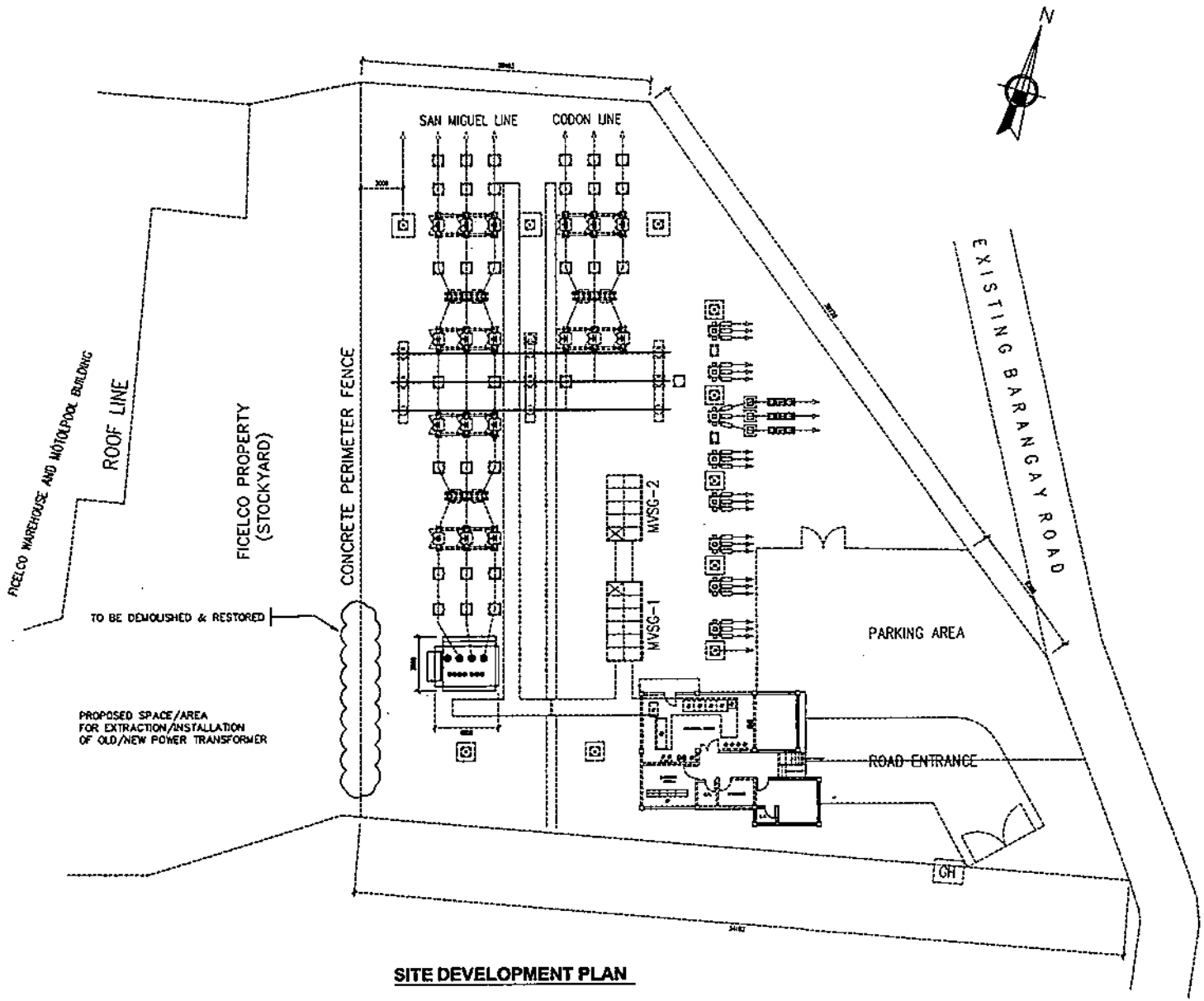
APPROVED: N. G. SORIANO-GUERRA, Manager, DOO

DWG. NO. **UVSS-BDE-22.001** SPECS. NO. **LuzP22Z1478Se**

SCALE: **NTS** **BID DRAWING** REV. **0**

NOTES:

1. EXISTING POWER TRANSFORMER AS SHOWN SHALL BE REPLACED WITH NEW 20MVA POWER TRANSFORMER INCLUDING OLTC/REMOTE CONTROL PANEL INSIDE THE CONTROL ROOM
2. EXTENT OF DEMOLITION/RESTORATION WORKS INCLUDING AVAILABLE SPACE/AREA REQUIRED BY LIFTING EQUIPMENT NECESSARY FOR THE SAFE DISMANTLING, HAULING AND INSTALLATION OF OLD AND NEW POWER TRANSFORMER SHALL BE DETERMINED BY THE CONTRACTOR
3. EXISTING POWER TRANSFORMER SHALL BE STORED/STOCKED AT NPC'S EXISTING MARINAWA DIESEL POWER PLANT SWITCHYARD OR AS PER DIRECTION FROM NPC'S SITE AUTHORIZED PERSONNEL
4. WORK THIS DRAWING WITH CEAD & MED DRAWINGS



SITE DEVELOPMENT PLAN

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

OWNER: **NATIONAL POWER CORPORATION**
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: **UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA SUBSTATION**

LOCATION: MARINAWA, BATO, CATANDUANES

TITLE: **EQUIPMENT LAYOUT**

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENGR./ ARCHT.		
CIVIL/ARCHT			
ELEC.			
MECH.			

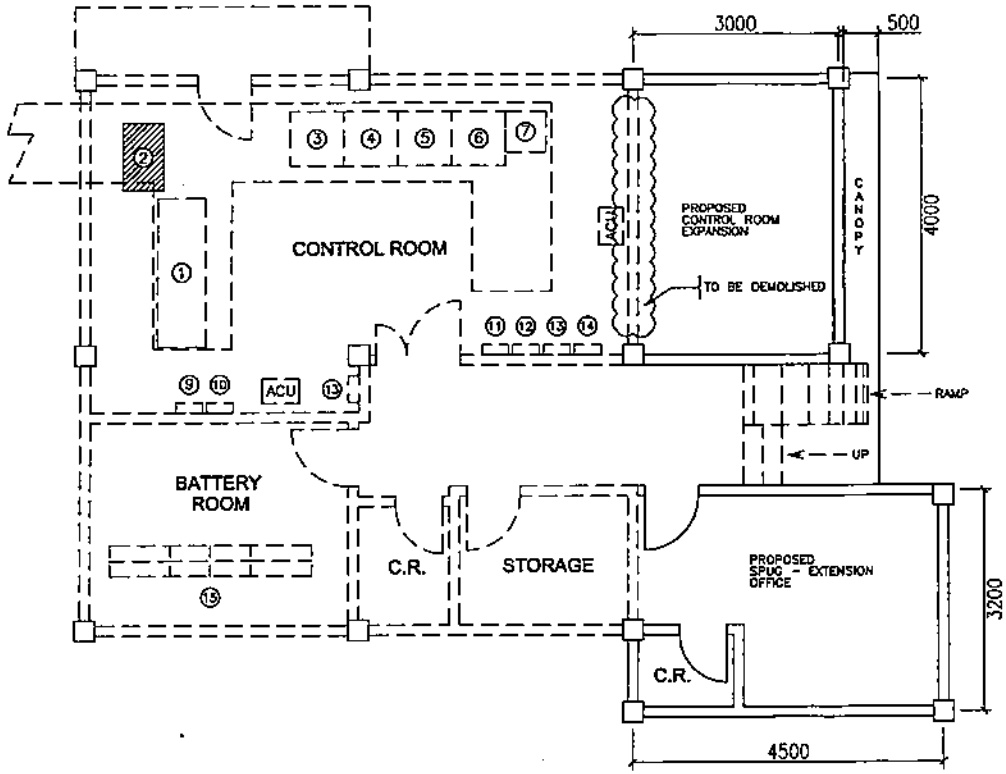
SUBMITTED: R. P. VERAR, Project Engineer A, CEDD

RECOMMENDED: C. C. LUGOD, JR., Manager, CEDD

APPROVED: N. G. SOMBILLERA, Manager, DDD

DWG. NO. UVSS-BDE-22.002 | SPECS. NO. LuzP22Z1476So

SCALE: 1:300 | **BID DRAWING** | REV. 0



NOTES:

1. DRAWING IN BROKEN LINES ARE EXISTING. ALL OTHER ARE INCLUDED IN THE SCOPE OF WORK
3. ALL DIMENSIONS AS SHOWN ARE IN METERS UNLESS OTHERWISE INDICATED
4. OLTC/REMOTE CONTROL PANEL AS SHOWN IN SHADED PORTION SHALL BE DISMANTLED AND REPLACED WITH BRAND NEW ASSOCIATED WITH THE NEW 20MVA POWER TRANSFORMER. EXISTING POWER AND/OR CONTROL CABLES SHALL BE REPLACED WITH BRAND NEW
5. WORK THIS DRAWING WITH CEAD AND MED DRAWINGS

LEGENDS:

① – MAIN CONTROL BOARD (2.2x0.72)
② – TRANSFORMER REMOTE CONTROL (1x0.60) (TO BE REPLACED WITH BRAND NEW)
③ – SAN MIGUEL LINE PROTECTION PANEL (0.8x0.8)
④ – CODON LINE PROTECTION PANEL (0.8x0.8)
⑤ – 69KV BUSBAR PROT. PANEL (0.8x0.8)
⑥ – TRANSFORMER PROTECTION PANEL (0.8x0.8)
⑦ – 125VDC RECTIFIER/CHARGER (0.4x0.15)
⑧ – 125VDC LOW VOLTAGE PANEL (0.4x0.15)
⑨ – 125VDC BAY PANEL (0.4x0.15)
⑩ – 230VAC MAIN DIST. PANEL (0.4x0.15)
⑪ – 230VAC BAY PANEL (0.4x0.15)
⑫ – 230VAC AUX PANEL (0.4x0.15)
⑬ – LIGHTING AND POWER PANEL (0.4x0.15)
⑭ – 230VAC SUB-DIST PANEL (0.4x0.15)
⑮ – 125VDC BATTERY BANK

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

OWNER: **NATIONAL POWER CORPORATION**
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: **UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA**

LOCATION: MARINAWA, BATO, CATANDUANES

TITLE: **PROPOSED EXPANSION OF CONTROL HOUSE**

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENGR. / ARCHT.		
CIVIL/ARCHT.			
ELEC.			
MECH.			

SUBMITTED: R/P. VERAR, Project Engineer A, PMCD

RECOMMENDED: C.Z. C. LUGOD, JR., Manager, PMCD

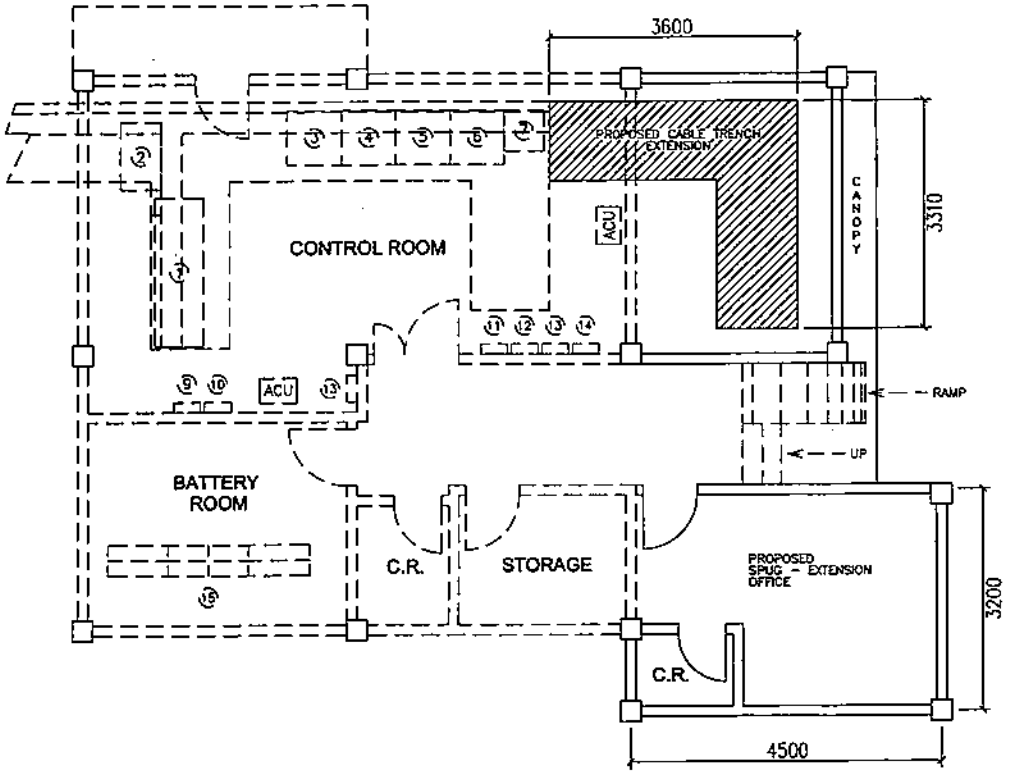
APPROVED: N. G. SOMBILLERA, Manager, DDD

DWG. NO. UVSS-BDE-22.003 | SPECS. NO. LuzP22Z1478Se

SCALE: 1:75 | **BID DRAWING** | REV. 0

NOTES:

1. ALL DIMENSIONS AS SHOWN ARE IN METERS UNLESS OTHERWISE INDICATED
2. DRAWING IN BROKEN LINES ARE EXISTING. PROPOSED CABLE TRENCH EXTENSION IS HIGHLIGHTED IN SHADED AREA
3. WORK THIS DRAWING WITH CEAD DRAWINGS



REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

OWNER: **NATIONAL POWER CORPORATION**
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: **UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA**

LOCATION: MARINAWA, BATO, CATANDUANES

TITLE: **PROPOSED EXPANSION OF CONTROL HOUSE (CABLE TRENCH EXTENSION)**

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENGR. / ARCHT.		
CIVIL/ARCHT.			
ELEC.			
MECH.			

SUBMITTED: R. P. VERAR, Project Engineer A, DCD

RECOMMENDED: O. Z. C. LUGOD, JR., Manager, DCD

APPROVED: N. G. SO[illegible]MA, Manager, DDD

DWG. NO. **UVSS-BDE-22.004** SPECS. NO. **LuzP22Z1478Se**

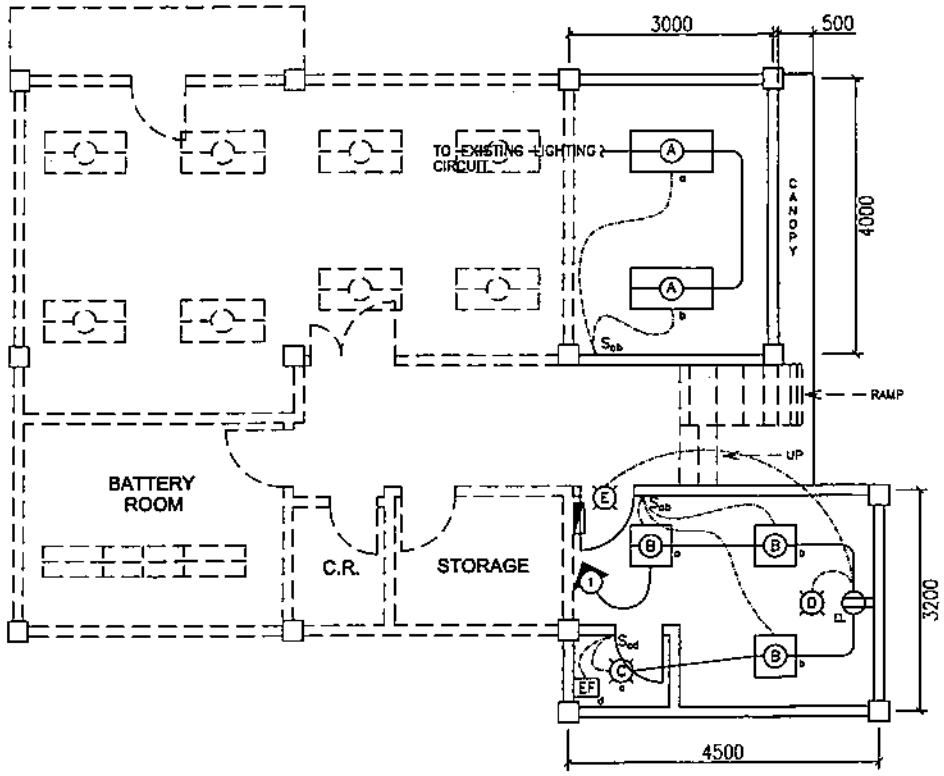
SCALE: **1:75** **BID DRAWING** REV. **0**

NOTES:

1. ALL DIMENSIONS AS SHOWN ARE IN METERS UNLESS OTHERWISE INDICATED
2. LIGHTING FIXTURES "A" AS SHOWN IN THE CONTROL ROOM EXTENSION SHALL BE CONNECTED TO THE EXISTING LIGHTING CIRCUIT OF CONTROL ROOM
3. EXIT SIGNAGE POWER SUPPLY SHALL BE TAKEN FROM EMERGENCY LIGHT CONVENIENCE OUTLET
4. EMERGENCY LIGHT CONVENIENCE OUTLET SHALL BE CONNECTED TO LIGHTING CIRCUIT AS SHOWN. EMERGENCY LIGHT SHALL BE ACTIVATED WHEN NO AC POWER IS AVAILABLE IN THE LIGHTING CIRCUIT
5. EMERGENCY LIGHT OUTLET SHALL BE INSTALLED 2METERS ABOVE THE FINISHED FLOOR LINE
6. LIGHTING & POWER PANELBOARD SHALL BE INSTALLED 1.8METERS FROM THE CENTER OF THE PANEL TO FINISHED FLOOR LINE
5. WORK THIS DRAWING WITH CEAD AND MED DRAWINGS

LEGENDS:

- (A) — FIXTURE TYPE "A"
- (B) — FIXTURE TYPE "B"
- (C) — FIXTURE TYPE "C"
- EL — EMERGENCY LIGHT OUTLET, TWO GANG, FLUSH MOUNTED
- EF — EXHAUST FAN
- EXIT — EXIT SIGNAGE
- ——— — CIRCUIT RUNNING ON CEILING
- - - - - — SWITCH CONTROL CIRCUIT
- S_{ab} — TWO GANG SWITCH, FLUSH TYPE (SMALL LETTER DENOTES LIGHTING FIXTURES TO BE CONTROLLED)
- — LIGHTING & POWER PANELBOARD



OWNER: NATIONAL POWER CORPORATION
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA

LOCATION: MARINAWA, BATO, CATANDUANES

TITLE: PROPOSED EXPANSION OF CONTROL HOUSE (LIGHTING LAYOUT)

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENGR. / ARCHT.		
CIVIL/ARCHT			
ELEC.			
MECH.			

SUBMITTED: R. P. VERAR, Project Engineer, DDO

RECOMMENDED: E. Z. C. LUGOD, JR., Manager, DDO

APPROVED: N. G. DOMINGUEZ, Manager, DDO

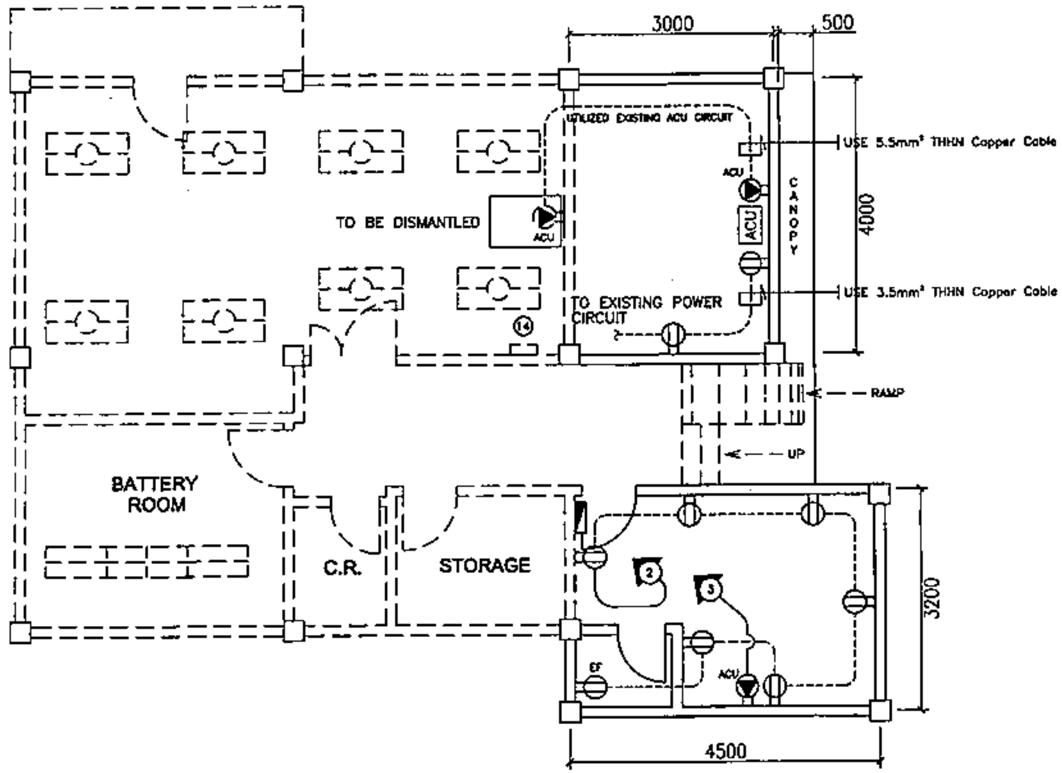
DWG. NO. UVSS-BDE-22.005 SPECS. NO. LuzP22Z1478Se

SCALE: 1:75 BID DRAWING REV. 0

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

NOTES:

1. ALL DIMENSIONS AS SHOWN ARE IN METERS UNLESS OTHERWISE INDICATED
2. NEW ACU OUTLET SHALL BE PROVIDED FOR THE RELOCATED ACU AS SHOWN INSIDE THE CONTROL ROOM. SAME POWER POWER CIRCUIT SHALL BE UTILIZED FOR THE NEW ACU OUTLET
3. NEW CONVENIENCE OUTLET INSIDE THE CONTROL AS SHOWN SHALL BE CONNECTED TO THE EXISTING POWER CIRCUIT
6. LIGHTING & POWER PANELBOARD SHALL BE INSTALLED 1.8METERS FROM THE CENTER OF THE PANEL TO FINISHED FLOOR LINE
5. OUTLETS SHALL BE INSTALLED WITH THE FOLLOWING CLEARANCES TO FINISHED FLOOR LINE:
   - ACU OUTLET, WINDOW TYPE — 2METERS
   - CONVENIENCE OUTLET — 0.3METERS
   - EXHAUST FAN OUTLET — 2METERS
7. WORK THIS DRAWING WITH CEAD AND MED DRAWINGS



LEGENDS:

- ACU — AIRCONDITIONING UNIT OUTLET, FLUSH MOUNTED
- — CONVENIENCE OUTLET, TWO GANG, FLUSH MOUNTED
- EF — EXHAUST FAN OUTLET, ONE GANG, FLUSH MOUNTED
- 1 — CIRCUIT HOMERUN
- - - - - — CIRCUIT RUNNING UNDERGROUND
- — LIGHTING & POWER PANELBOARD

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

OWNER: **NATIONAL POWER CORPORATION**
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: **UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA**

LOCATION: MARINAWA, BATO, CATANDUANES

TITLE: **PROPOSED EXPANSION OF CONTROL HOUSE (POWER LAYOUT)**

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENGR. / ARCHT.		
CIVIL/ARCH'T			
ELEC.			
MECH.			

SUBMITTED: R. P. VERAR
RECOMMENDED: C. Z. C. LUCOB, JR.
APPROVED: N. G. SOMOSIERRA

DWG. NO. **UVSS-BDE-22.006** SPECS. NO. **LuzP22Z1478Se**

SCALE: 1:75 **BID DRAWING** REV. **0**

LOAD SCHEDULED
PROPOSED SPUG-OFFICE (EXTENSION)

CIRCUIT NO.	DESCRIPTION	QTY	VA	V	A	CB	WIRE	CONDUIT
1	FIXTURE TYPE "B"	3	125	230	0.54	15AT	2-3.5mm² THHN 1-3.5mm² THHN (G)	20mm dia. uPVC
	FIXTURE TYPE "C"	1						
	FIXTURE TYPE "D"	1						
	FIXTURE TYPE "E"	1						
2	DUPLEX CONVENIENCE OUTLET	5	1180	230	5.13	20AT	2-3.5mm² THHN 1-3.5mm² THHN (G)	20mm dia. uPVC
	EXHAUST FAN	1						
3	1HP ACU	1	1840	230	8.00	25AT	2-5.5mm² THHN 1-5.5mm² THHN (G)	20mm dia. uPVC
4	SPARE			230		20AT		
			3144	230	13.67			

MAIN BREAKER SIZE:

USE 30AT/100AF, 2P, MCCB SUITBALE TO BE INSTALLED AT THE EXISTING 230VAC SUB-DISTRIBUTION PANELBOARD

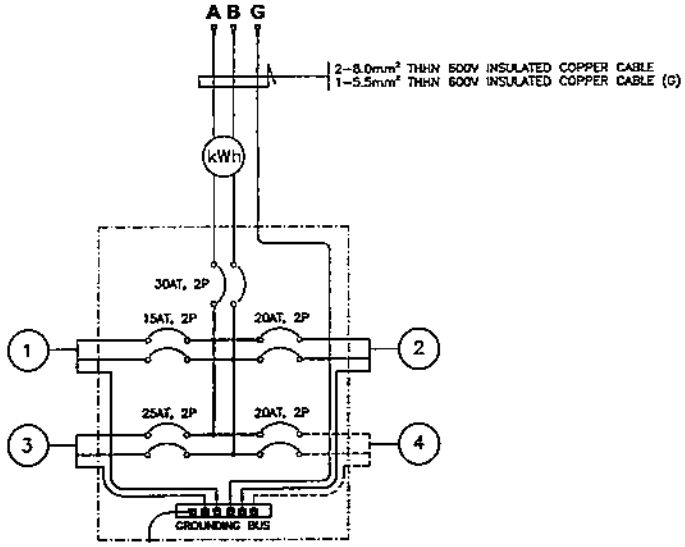
MAIN FEEDER SIZE:

USE 2-8.0mm² THHN 600V INSULATED COPPER CABLE
1-5.5mm² THHN 600V INSULATED COPPER CABLE (G)

NOTES:

1. POWER SUPPLY FOR LIGHTING & POWER PANELBOARD (LPP) OF PROPOSED NEW SPUG-OFFICE SHALL BE TAKEN FROM THE EXISTING 230VAC SUB-DISTRIBUTION PANELBOARD INSIDE THE CONTROL ROOM.
2. DEPENDING ON THE ACTUAL LOADING OF THE 230VAC SUB-DISTRIBUTION PANELBOARD, THE TENTATIVE CONNECTION OF NEW LPP SHALL BE FROM PHASE A & B OF THE SAID EXISTING SUB-DIST PANELBOARD.
3. SUB-KILOWATTHOUR METER SHALL BE INSTALLED AT THE SOURCE SIDE OF THE PROPOSED NEW LPP WHICH SHALL BE LOCATED AS DIRECTED OF SPUG-CATANDUANES AUTHORIZED PERSONNEL

REFER TO DWG NO.: UVSS-BDE-22.001



PANEL SCHEDULE
230VAC SUB-DISTRIBUTION PANELBOARD (EXISTING)

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

OWNER: NATIONAL POWER CORPORATION
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA

LOCATION: MARINAWA, BATO, CATANDUANES

TITLE: PROPOSED EXPANSION OF CONTROL HOUSE (LOAD & PANEL SCHEDULED)

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENGR./ARCHT.		
CIVIL/ARCH'T			
ELEC.			
MECH.			

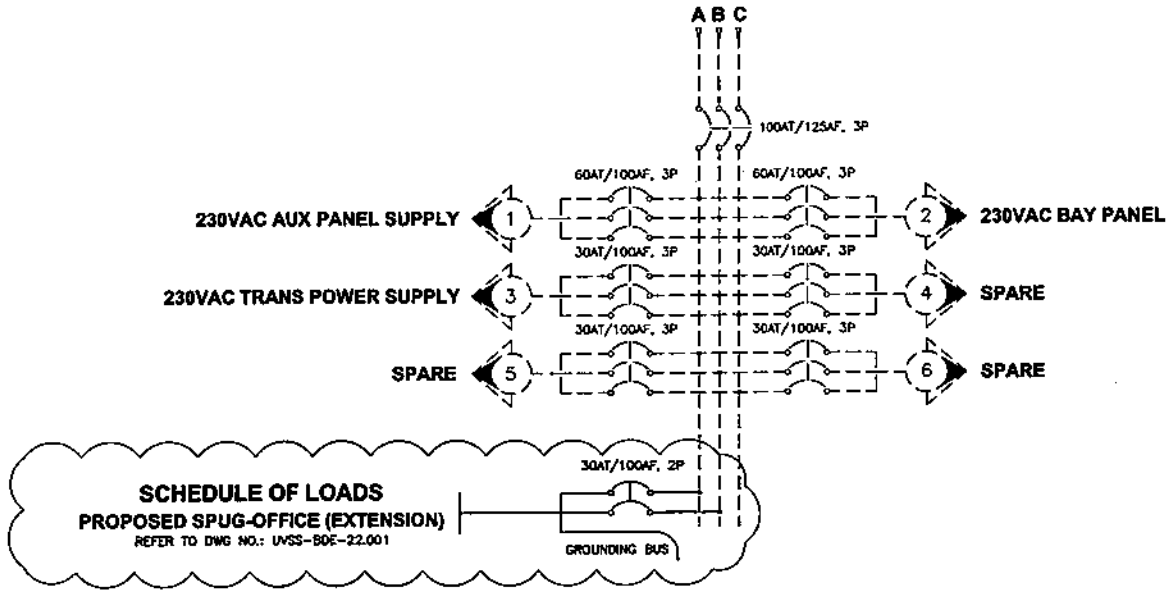
SUBMITTED: R. P. VERAR, Project Engineer A, DDD
RECOMMENDED: ENGR. C. LUGOD, JR., Manager, DDD
APPROVED: N. G. [illegible], Manager, DDD

DWG. NO. UVSS-BDE-22.007 SPECS. NO. LuzP22Z1478Se

SCALE: NTS BID DRAWING REV. 0

NOTES:

1. POWER SUPPLY FOR LIGHTING & POWER PANELBOARD (LPP) OF PROPOSED NEW SPUG-OFFICE SHALL BE TAKEN FROM THE EXISTING 230VAC SUB-DISTRIBUTION PANELBOARD INSIDE THE CONTROL ROOM
2. DEPENDING ON THE ACTUAL LOADING OF THE 230VAC SUB-DISTRIBUTION PANELBOARD, THE TENTATIVE CONNECTION OF NEW LPP SHALL BE FROM PHASE A & B OF THE SAID EXISTING SUB-DIST PANELBOARD
3. SUB-KILOWATTHOUR METER SHALL BE INSTALLED AT THE SOURCE SIDE OF THE PROPOSED NEW LPP WHICH SHALL BE LOCATED AS DIRECTED OF SPUG-CATANDUANES AUTHORIZED PERSONNEL



PANEL SCHEDULE
230VAC SUB-DISTRIBUTION PANELBOARD (EXISTING)

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

OWNER: NATIONAL POWER CORPORATION
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA

LOCATION: MARINAWA, BATO, CATANDUANES

TITLE: DETAILS OF EXISTING 230VAC SUB-DISTRIBUTION PANELBOARD (EXISTING)

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENGR./ARCHT.		
CIVIL/ARCHT			
E.E.C.			
MECH.			

SUBMITTED: R. P. VERAR
RECOMMENDED: E. Z. C. LUGOD, JR.
APPROVED: N. S. [illegible]

DWG. NO. UVSS-BDE-22.008 SPECS. NO. LuzP22Z1478Se

SCALE: NTS BID DRAWING REV. 0

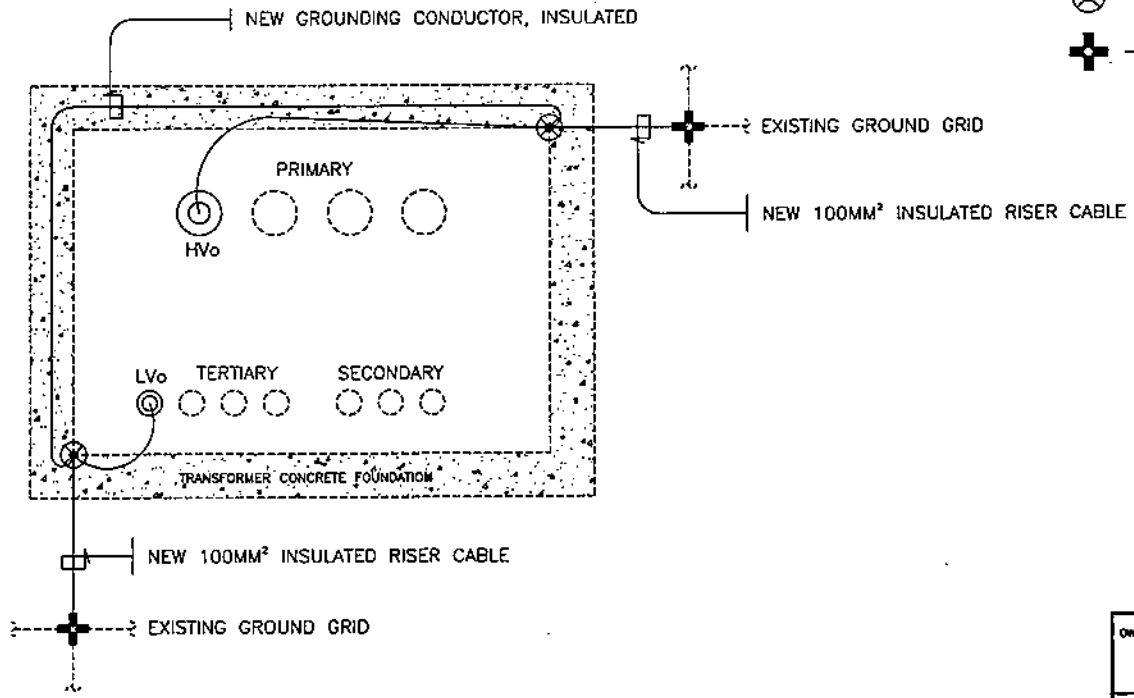
NOTES:

1. THIS DRAWING IS TENTATIVE AND FOR BIDDING PURPOSES ONLY
2. ALL NEW GROUNDING GRID AND RISER CONDUCTORS SHALL BE 100MM² COPPER, SOFT DRAWN
3. POWER TRANSFORMER TANK SHALL BE GROUNDED AT TWO POINTS DIAGONALLY OPPOSITE TO EACH OTHER AS SHOWN
4. POWER TRANSFORMER NEUTRAL SHALL BE GROUNDED TO TWO DIFFERENT POINTS OF THE GRID. THE TRANSFORMER GROUNDING STRIP SHALL BE ≥ 100MM² COPPER
5. OTHER EQUIPMENT NOT SHOWN BUT REQUIRED TO BE GROUNDED SHALL BE CONNECTED TO THE GROUNDING MAT
6. LOCATION OF THE TERTIARY AND THE HV & LV NEUTRAL TERMINALS ARE TENTATIVE. FINAL ARRANGEMENT SHALL DEPEND ON THE FINAL LAYOUT OF THE SUBSTATION AND THE SUBSTATION EQUIPMENT TO BE SUPPLIED

LEGENDS:

⊗ — TRANSFORMER GROUNDING POINT

✚ — EXOTHERMIC WELD CONNECTION



OWNER: **NATIONAL POWER CORPORATION**
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: **UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA**

LOCATION: MARINAWA, BATO, CATANDUANES

TITLE: **GROUNDING SYSTEM (POWER TRANSFORMER)**

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENGTR. / ARCHT.		
CIVIL/ARCHT.			
ELEC.			
MECH.			

SUBMITTED: R.P. VERAR, Assistant Engineer A, EPDD

RECOMMENDED: C.Z.C. LUGOD JR., Manager, EPDD

APPROVED: N. G. SOMOGUERRA, Manager, ODD

DWG. NO. **UVSS-BDE-22.009** SPECS. NO. **LuzP22Z1478So**

SCALE: **NTS** **BID DRAWING** REV. **0**

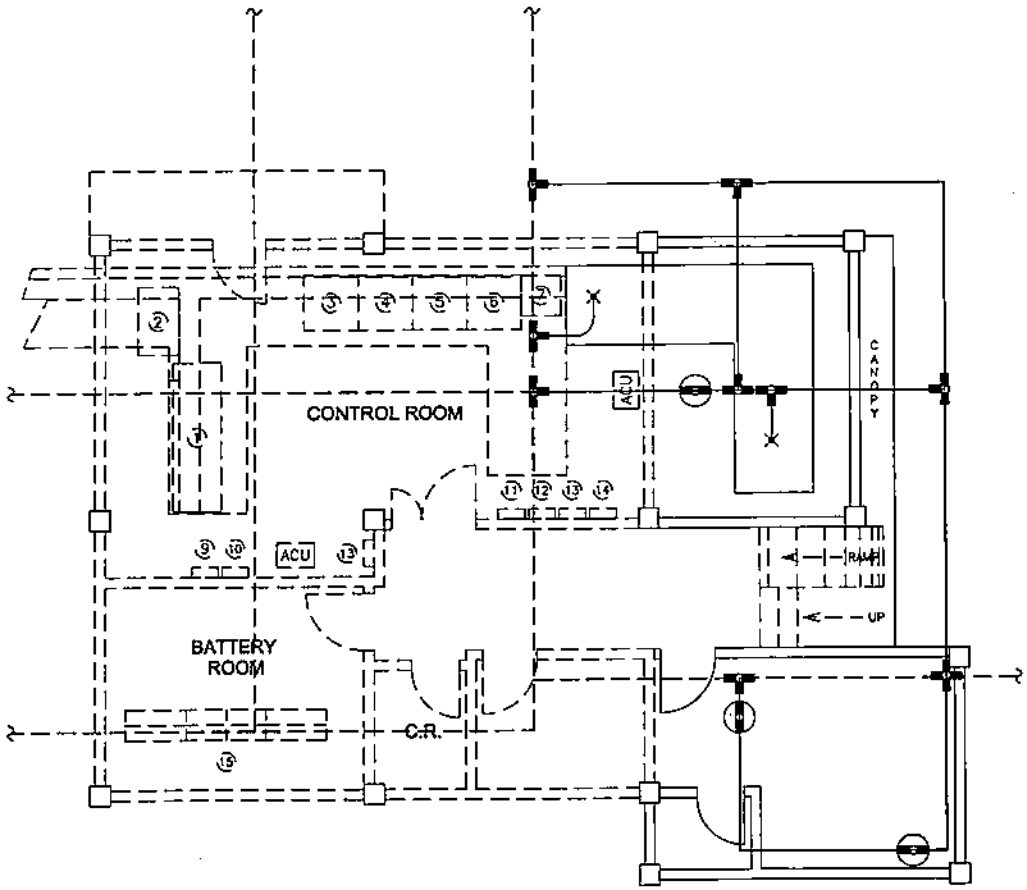
REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

NOTES:

1. THIS DRAWING IS TENTATIVE AND FOR BIDDING PURPOSES ONLY.
2. ALL NEW GROUNDING GRID AND RISER CONDUCTORS SHALL BE 100MM² COPPER, SOFT DRAWN.
3. GROUNDING GRID SHOWN IN BROKEN LINES ARE EXISTING. ALL OTHERS ARE ADDITIONAL GROUNDING GRID CONDUCTOR WITH EXOTHERMIC WELD CONNECTION TO BE PROVIDED BY THE CONTRACTOR. TOTAL LENGTH OF ADDITIONAL GROUNDING GRID CONDUCTOR TO BE BURIED SHALL NOT BE LESS THAN 30.2M AS SHOWN.
4. TWO RISER CONDUCTOR/CABLE SHALL BE BROUGHT OUT OF THE CONCRETE CABLE TRENCH FOR FUTURE GROUNDING CONNECTION OF CABLE TRAY.

LEGENDS:

- — EXOTHERMIC WELD, CROSS CONNECTION
- — EXOTHERMIC WELD, TEE CONNECTION
- — EXOTHERMIC WELD, WITH GROUND ROD
- — RISER CONDUCTOR/CABLE
- — EXISTING GROUDING GRID
- — ADDITIONAL 100MM² GROUNDING GRID CONDUCTOR



OWNER: NATIONAL POWER CORPORATION
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA

LOCATION: MARINAWA, BATO, CATANDUANES

TITLE: GROUNDING SYSTEM (PROPOSED EXPANSION OF CONTROL HOUSE)

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENGR. / ARCHT.		
CIVIL/ARCHT			
ELEC.			
MECH.			

SUBMITTED: R. P. VERAR
RECOMMENDED: C. Z. C. LUGOD JR.
APPROVED: N. G. SOMBILLERIA

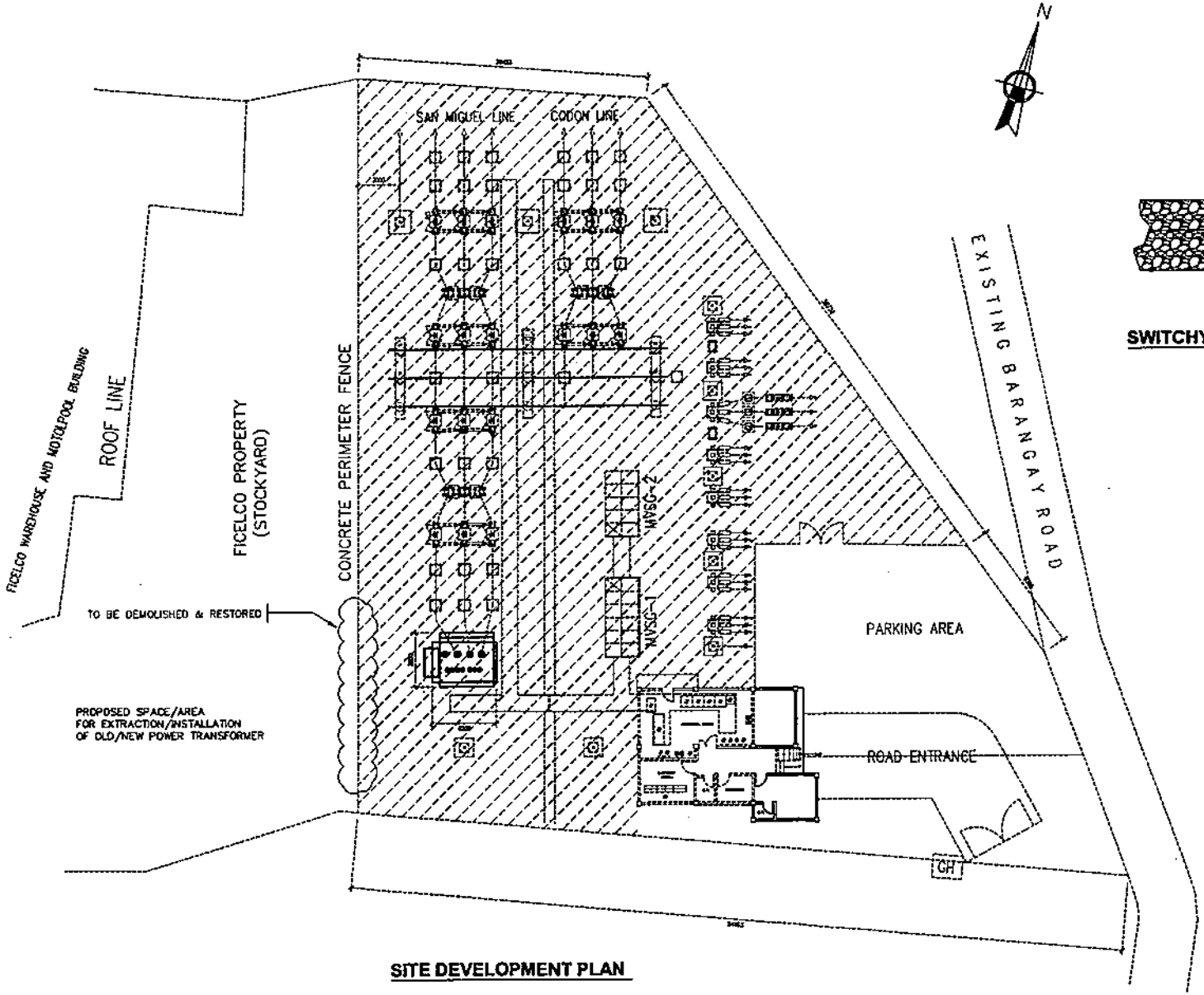
DWG. NO. UVSS-BDE-22.010 SPECS. NO. LuzP22Z1478So

SCALE: NTS BID DRAWING REV. 0

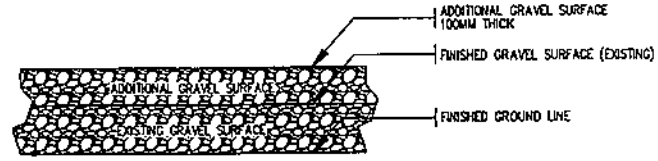
REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

NOTES:

1. SWITCHYARD AREA INSIDE SHADED PORTION SHALL BE COVERED WITH NEW CRUSH ROCKS



SITE DEVELOPMENT PLAN



SWITCHYARD GRAVEL ELEVATION

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

OWNER: **NATIONAL POWER CORPORATION**
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: **UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA SUBSTATION**

LOCATION: MARINAWA, BATO, CATANDUANES

TITLE: **SWITCHYARD GRAVEL RESURFACING**

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENGR. / ARCHT.		
CIVIL/ARCHT			
ELEC.			
MECH.			

SUBMITTED: R. P. VERAR, Senior Engineer, EESD

RECOMMENDED: C. Z. C. LUGOD, JR., Manager, EESD

APPROVED: N. G. SOBREVEGA, Manager, DDD

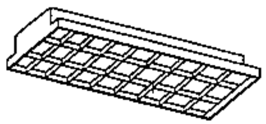
DWG. NO. UVSS-BDE-22.011 | SPECS. NO. LuzP22Z1478Se

SCALE: 1:300 | **BID DRAWING** | REV. 0

NOTES:

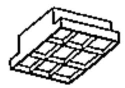
1. POWER SUPPLY FOR LIGHTING & POWER PANELBOARD (LPP) OF PROPOSED NEW SPUG-OFFICE SHALL BE TAKEN FROM THE EXISTING 230VAC SUB-DISTRIBUTION PANELBOARD INSIDE THE CONTROL ROOM
2. DEPENDING ON THE ACTUAL LOADING OF THE 230VAC SUB-DISTRIBUTION PANELBOARD, THE TENTATIVE CONNECTION OF NEW LPP SHALL BE FROM PHASE A & B OF THE SAID EXISTING SUB-DIST PANELBOARD
3. SUB-KILOWATTHOUR METER SHALL BE INSTALLED AT THE SOURCE SIDE OF THE PROPOSED NEW LPP WHICH SHALL BE LOCATED AS DIRECTED OF SPUG-CATANDUANES AUTHORIZED PERSONNEL

A



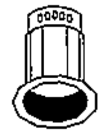
FLUORESCENT LIGHTING FIXTURE, WITH MIRROR FINISHED ALUMINUM REFLECTORS, RECESS TYPE, 1200MMx600MM WITH 2x16W LED LAMP WITH LOUVER TYPE DIFFUSER

B



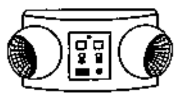
FLUORESCENT LIGHTING FIXTURE, WITH MIRROR FINISHED ALUMINUM REFLECTORS, RECESS TYPE, 600MMx600MM WITH 2x16W LED LAMP WITH LOUVER TYPE DIFFUSER

C



PIN LIGHT LIGHTING FIXTURE, RECESSED TYPE STAINLESS STEEL BODY COMPLETE WITH SELF-CONTAINED COMPACT 18W LED.

D



PORTABLE EMERGENCY LIGHTING FIXTURE.
2 x 2 WATTS LED, WARM WHITE WITH BUILT-IN SEALED LEAD ACID BATTERY. CHARGING TIME < 20 HRS. USAGE TIME ≥ 4 HRS.

E

EXIT SIGN LIGHTING, INDOOR, LED TYPE WITH BUILT-IN BATTERY, 240VAC, 1PH POWER SUPPLY

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

OWNER: **NATIONAL POWER CORPORATION**
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: **UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA**

LOCATION: MARINAWA, BATO, CATANDUANES

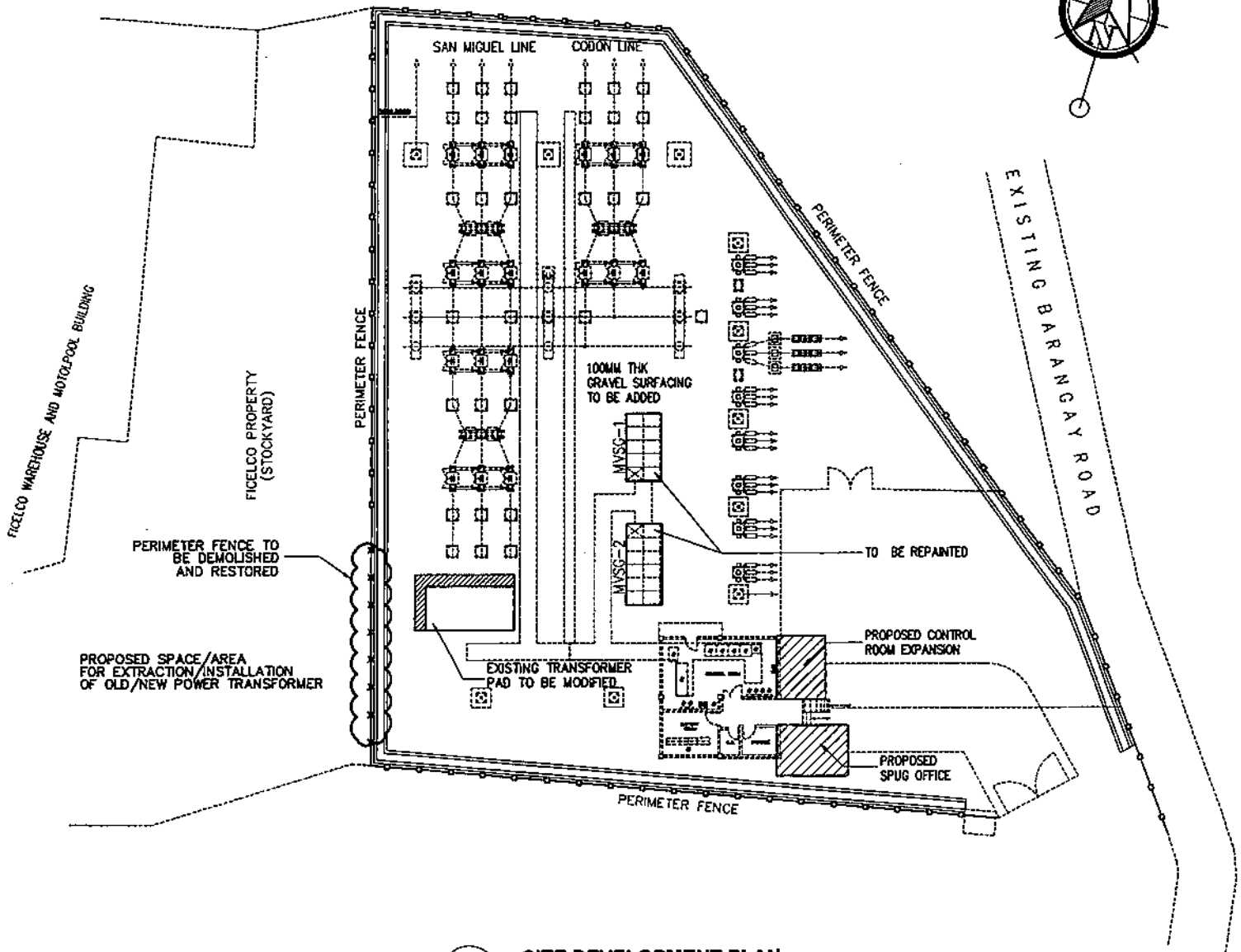
TITLE: **DETAILS OF LIGHTING FIXTURES**

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENGR. / ARCHT.		
CIVIL/ARCH'T			
ELEC.			
MECH.			

SUBMITTED: R. P. VERAR
RECOMMENDED: C. Z. C. LUGOD, JR., Manager, [illegible]
APPROVED: N. G. SO[illegible]RA, Manager, ODD

DWG. NO. UVSS-BDE-22.012 | SPECS. NO. LuzP22Z1478Se

SCALE: NTS | **BID DRAWING** | REV. 0



SITE DEVELOPMENT PLAN

SCALE 1:300

NOTES:

1. EXISTING POWER TRANSFORMER AS SHOWN SHALL BE REPLACED WITH NEW 20MVA RATED POWER TRANSFORMER INCLUDING OLTC/REMOTE CONTROL PANEL INSIDE THE CONTROL ROOM
2. EXTENT OF DEMOLITION/RESTORATION WORKS INCLUDING AVAILABLE SPACE/AREA REQUIRED BY LIFTING EQUIPMENT NECESSARY FOR THE SAFE DISMANTLING, HAULING AND INSTALLATION OF OLD AND NEW POWER TRANSFORMER SHALL BE DETERMINED BY THE CONTRACTOR
3. EXISTING POWER TRANSFORMER SHALL BE STORED/STOCKED AT NPC'S EXISTING MARINAWA DIESEL POWER PLANT SWITCHYARD OR AS PER DIRECTION FROM NPC'S AUTHORIZED PERSONNEL
4. PROVIDE ADDITIONAL 100MM THICK GRAVEL SURFACING

LEGEND:

- STRUCTURE TO BE CONSTRUCTED
- PERIMETER FENCE TO BE DEMOLISHED AND RESTORED
- EXISTING PERIMETER FENCE

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

OWNER: **NATIONAL POWER CORPORATION**
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA

LOCATION: MARINAWA, BATO, CATANDUANES

TITLE: **SITE DEVELOPMENT PLAN**

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENG'R. / ARCH'T.		
CIVIL/ARCH'T			
ELEC.			
MECH.			

SUBMITTED: H. L. MENDOZA, Principal Engineer A, OEAD

RECOMMENDED: A. C. ESPIRITU, Manager, OEAD

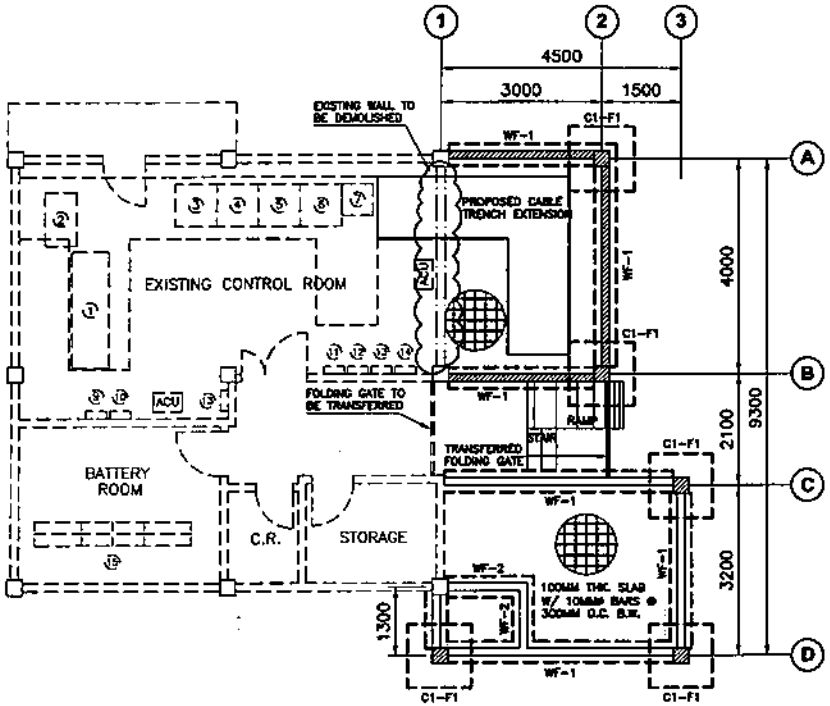
APPROVED: N. C. [illegible] CERRA, Manager, DDD

DWG. NO. UVSS-BDC-22.001 SPECS NO. LuzP22Z1478Se

SCALE: 1:300 **BID DRAWING** REV. 0

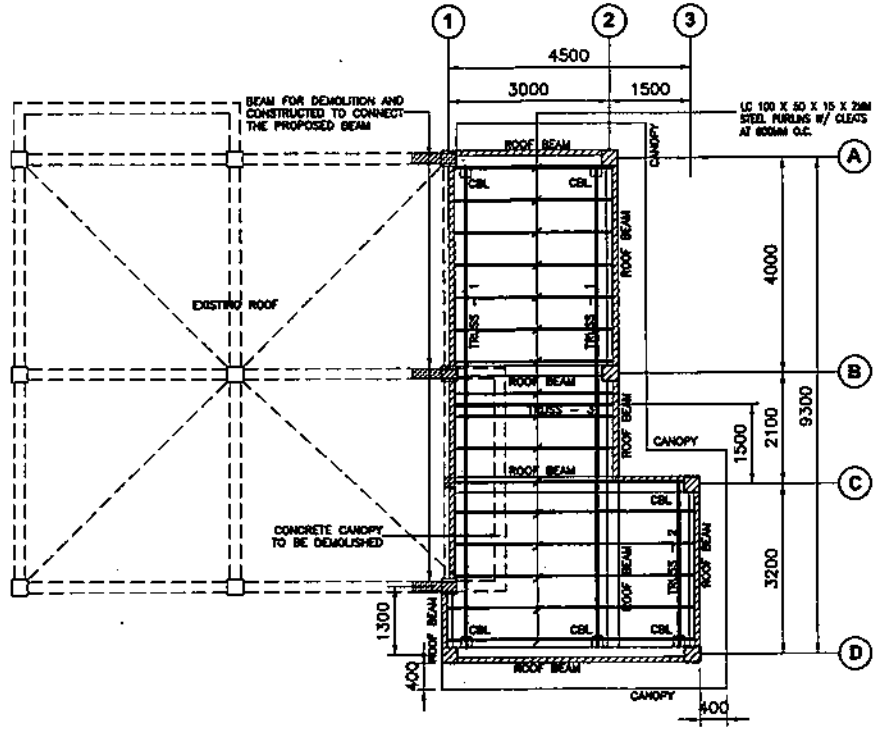
LEGEND:

CBL – CORBEL



FOUNDATION PLAN

SCALE 1:100



ROOF FRAMING PLAN

SCALE 1:100

OWNER: NATIONAL POWER CORPORATION
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA

LOCATION: MARINAWA, BATO, CATANDUANES

TITLE: **FLOOR PLAN AND ROOF PLAN**

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENGR. / ARCHT.		
CIVIL/ARCHT			
ELEC.			
MECH.			

SUBMITTED: H. L. MENDOZA, Principal Engineer A, OEAD

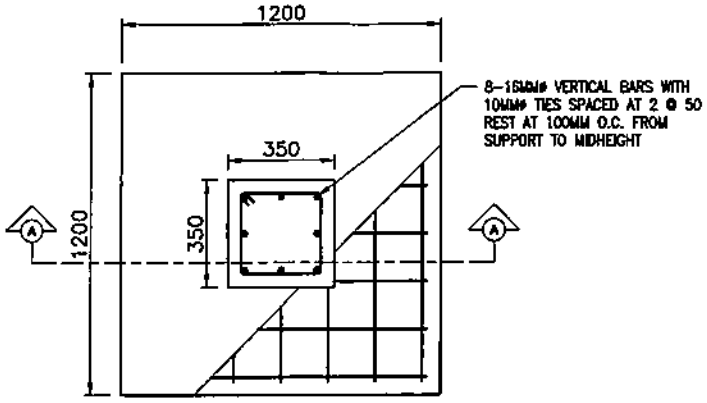
RECOMMENDED: A. C. ESPIRITU, Deputy, OEAD

APPROVED: N. G. [illegible] SERRA, Manager, OEAD

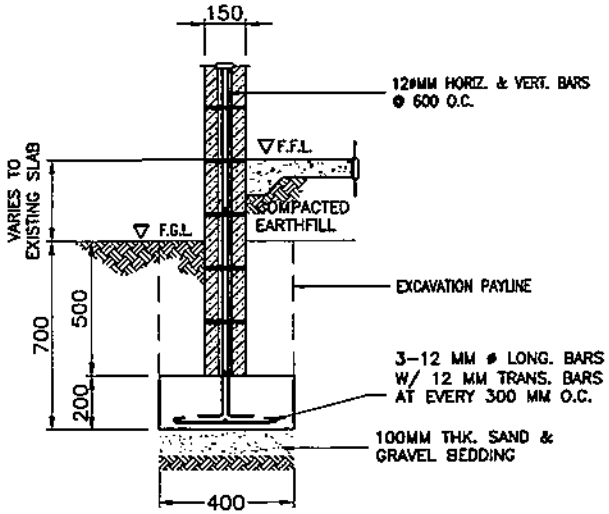
DWG. NO. UVSS-BDC-22.002 SPECS NO. LuzP22Z1478Se

SCALE: AS SHOWN **BID DRAWING** REV. 0

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.



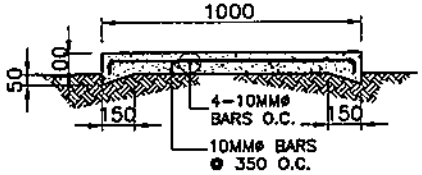
C1-F-1 (PLAN)
SCALE 1:20



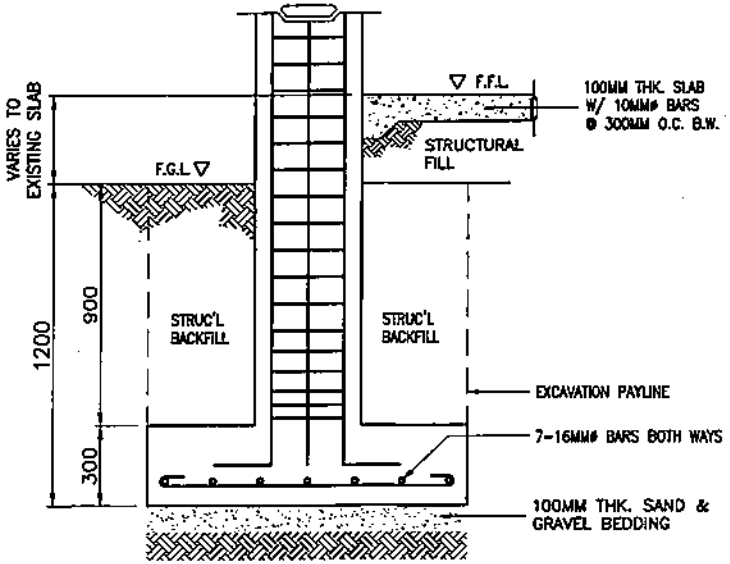
WF-1 (SECTION)
SCALE 1:20

NOTE:

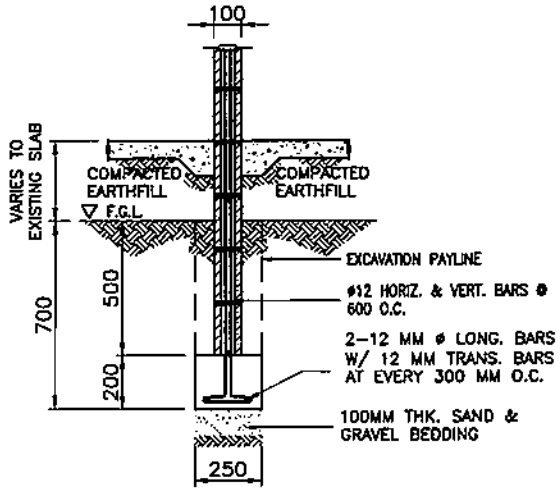
1. ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE INDICATED.
2. DEGREE OF COMPACTION OF GRADING FILL SHALL BE 95% OF RELATIVE DENSITY.
4. ALLOWABLE BEARING CAPACITY OF SOIL SHALL NOT BE LESS THAN 143.9 KPa.
5. MINIMUM COMPRESSIVE STRENGTH OF CONCRETE SHALL BE f'c= 20.7 MPa (3000 psi) AT 28-DAY PERIOD.
6. REINFORCING STEEL BARS SHALL CONFORM TO THE LATEST REQUIREMENTS OF THE PNS FOR DEFORMED STEEL BARS GRADE 275.
7. ALL ASPECTS OF CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE PROVISIONS OF THE LATEST APPLICABLE CODE.



CONCRETE WALK (DETAILS)
SCALE 1:20



SECTION A



WF-2 (SECTION)
SCALE 1:20

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE INDICATED.

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

OWNER: **NATIONAL POWER CORPORATION**
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA

LOCATION: MARINAWA, BATO, CATANDUANES

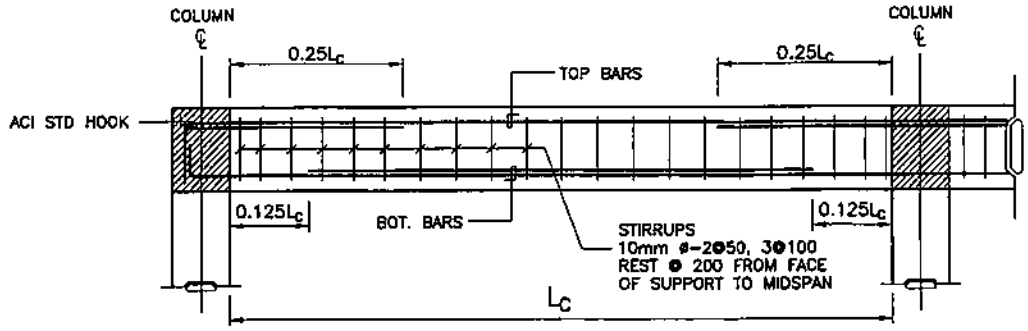
TITLE: **C1-F1, WF-1, WF-2 & CONCRETE WALK (PLAN, SECTION & DETAILS)**

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENG'R. / ARCH'T.		
CIVIL/ARCH'T			
ELEC.			
MECH.			

SUBMITTED: H. L. MENDOZA, Principal Engineer A, OIC
RECOMMENDED: A. C. ESPIRITU, Manager, SEAD
APPROVED: H. C. [illegible], Manager, DDD

DWG. NO. UVSS-BDC-22.003 SPECS NO. LuzP22Z1478Se

SCALE: AS SHOWN **BID DRAWING** REV. 0

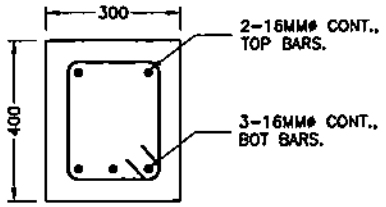


ROOF BEAM DETAILS

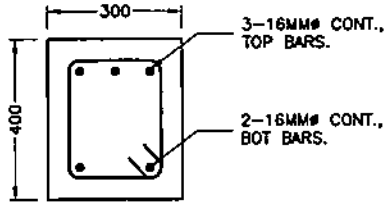
SCALE NTS

NOTES:

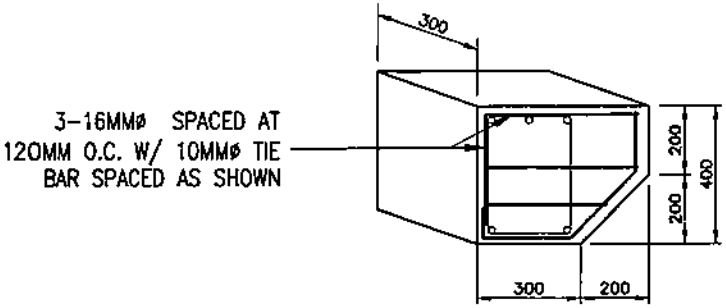
1. MINIMUM COMPRESSIVE STRENGTH OF CONCRETE SHALL BE 20.7MPa AT 28 DAYS PERIOD.
2. REINFORCING STEEL BARS SHALL CONFORM TO THE LATEST REQUIREMENTS OF PNS FOR DEFORMED STEEL BARS GRADE 275.
3. SPLICES, BENDS, HOOKS AND DETAILING OF REINFORCING BARS SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE LATEST ACI BUILDING CODE.
4. ALL ASPECTS OF CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE PROVISIONS OF THE LATEST APPLICABLE CODE.
5. SEE LOCATION OF CORBEL AT ROOF FRAMING PLAN.



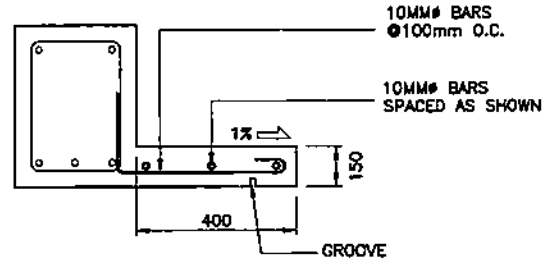
SECTION AT MID SPAN



SECTION AT SUPPORT



CORBEL (CBL) DETAIL



CONCRETE CANOPY

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

OWNER: NATIONAL POWER CORPORATION
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA

LOCATION: MARINAWA, BATO, CATANDUANES

TITLE: ROOF BEAM, CORBEL AND CONCRETE CANOPY (SECTION & DETAILS)

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENGR. / ARCH'L		
ENG./ARCH'T			
ELEC.			
MECH.			

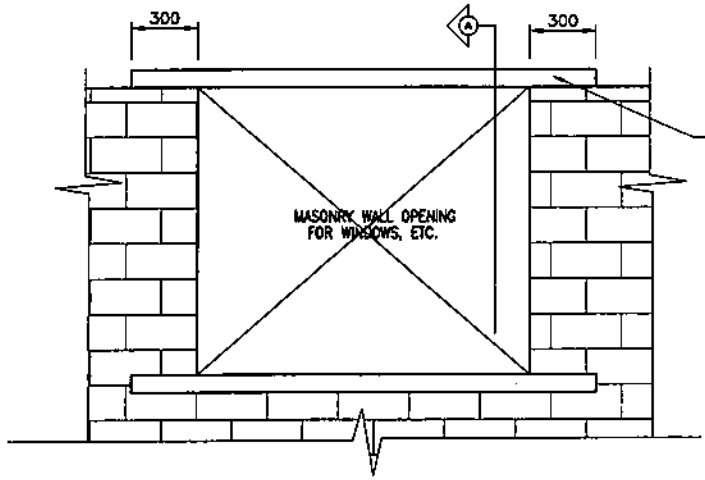
SUBMITTED: H. L. MENDOZA, Principal Engineer A, CEAD

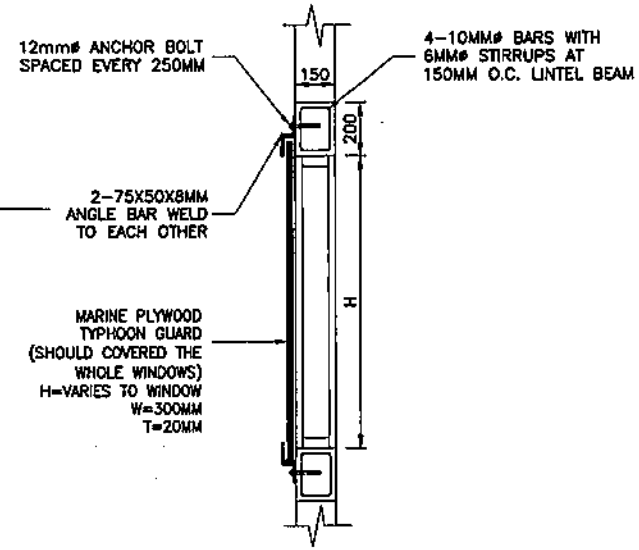
RECOMMENDED: A. C. BASARITU, Manager, CEAD

APPROVED: N. G. SO[illegible]RA, Manager, CDD

DWG. NO. UVSS-BDC-22.004 SPECS NO. LuzP22Z147SS0

SCALE: AS SHOWN BID DRAWING REV. 0





SECTION A

TYPHOON GUARD FOR WINDOWS

SCALE NTS

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

OWNER: **NATIONAL POWER CORPORATION**
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA

LOCATION: MARINAWA, BATO, CATANDUANES

TITLE: **TYPHOON GUARD FOR WINDOWS (SECTION & DETAILS)**

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENG'R. / ARCH'T.		
CIVIL/ARCH'T			
ELEC.			
MECH.			

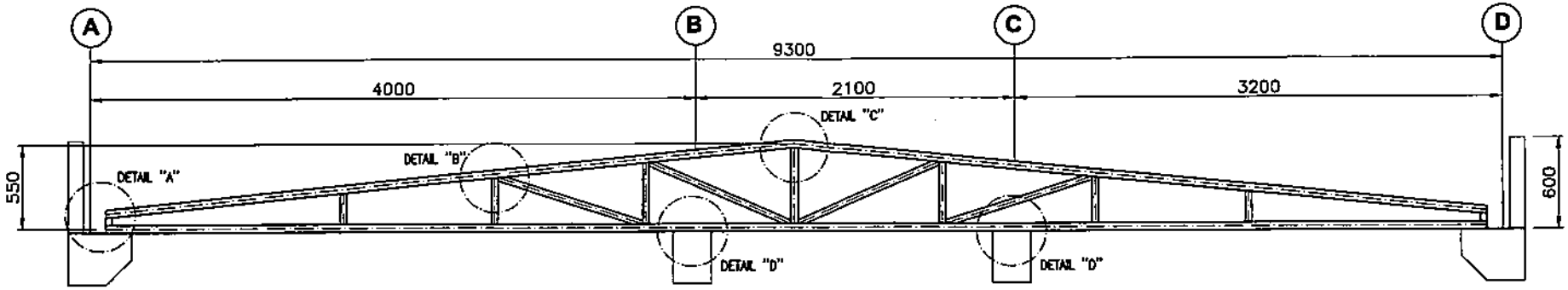
SUBMITTED: H. L. MENDOZA, Principal Engineer A, CEAD

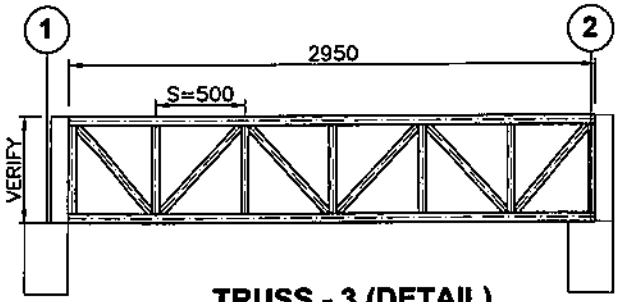
RECOMMENDED: A. C. ESPIRITU, Division Chief, CEAD

APPROVED: N. G. SOMBILLERA, Manager, CDD

DWG. NO. UVSS-BDC-22.005 SPECS NO. LuzP22Z1478Se

SCALE: AS SHOWN **BID DRAWING** REV. 0



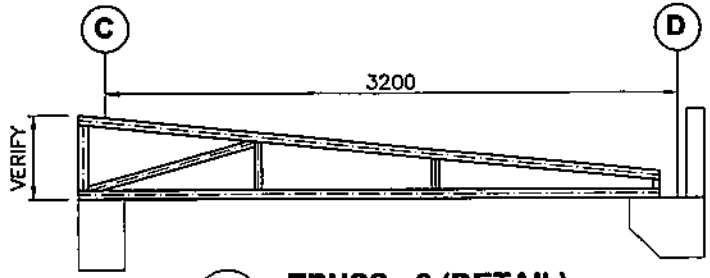


TRUSS - 3 (DETAIL)
CONNECTED TO 2-T1
SCALE 1:30

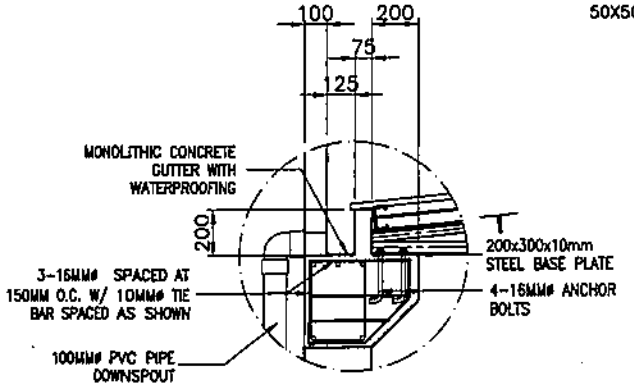
TOP CHORD = 2L-50x50x6mm ANGLE BARS
BOTTOM CHORD = 2L-50x50x6mm ANGLE BARS
WEB MEMBERS = 2L-40x40x6mm ANGLE BARS

PROVIDE 6MM THK GUSSET PLATES FOR ALL STRUCTURAL STEEL JOINTS

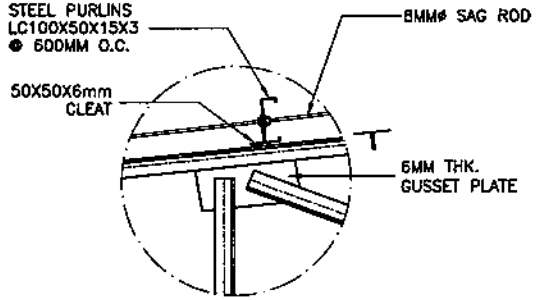
TRUSS - 1 (DETAIL)
SCALE 1:30



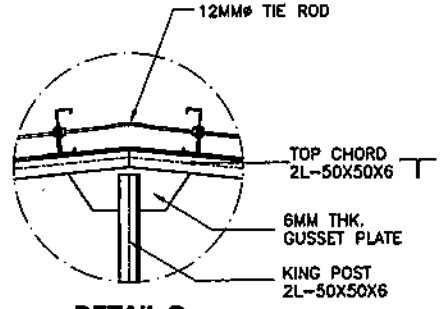
TRUSS - 2 (DETAIL)
SCALE 1:30



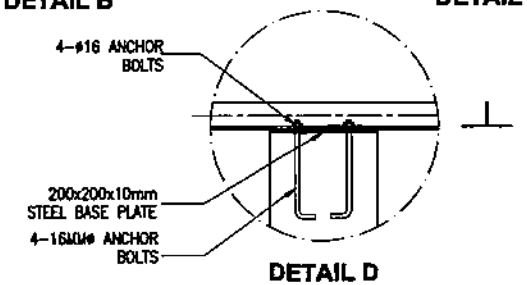
DETAIL A



DETAIL B



DETAIL C



DETAIL D

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE INDICATED.
2. USE STRUCTURAL GRADE STEEL SHAPES, BARS AND PLATES CONFORMING TO ASTM A36.
5. WELDING SHALL CONFORM TO E70 SERIES OF SPECIFICATIONS FOR MILD STEEL ARC WELDING ELECTRODES ASTM A233, LATEST EDITION.
6. ALL ASPECTS OF CONSTRUCTION AND DETAILING SHALL BE IN ACCORDANCE WITH THE PROVISIONS OF ACI CODE.
7. ALL STRUCTURAL STEEL SHALL BE FABRICATED AND ERECTED IN ACCORDANCE WITH THE AISC SPECIFICATIONS AND CODE OF STANDARD PRACTICE.
8. USE 6MM THK. GUSSET PLATE.

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

OWNER: **NATIONAL POWER CORPORATION**
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA

LOCATION: MARINAWA, BATO, CATANDUANES

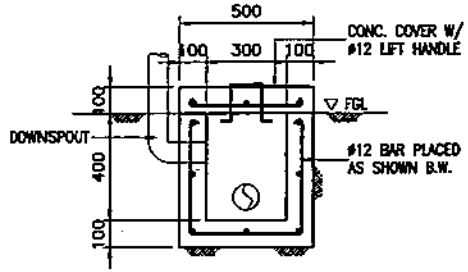
TITLE: **ROOF TRUSS DETAILS**

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENGR. / ARCHT.		
CIVIL/ARCHT.			
ELEC.			
MECH.			

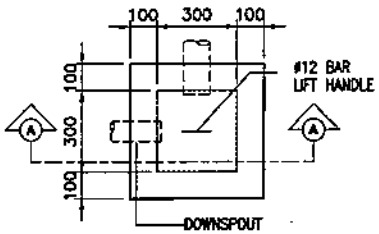
SUBMITTED: H. L. MENDOZA, Principal Engineer A, CDO
RECOMMENDED: A. C. ESPIRITU, Manager, CDO
APPROVED: N. G. SANTOSTEFANO, Manager, BDO

DWG. NO. UVSS-BDC-22.006 SPECS NO. LuzP2Z1478So

SCALE: AS SHOWN **BID DRAWING** REV. 0

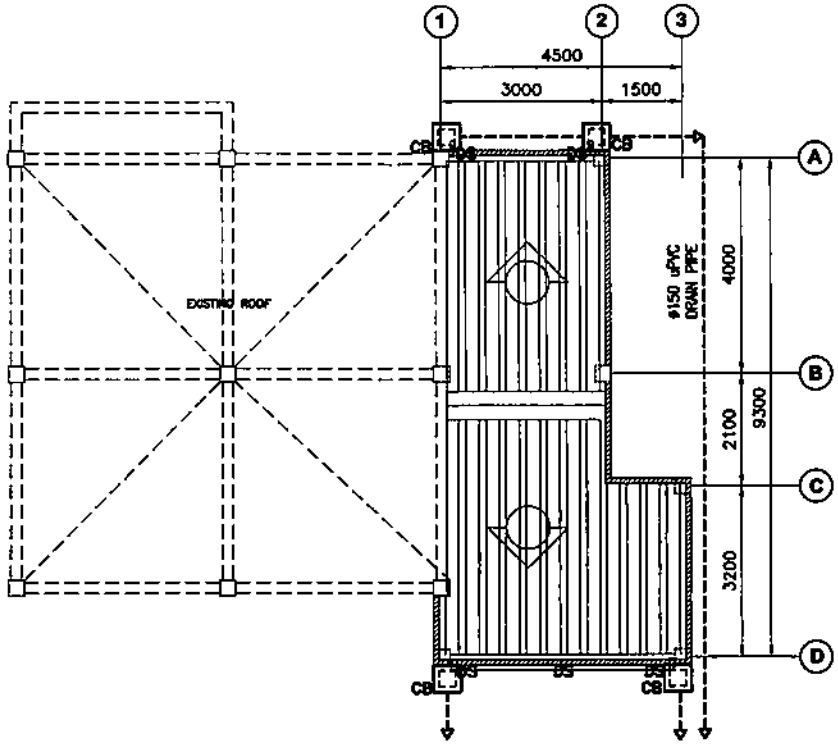


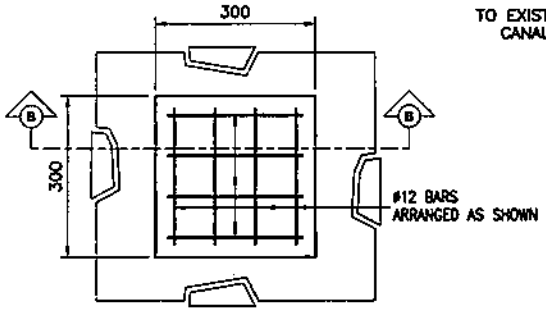
SECTION 'A'



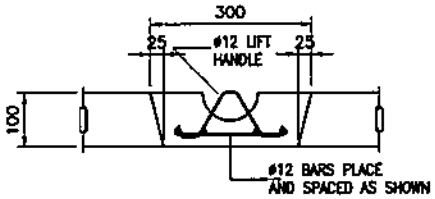
PLAN

CATCH BASIN DETAILS
SCALE 1:20





PLAN



SECTION 'B'

MANHOLE COVER
SCALE 1:10

LEGENDS:

1. DS --------DOWNSPOUT
2. CB --------CATCH BASIN

NOTES:

1. ALL ASPECTS OF CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE PROVISIONS OF THE LATEST APPLICABLE CODE OR EDITION OF THE NATIONAL PLUMBING CODE,LOCAL REQUIREMENTS AND SUBDIVISION RULES AND REGULATIONS.
2. ALL CLEAN OUT SHALL BE FLUSHED MOUNTED AND PROVIDED WITH POLISHED COVER. DO NOT INSTALL FLOOR CLEANOUT AT LINE ON GRADE AND SERVICE AREA NOT SUBJECT TO TRAFFIC.
3. PROVIDE GATE VALVES TO ALL WATER SUPPLY LINES TO FIXTURES.
4. THE PLUMBING LAYOUTS ARE ONLY DIAGRAMMATIC PIPES, CLEANOUT, CHECK VALVES SHALL BE LOCATED INSIDE BATHROOMS AND SERVICE AREA CONCEALED AS MUCH AS POSSIBLE
5. PROVIDE VENT PIPES AND VENT STACK THRU ROOF AS REQUIRED.
6. THE MINIMUM SLOPE OF SEWER SHALL BE TWO PERCENT (2%) AND FOR DRAIN LINES SHALL BE ONE PERCENT (1%).

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

OWNER: NATIONAL POWER CORPORATION
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA

LOCATION: MARINAWA, BGTD, CATANDUANES

TITLE: DRAINAGE PLAN

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENGR'L. / ARCH'T.		
CIVIL/ARCH'T.			
ELEC.			
MECH.			

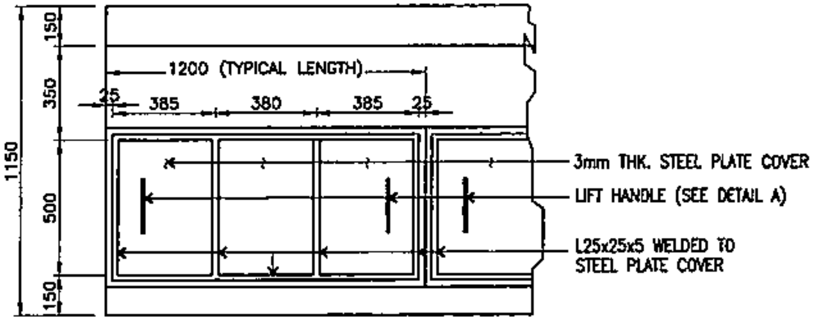
SUBMITTED: H. L. MENDOZA, Principal Engineer A, EDAD
RECOMMENDED: A. C. ESPIRITU, Manager, EDAD
APPROVED: N. G. DOMINGUEZ, Manager, DDD

DWG. NO. UVSS-BDC-22.007 SPECS NO. LuzP22Z1478Se

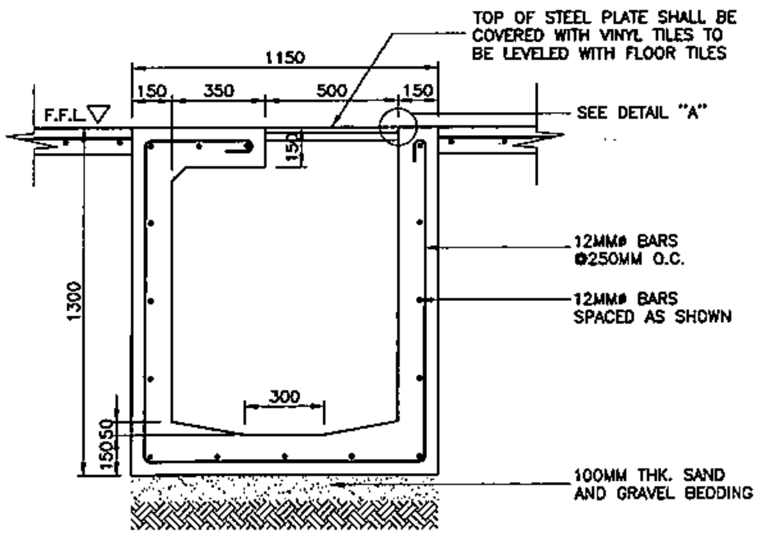
SCALE: AS SHOWN BID DRAWING REV. 0

NOTES:

1. 1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE INDICATED.
2. MINIMUM COMPRESSIVE STRENGTH OF CONCRETE SHALL BE f'c = 20.70 MPa AT 28-DAYS PERIOD.
3. ALL REINFORCING BARS SHALL CONFORM TO THE LATEST REQUIREMENTS OF PHILIPPINE NATIONAL STANDARD FOR DSB GRADE 275.
4. PLEASE REFER TO ELECTRICAL DRAWINGS FOR DETAILS OF CABLE TRAYS & CABLE TRENCH LAYOUT.
5. PROVIDE OPENING/BLOCKOUTS FOR CABLE TRENCH GOING TO PANEL BOARD.

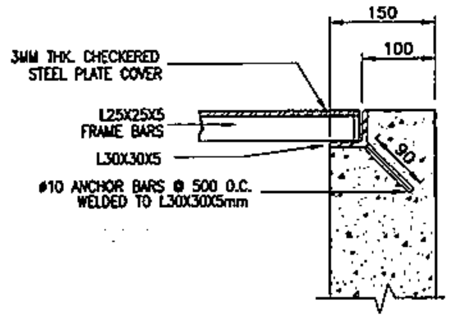


PLAN



CABLE TRENCH DETAILS

SCALE 1:20



DETAIL 'A'

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECO.	APPD.

OWNER: **NATIONAL POWER CORPORATION**
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA

LOCATION: MARINAWA, BATO, CATANDUANES

TITLE: **CABLE TRENCH DETAILS**

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENG'R. / ARCH'T.		
CIVIL/ARCH'T			
ELEC.			
MECH.			

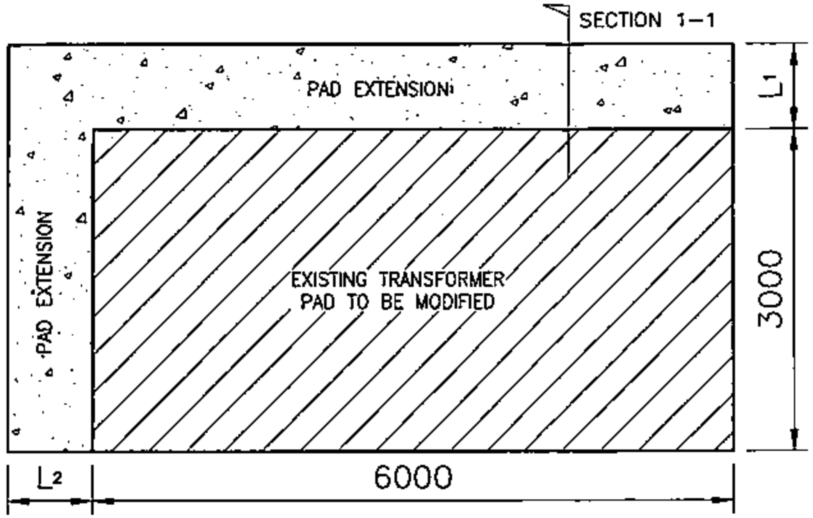
SUBMITTED: H. L. MENDOZA, Principal Engineer A, CEAD

RECOMMENDED: A. C. ESPIRITU, Manager, [illegible]

APPROVED: N. G. [illegible], Manager, [illegible]

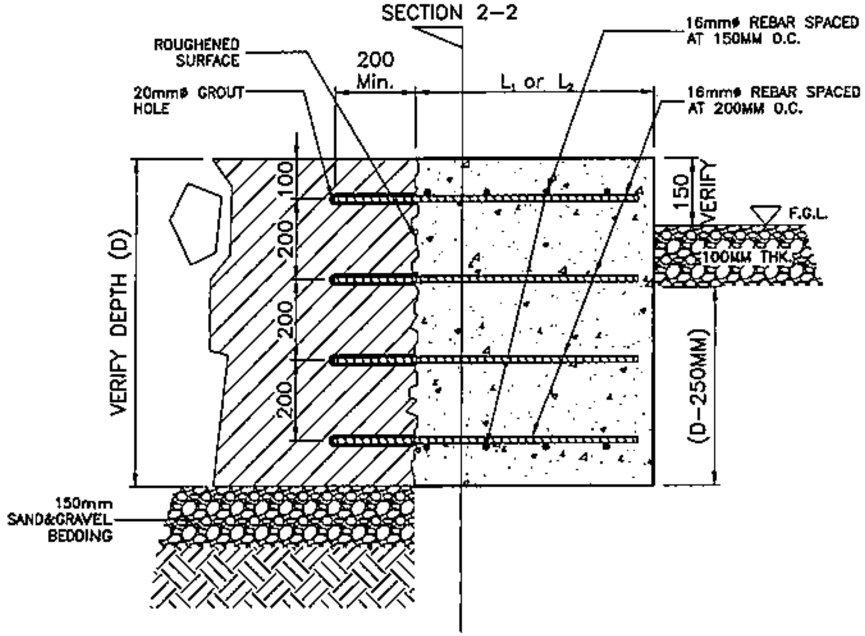
DWG. NO. UVSS-BDC-22.008 | SPECS NO. LuzP22Z1478Se

SCALE: AS SHOWN | **BID DRAWING** | REV. 0

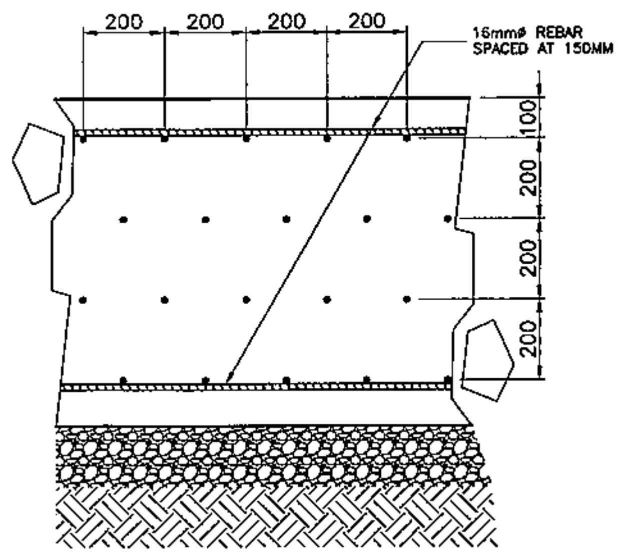


TRANSFORMER PAD PLAN

SCALE NTS



SECTION 1-1



SECTION 2-2

NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE INDICATED.
2. DEGREE OF COMPACTION OF GRADING FILL SHALL BE 95% OF RELATIVE DENSITY.
3. MINIMUM COMPRESSIVE STRENGTH OF CONCRETE SHALL BE f'c= 20.7 MPa (3000 psi) AT 28-DAY PERIOD.
4. REINFORCING STEEL BARS SHALL CONFORM TO THE LATEST REQUIREMENTS OF THE PNS FOR DEFORMED STEEL BARS GRADE 275.
5. ALL ASPECTS OF CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE PROVISIONS OF THE LATEST APPLICABLE CODE.
6. L_1 AND L_2 WILL BE BASED ON THE ACTUAL SIZE OF THE 20MVA TRANSFORMER TO BE SUPPLIED.
7. IN-SITU EXISTING SOIL SHALL BE THOROUGHLY COMPACTED.

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECO.	APPD.

OWNER: **NATIONAL POWER CORPORATION**
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA

LOCATION: MARINAWA, BATO, CATANDUANES

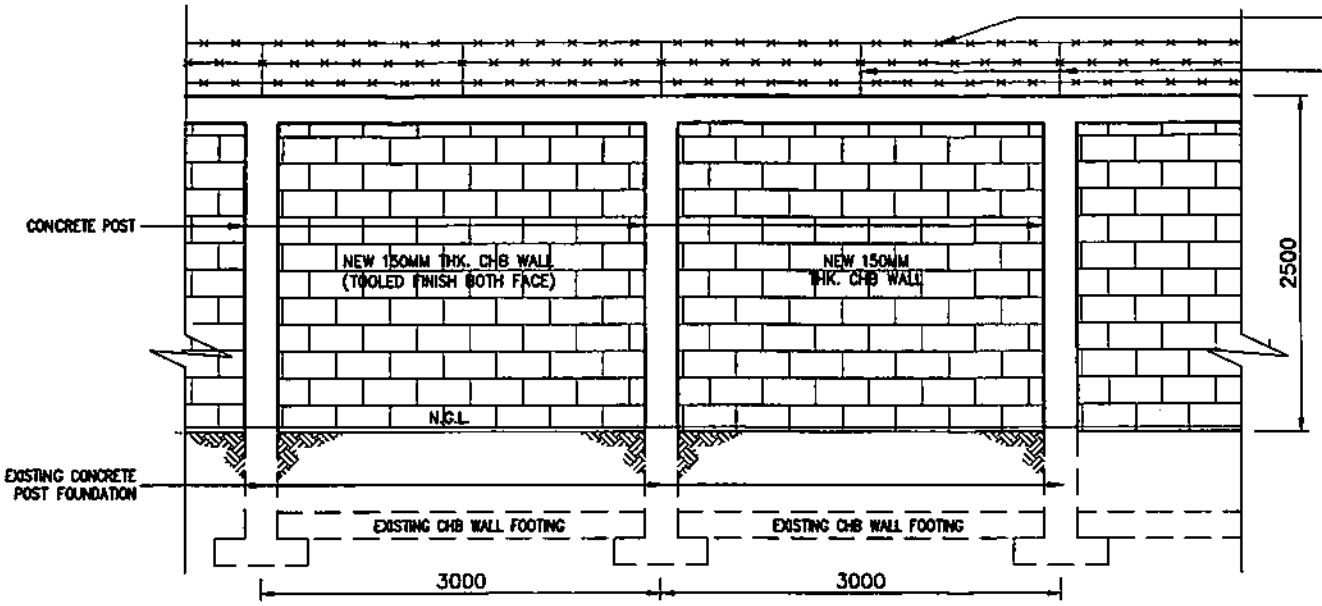
TITLE: **TRANSFORMER PAD (DETAIL AND SECTIONS)**

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENG'R. / ARCH'T.		
CIVIL/ARCH'T			
ELEC.			
MECH.			

SUBMITTED: H. L. MENDOZA, Principal Engineer A, CEAD
RECOMMENDED: A. C. BOPIRITU, Manager, CEAD
APPROVED: M. G. SOBREPEÑA, Manager, DDD

DWG. NO. UVSS-BDC-22.009 | SPECS NO. LuzP22Z1478Se

SCALE: AS SHOWN | **BID DRAWING** | REV. 0

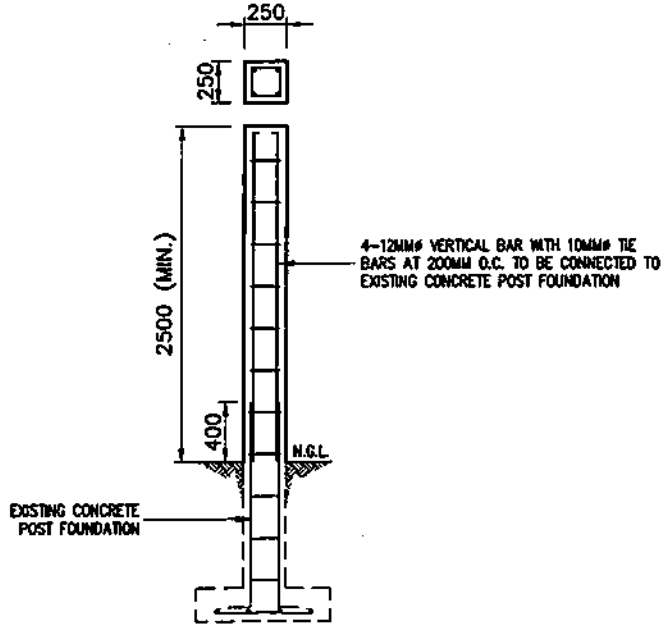


CHB PERIMETER FENCE (ELEVATION)

SCALE 1:40

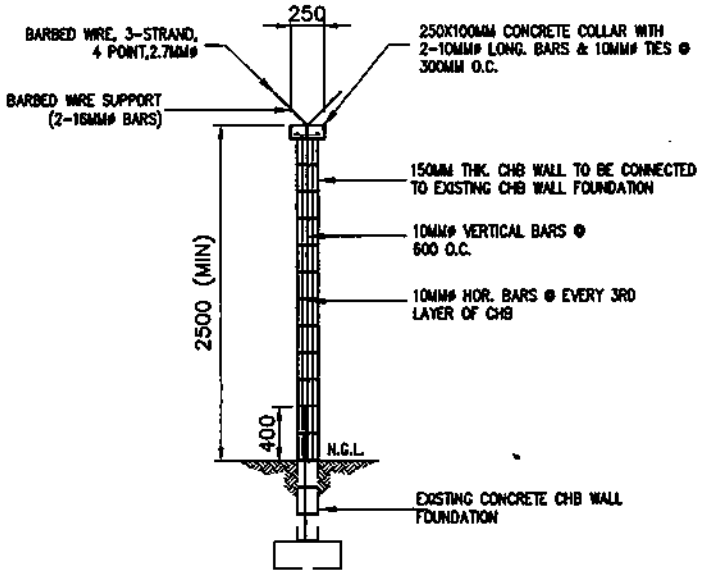
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHER WISE INDICATED.
2. AFTER DEMOLITION OF AFFECTED PERIMETER FENCE DUE TO INSTALLATION OF 20MVA TRANSFORMER THE CONTRACTOR SHOULD BE RECONSTRUCT NEW CHB PERIMETER FENCE.
3. SEE LOCATION OF DEMOLITION AND RECONSTRUCTION IN SITE DEVELOPMENT PLAN.



CONCRETE POST SECTION

SCALE 1:40



CHB WALL SECTION

SCALE 1:40

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

OWNER: NATIONAL POWER CORPORATION
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA

LOCATION: MARINAWA, BATO, CATANDUANES

TITLE: CHB PERIMETER FENCE

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENGR. / ARCHT.		
CIVIL/ARCHT			
ELEC.			
MECH.			

SUBMITTED: H. L. MENDOZA, Principal Engineer A, ODO
RECOMMENDED: A. C. ESPIRITU, Manager, ODO
APPROVED: R. G. SOMOSIERRA, Manager, ODO 6/04/

DWG. NO. UVSS-BDC-22.010 SPECS NO. LuzP22Z1478Sa

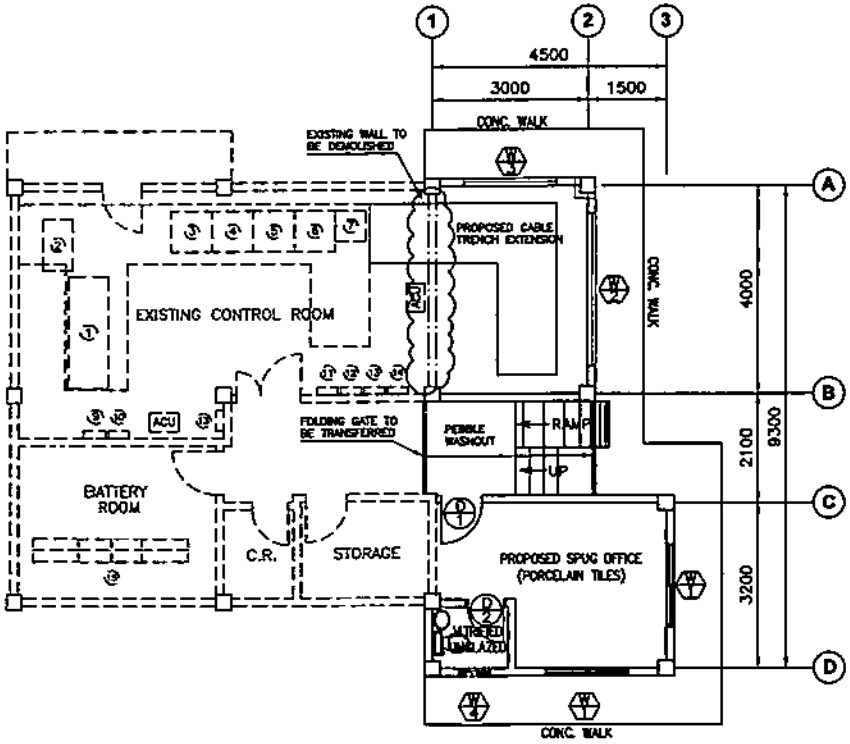
SCALE: AS SHOWN BID DRAWING REV. 0

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE INDICATED.
2. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS PRIOR TO CONSTRUCTION. THE NPC SHALL BE NOTIFIED OF ANY DISCREPANCIES OR INCONSISTENCIES.
3. DIMENSION SHALL TAKE PRECEDENCE OVER SCALED DRAWINGS.
4. ELEVATION OF PROPOSED OFFICE AND CONTROL ROOM SHOULD BE THE SAME ELEVATION ON THE EXISTING CONTROL ROOM.

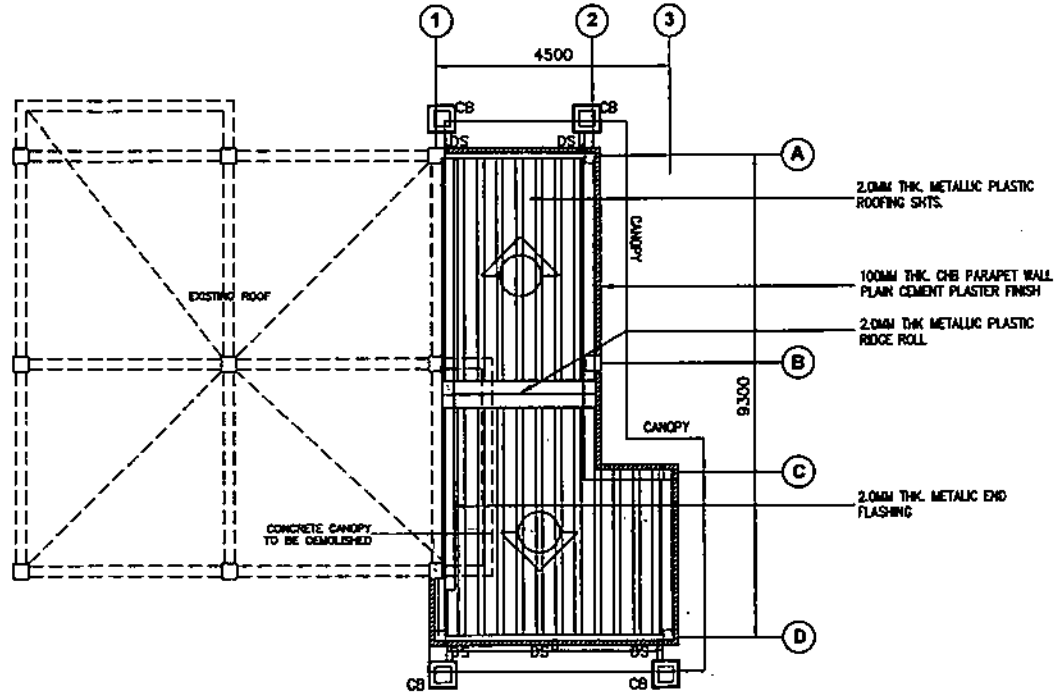
LEGEND:

- EXISTING STRUCTURES



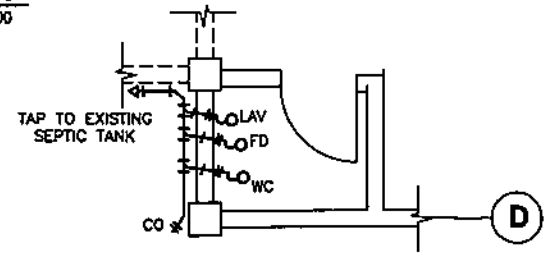
FLOOR PLAN

SCALE 1:100



ROOF PLAN

SCALE 1:100



PLUMBING LAYOUT

SCALE 1:100

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

OWNER: NATIONAL POWER CORPORATION
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA

LOCATION: MARINAWA, BATO, CATANDUANES

TITLE: **FLOOR PLAN AND ROOF PLAN**

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVISED	PRINCIPAL ENGR. / ARCHT.		
CIVIL/ARCHT			
ELEC.			
MECH.			

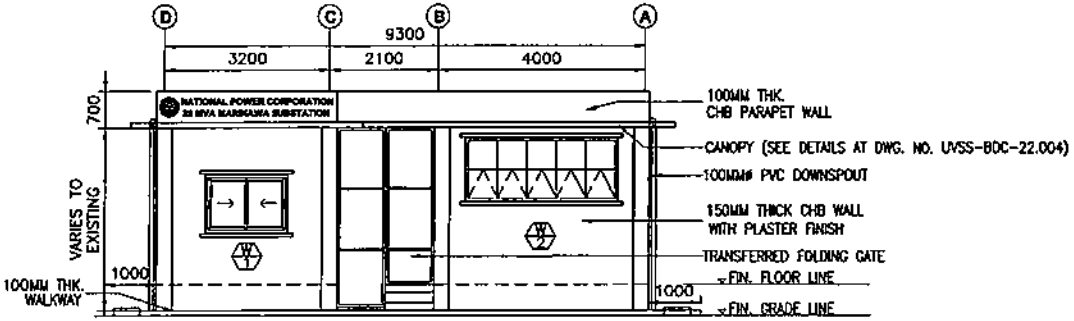
SUBMITTED: R. R. C. VILLANUEVA, Principal Architect A, OEM

RECOMMENDED: A/C. ESPIRITU, Manager, OEM

APPROVED: M. G. [illegible]ERA, Manager, OEM

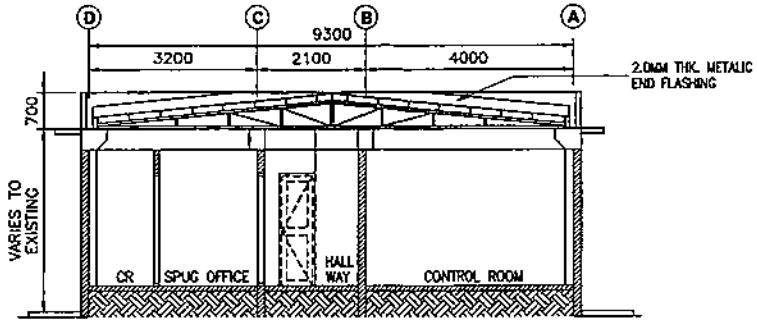
DWG. NO. UVSS-BDA-22.001 | SPECS NO. LuzP22Z1478Se

SCALE: AS SHOWN | BID DRAWING | REV. 0



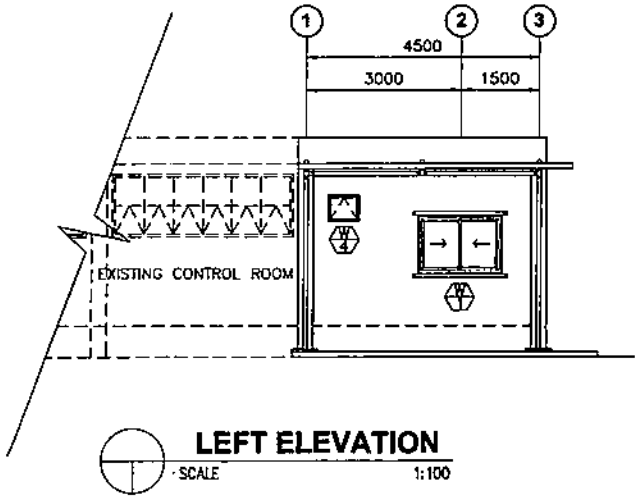
FRONT ELEVATION

SCALE 1:100



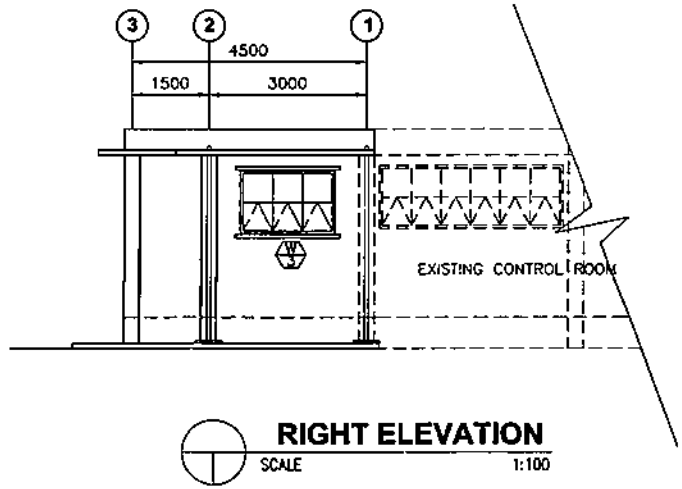
SECTION A

SCALE 1:100



LEFT ELEVATION

SCALE 1:100



RIGHT ELEVATION

SCALE 1:100

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

OWNER: NATIONAL POWER CORPORATION
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA

LOCATION: MARINAWA, BATO, CATANDUANES

TITLE: ELEVATIONS

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENG'R. / ARCHT.		
CIVIL/ARCHT			
ELEC.			
MECH.			

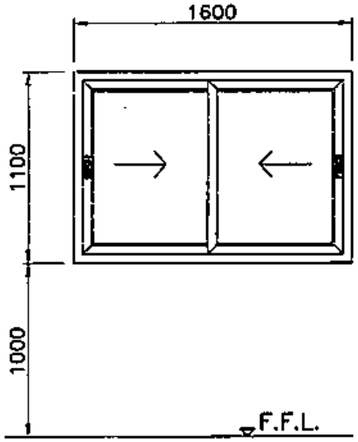
SUBMITTED: R. R. R. VILLANUEVA, Precinct Architect A, SEAD

RECOMMENDED: A. C. ESPIRITU, Manager, SAD

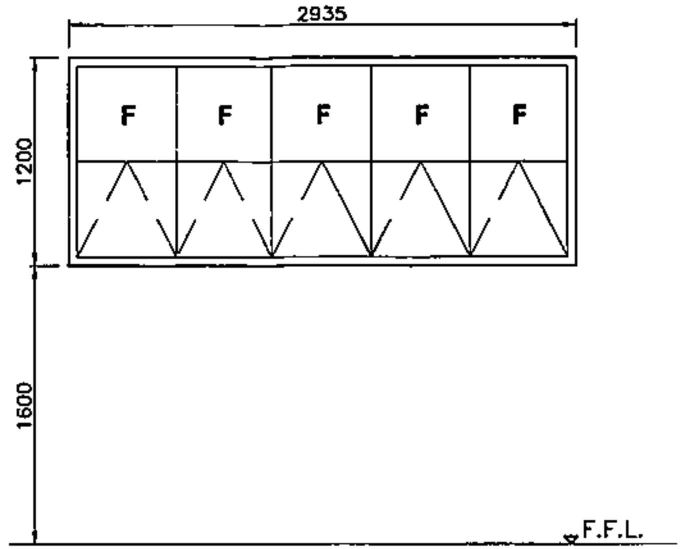
APPROVED: N. G. GONZALES, Manager, DDO

DWG. NO. UVSS-BDA-22.002 SPECS NO. LuzP22Z1478Se

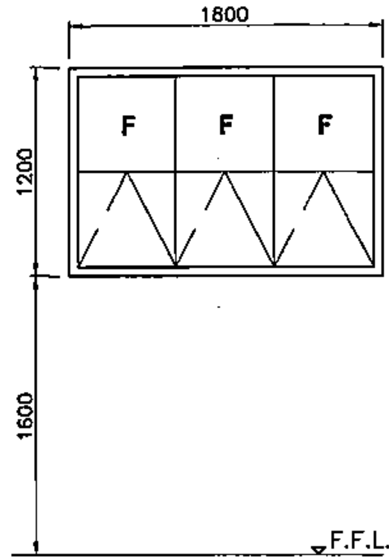
SCALE: AS SHOWN BID DRAWING REV. 0



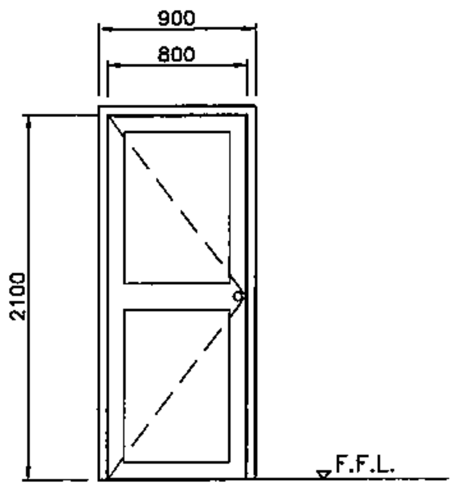
W1
: GLASS AND ALUM. SLIDING WINDOW
: 6MM THK. CLEAR GLASS ONE WHOLE PIECE PANEL
: HEAVY GAGE EXTRUDED, DARK COLOR
: 50X100MM ANODIZED ALUMINUM FRAME
: HEAVY DUTY MECHANISM



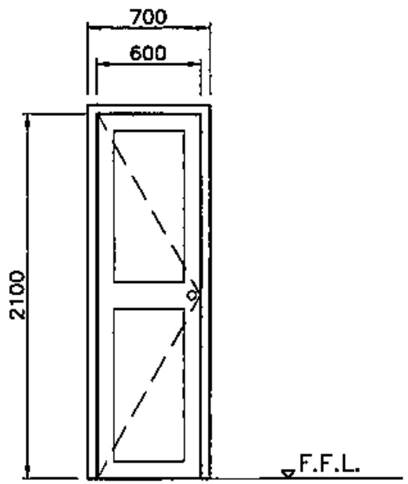
W2
: 1/8" X 7/8" ZEE BARS
: 5.6MM CLEAR GLASS
: AWNING AND FIX TYPE



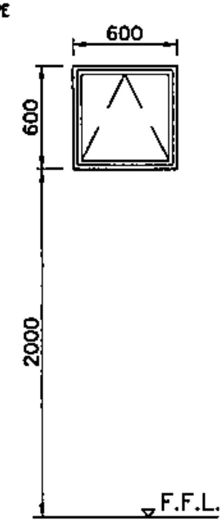
W3
: 1/8" X 7/8" ZEE BARS
: 5.6MM CLEAR GLASS
: AWNING AND FIX TYPE



D1
: PANEL TYPE WOOD DOOR
: 2 x 5 HARD WOOD JAMB
: 3 PIECES OF HEAVY DUTY LOOSE PIN HINGES
: ONE SET DOOR KNOB, WEATHERPROOF
: GLAZED LACQUER PAINT FINISH ON DOOR AND JAMB



D2
: FLUSH TYPE WOOD DOOR
: MARINE PLYWOOD BOTH SIDES
: 2 x 5 HARD WOOD JAMB
: 3 PIECES OF HEAVY DUTY LOOSE PIN HINGES
: ONE SET DOOR KNOB, WEATHERPROOF
: GLAZED LACQUER PAINT FINISH ON DOOR AND JAMB



W4
: GLASS AND ALUM. AWNING WINDOW
: 6MM THICK CLEAR GLASS ONE WHOLE PIECE PANEL
: HEAVY GAGE EXTRUDED,
: 50 X 100MM ANODIZED ALUMINUM FRAME
: HEAVY DUTY MECHANISM

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE INDICATED.
2. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS PRIOR TO CONSTRUCTION. THE NPC SHALL BE NOTIFIED OF ANY DISCREPANCIES OR INCONSISTENCIES.
3. DIMENSION SHALL TAKE PRECEDENCE OVER SCALED DRAWINGS.
4. PROVIDE MARINE PLYWOOD ~~FOR WINDOW~~ TYPHOON GUARD TO ALL WINDOWS.

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

OWNER: **NATIONAL POWER CORPORATION**
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA

LOCATION: MARINAWA, BATO, CATANDUANES

TITLE:

SCHEDULE OF DOORS AND WINDOWS

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENG'R. / ARCH'T.		
CIVIL/ARCH'T			
ELEC.			
MECH.			

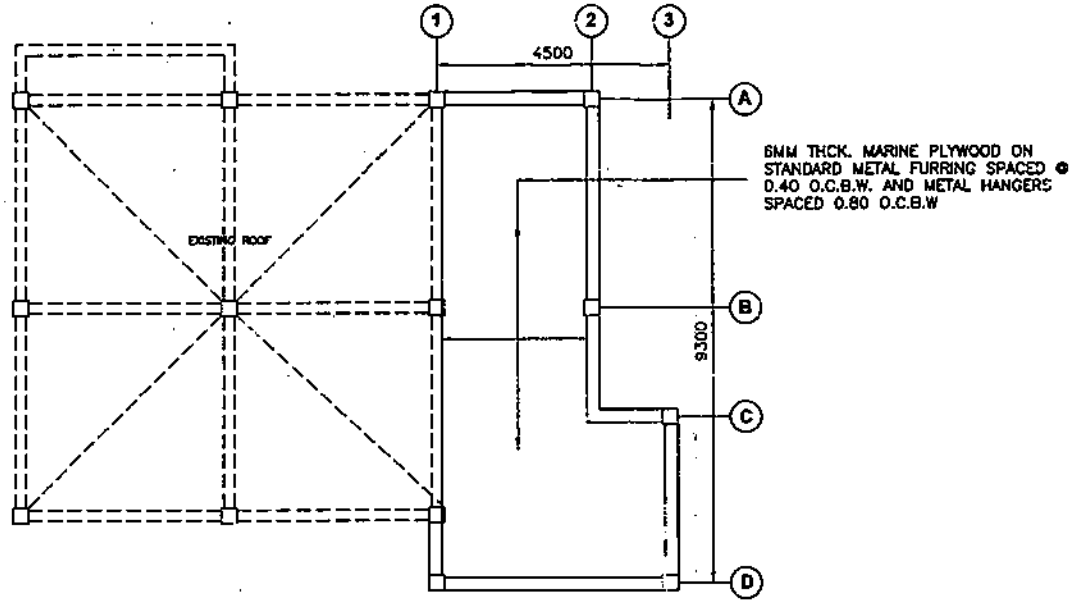
SUBMITTED: R. R. R. VILLANUEVA, Principal Architect A, CEAD

RECOMMENDED: A. C. ESPIRITU, Manager, CEAD

APPROVED: N. S. SOMBRERO, Manager, CDD

DWG. NO. UVSS-BDA-22.003 | SPECS NO. LuzP22Z1478Se

SCALE: AS SHOWN | **BID DRAWING** | REV. 0



REFLECTED CEILING PLAN

SCALE 1:100

OWNER: NATIONAL POWER CORPORATION
AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA

LOCATION: MARINAWA, BATO, CATANDUANES

TITLE: REFLECTED CEILING PLAN

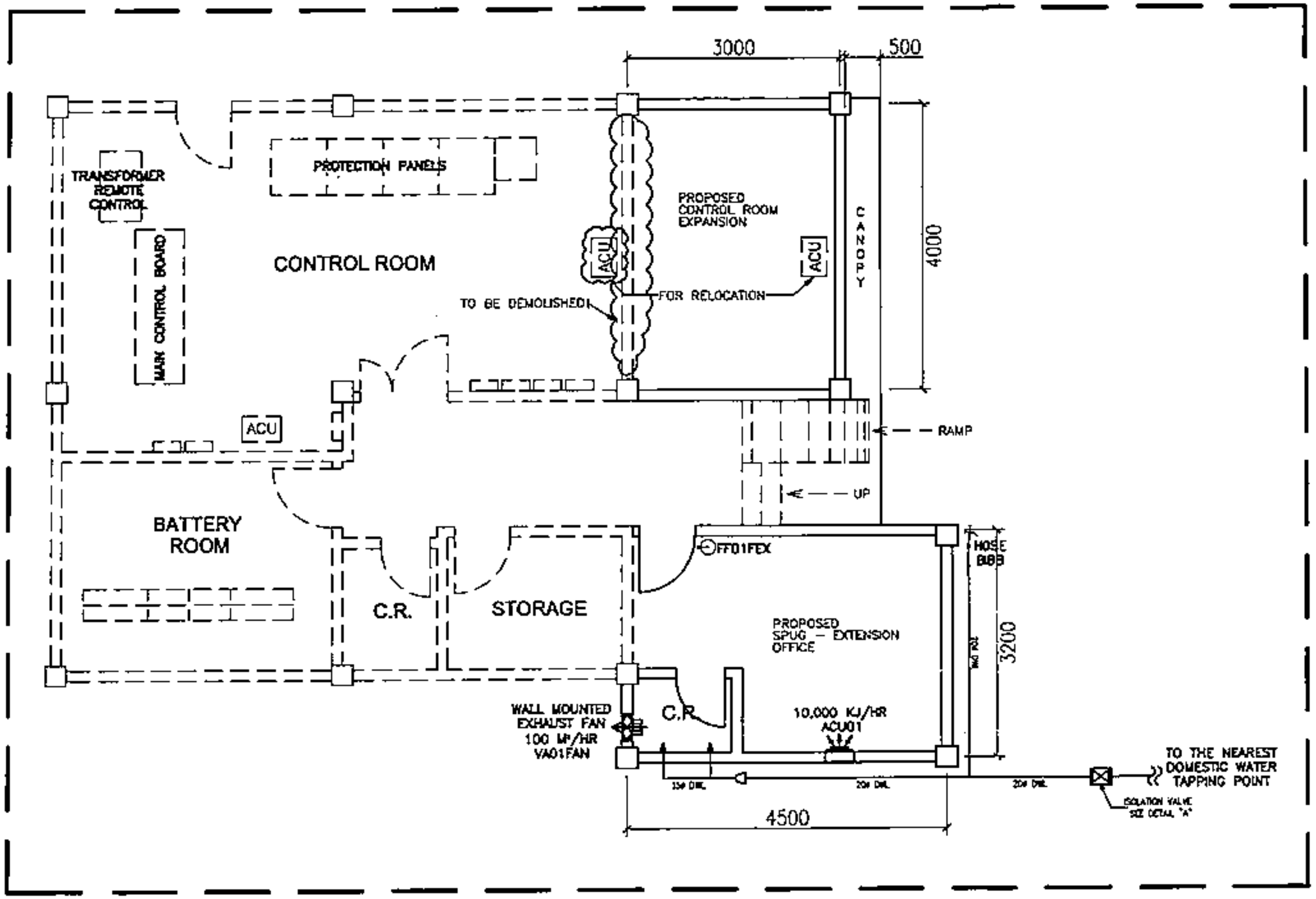
	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVISED	PRINCIPAL ENGR. / ARCHT.		
CIVIL/ARCHT			
ELEC.			
MECH.			

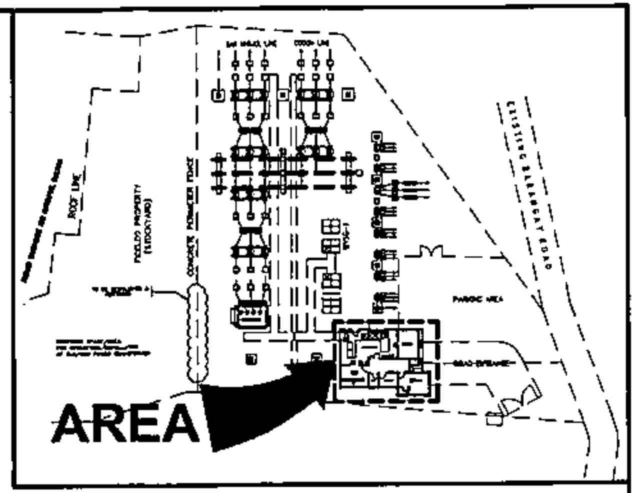
SUBMITTED: R. R. R. VILLANUEVA, Principal Architect A, EDD
RECOMMENDED: A. C. ESPIRITU, Manager, EDD
APPROVED: N. G. SOMBILLERA, Manager, EDD

DWG. NO. UVSS-BDA-22.004 SPECS NO. LuzP22Z1478Se

SCALE: AS SHOWN BID DRAWING REV. 0

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.



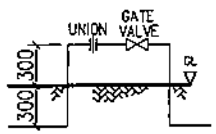


NOTES:

1. THIS DRAWING IS FOR BIDDING PURPOSES ONLY.
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
3. EQUIPMENT TO BE FURNISHED SHALL BE DESIGNED & CONSTRUCTED IN ACCORDANCE WITH THE REQUIREMENTS OF THE SPECIFICATIONS & SHALL FIT INTO THE SPACE AVAILABLE WITH PROPER REGARD TO ACCESSIBILITY, PASSAGEWAY, HANDLING AND STRUCTURE LIMITATIONS.
4. ALL WORKS SHALL BE DONE IN ACCORDANCE WITH THE REQUIREMENTS OF THE TECHNICAL SPECIFICATIONS.
5. ALL EXHAUST FAN AND AIRCONDITIONING EQUIPMENT BROCHURES/CATALOGUES SHALL BE SUBMITTED BY THE SUPPLIER, FOR NPC'S REVIEW AND APPROVAL, PRIOR TO PROCUREMENT/INSTALLATION.
6. ALL PIPES, CABLES, FITTINGS, AND ANGLE SUPPORTS SHALL BE INSTALLED FOR THE EFFICIENT AND PROPER OPERATION OF THE AIRCONDITIONING SYSTEM.
7. PIPING LAID UNDERGROUND SHALL NOT BE LESS THAN 300MM FROM THE GROUND SURFACE TO THE BOTTOM OF PIPE.
8. FOR PIPES THAT CROSSES ROADWAYS, PIPE SLEEVE OF STEEL MATERIAL SHALL BE PROVIDED.
9. ALL PIPES, VALVES, VALVE BOXES, FITTINGS, AND PIPE SUPPORTS SHALL BE INSTALLED FOR THE EFFICIENT AND PROPER OPERATION OF THE SYSTEM.
10. ALL PIPES, VALVES AND OTHER EQUIPMENT BROCHURES/CATALOGUES SHALL BE SUBMITTED BY THE SUPPLIER, FOR NPC'S REVIEW AND APPROVAL, PRIOR TO PROCUREMENT/INSTALLATION.
11. FINAL DETAILS AND ADJUSTMENT SHALL BE DONE IN THE FIELD BY THE SUPPLIER DURING INSTALLATION TO SUIT ACTUAL SITE CONDITIONS. ALL WORKS SHALL BE EXECUTED IN CLOSE COORDINATION WITH ALL TRADES.
12. ALL PVC/PE PIPE DIMENSIONS SHOWN ARE IN NOMINAL DIAMETER (MM) WITH THE FOLLOWING EQUIVALENTS:
    20MM (3/4") = 25MM O.D. (OUTSIDE DIAMETER)
    15MM (1/2") = 20MM O.D.

LEGEND:

- DWL – DOMESTIC WATER LINE
- ACU – AIR-CONDITIONING UNIT, FLOOR MOUNTED (FOR RELOCATION)
- AIR-CONDITIONING UNIT, INVERTER-WINDOW TYPE (10,000 KJ/HR)
- FIRE EXTINGUISHER, WALL-HUNG TYPE (HCFC OR HALOTRON I)
- EXISTING EQUIPMENT/STRUCTURES
- PROPOSED EQUIPMENT/STRUCTURES
- GATE VALVE
- EXHAUST FAN, WALL MOUNTED (100 M³/HR)



"ISOLATION VALVE" DETAIL "A"

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

OWNER: NATIONAL POWER CORPORATION
AGHAM ROAD, DILIMAN QUEZON CITY

PROJECT: UPRATING OF VIRAC (MARINAWA) SUBSTATION FROM 10MVA TO 20MVA

LOCATION: MARINAWA, BATO, CATANDUANES

TITLE: DOMESTIC WATER, AIR-CONDITIONING, VENTILATION AND FIREFIGHTING LAYOUT

	BY	CHKD	DATE
DESIGNED			
DRAWN			
REVIEWED	PRINCIPAL ENGR. / ARCHT.		
CIVIL/ARCHT			
ELEC.			
MECH.		MAN	

SUBMITTED: N. G. ESPAYOS, Principal Engineer A, MED

RECOMMENDED: J. A. [illegible] JR.

APPROVED: N. G. [illegible]RA, Manager, DDD

DWG. NO. UVSS-BDM-22.001 | SPECS. NO. LuzP22Z14735e

SCALE: 1:75 | BID DRAWING | REV 0