



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

BID DOCUMENTS

Name of Project : DESIGN, SUPPLY, DELIVERY, INSTALLATION,
TESTING AND COMMISSIONING OF PALANAN
SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS)

Project Location : CULASI, PALANAN, ISABELA

Specification No.: LuzP21Z1221Se | 40-P1B72 - 001 (P32)

Contents:

- | | |
|--------------|--|
| SECTION I | - INVITATION TO BID |
| SECTION II | - INSTRUCTION TO BIDDERS |
| SECTION III | - BID DATA SHEETS |
| SECTION IV | - GENERAL CONDITIONS OF THE CONTRACT |
| SECTION V | - SPECIAL CONDITIONS OF THE CONTRACT |
| SECTION VI | - TECHNICAL SPECIFICATIONS
PART I – TECHNICAL SPECIFICATIONS
PART II – TECHNICAL DATA SHEETS |
| SECTION VII | - SCHEDULE OF REQUIREMENTS |
| SECTION VIII | - BIDDING FORMS |
| SECTION IX | - BID DRAWINGS |

Design and Development Department



SECTION I

INVITATION TO BID



National Power Corporation

INVITATION TO BID

PUBLIC BIDDING – BCS 2022-0079

- The NATIONAL POWER CORPORATION (NPC), through its approved Corporate Budget of CY 2022 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-PIB22-001 / PB220110-JC00511 (PB2) Design, Supply, Delivery, Installation, Testing and Commissioning of Palanan Solar PV-Diesel Hybrid System (wit ESS)	Test and Commissioning of a Solar PV Power Plant of at least 50kWp	17 February 2022 9:30 A.M	01 March 2022 9:30 A.M	P 46,760,900.00 / P 25,000.00
Venue: Kaňao Function Room, NPC Bldg. Diliman, Quezon City				

- The NPC now invites bids for Item 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-PIB22-001	Two Hundred Fifteen (215) Calendar Days	Ten (10) Years

- 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.

- 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.
- 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.
- 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 for 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. A "No Face mask / No Full Face Shield / No Entry" policy shall be implemented in the NPC premises. Face mask shall be 3-ply surgical or KN95 mask type.
 - 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 on 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

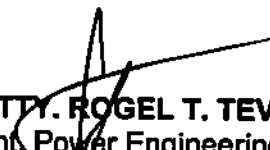
Tel Nos.: 8924-5211 and 8921-3541 local 5504

Fax No.: 8922-1622

Email: bcsd@napocor.gov.ph / bcsd_napocor@yahoo.com

12. You may visit the following websites:

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


ATTY. ROGEL T. TEVES
Vice President, Power Engineering Services and
Chairman, Bids and Awards Committee

SECTION II

INSTRUCTION TO BIDDERS

SECTION II – INSTRUCTIONS TO BIDDERS**TABLE OF CONTENTS**

<u>CLAUSE NO.</u>	<u>TITLE</u>	<u>PAGE NO.</u>
1.	SCOPE OF BID	1
2.	FUNDING INFORMATION.....	1
3.	BIDDING REQUIREMENTS	1
4.	CORRUPT, FRAUDULENT, COLLUSIVE, AND COERCIVE PRACTICES.....	1
5.	ELIGIBLE BIDDERS	1
6.	ORIGIN OF GOODS	2
7.	SUBCONTRACTS.....	2
8.	PRE-BID CONFERENCE.....	2
9.	CLARIFICATION AND AMENDMENT OF BIDDING DOCUMENTS.....	3
10.	DOCUMENTS COMPRISING THE BID: ELIGIBILITY AND TECHNICAL COMPONENTS	3
11.	DOCUMENTS COMPRISING THE BID: FINANCIAL COMPONENT	3
12.	BID PRICES	3
13.	BID AND PAYMENT CURRENCIES.....	4
14.	BID SECURITY	4
15.	SEALING AND MARKING OF BIDS	4
16.	DEADLINE FOR SUBMISSION OF BIDS.....	5
17.	OPENING AND PRELIMINARY EXAMINATION OF BIDS.....	5
18.	DOMESTIC PREFERENCE	5
19.	DETAILED EVALUATION AND COMPARISON OF BIDS	5
20.	POST-QUALIFICATION	6
21.	SIGNING OF THE CONTRACT	6

SECTION II – INSTRUCTIONS TO BIDDERS

1. Scope of Bid

The National Power Corporation (NPC or NAPOCOR) wishes to receive Bids for the DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS), with identification number LuzP21Z1221Se.

The Procurement Project (referred to herein as "Project") is composed of one (1) lot and will be awarded to one (1) Bidder in one complete contract, the details of which are described in Section VI (Technical Specifications).

2. Funding Information

2.1. The GOP through the source of funding as indicated below for CY 2021 in the amount specified in the Invitation to Bid.

2.2. The source of funding is the Corporate Operating Budget of the National Power Corporation.

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 Manuals 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 IB 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 verified and accepted the general requirements of this Project, including 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, and Coercive Practices

The Procuring Entity, as well as the Bidders and Suppliers, 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. Foreign ownership exceeding those allowed under the rules may participate when citizens, corporations, or associations of a country, included in the list issued by the GPPB, the laws or regulations of which grant reciprocal rights or privileges to citizens, corporations, or associations of the Philippines.

The foreign bidder claiming eligibility by reason of their country's extension of reciprocal rights to Filipinos shall submit a certification from the relevant government office of their country stating that Filipinos are allowed to participate in their government procurement activities for the same item/product. The said certification shall be validated during the post-qualification of bidders.

- 5.3. Pursuant to Section 23.4.1.3 of the 2016 revised IRR of RA No.9184, the Bidder shall have an SLCC that is at least one (1) contract similar to the Project the value of which, adjusted to current prices using the PSA's CPI, must be at least equivalent to at least fifty percent (50%) of the ABC.

- 5.4. The Bidders shall comply with the eligibility criteria under Section 23.4.1 of the 2016 IRR of RA No. 9184.

6. Origin of 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, subject to Domestic Preference requirements under ITB Clause 18.

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 twenty percent (20%) of the Project.

The portions of Project and the maximum percentage allowed to be subcontracted are indicated in the **BDS**, which shall not exceed twenty percent (20%) of the contracted Goods.

- 7.2. The Supplier may identify its subcontractor during the contract implementation stage. Subcontractors identified during the bidding may be changed during the implementation of this Contract. Subcontractors must submit the documentary requirements under Section 23.1 of the 2016 revised IRR of RA No. 9184 and comply with the eligibility criteria specified in ITB Clause 5 to the implementing or end-user unit.

- 7.3. Subcontracting of any portion of the Project does not relieve the Supplier 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 Supplier'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 Section VIII (NPCSF-GOODS-01 - Checklist of Technical and Financial Documents).

10.2. The Bidder's SLCC as indicated in ITB Clause 5.3 should have been completed within Ten (10) Years prior to the deadline for the submission and receipt of bids.

10.3. 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. Similar to the required authentication above, 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.

10.4. The Statement of the bidder's Single Largest Completed Contract (SLCC) (NPCSF-GOODS-03) and List of all Ongoing Government & Private Contracts Including Contracts Awarded but not yet Started (NPCSF-GOODS-02) shall comply with the documentary requirements specified 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 Section VIII (NPCSF-GOODS-01 - Checklist of Technical and Financial Documents).

11.2. If the Bidder claims preference as a Domestic Bidder or Domestic Entity, a certification issued by DTI shall be provided by the Bidder in accordance with Section 43.1.3 of the 2016 revised IRR of RA No. 9184.

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

11.4. 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. Bid Prices

12.1. Prices indicated on the Price Schedule shall be entered separately in the following manner:

- a. For Goods offered from within the Procuring Entity's country:

- i. The price of the Goods quoted EXW (ex-works, ex-factory, ex-warehouse, ex-showroom, or off-the-shelf, as applicable);
 - ii. The cost of all customs duties and sales and other taxes already paid or payable;
 - iii. The cost of transportation, insurance, and other costs incidental to delivery of the Goods to their final destination; and
 - iv. The price of other (incidental) services, if any, listed in the **BDS**.
- b. For Goods offered from abroad:
- i. Unless otherwise stated in the **BDS**, the price of the Goods shall be quoted delivered duty paid (DDP) with the place of destination in the Philippines as specified in the **BDS**. In quoting the price, the Bidder shall be free to use transportation through carriers registered in any eligible country. Similarly, the Bidder may obtain insurance services from any eligible source country.
 - ii. The price of other (incidental) services, if any, as listed in the **BDS**.

13. Bid and Payment Currencies

13.1. For Goods that the Bidder will supply from outside the Philippines, the 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.

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

14. Bid Security

14.1. 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**.

14.2. The Bid and bid security shall be valid for **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.

15. Sealing and Marking of Bids

Each Bidder shall submit one copy of the first and second components of its Bid.

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 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.

16. Deadline for Submission of Bids

16.1. 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.

17. Opening and Preliminary Examination of Bids

17.1. 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.

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

18. Domestic Preference

18.1. The Procuring Entity will grant a margin of preference for the purpose of comparison of Bids in accordance with Section 43.1.2 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 the 2016 revised IRR of RA No. 9184.

19.2. If the Project allows partial bids, bidders may submit a proposal on any of the lots or items, and evaluation will be undertaken on a per lot or item basis, as the case maybe. In this case, the Bid Security as required by ITB Clause 14 shall be submitted for each lot or item separately.

19.3. The descriptions of the lots or items shall be indicated in **Section VI (Technical Specifications)**, although the ABCs of these lots or items are indicated in the **BDS** for purposes of the NFCC computation pursuant to Section 23.4.2.6 of the 2016 revised IRR of RA No. 9184. The NFCC must be sufficient for the total of the ABCs for all the lots or items participated in by the prospective Bidder.

19.4. The Project shall be awarded to one (1) Bidder in one complete contract.

19.5. Except for bidders submitting a committed Line of Credit from a Universal or Commercial Bank in lieu of its NFCC computation, all Bids must include the NFCC computation pursuant to Section 23.4.1.4 of the 2016 revised IRR of RA

No. 9184, which must be sufficient for the total of the ABCs for all the lots or items participated in by the prospective Bidder. For bidders submitting the committed Line of Credit, it must be at least equal to ten percent (10%) of the ABCs for all the lots or items participated in by the prospective Bidder.

20. Post-Qualification

- 20.1. 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

- 21.1. 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	
5.3	<p>For this purpose, similar contracts shall refer to Test and Commissioning of a Solar PV Power Plant of at least 50kWp.</p> <p>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.</p> <p>It shall be a ground for disqualification, if verification and validation cannot be conducted for reasons attributable to the Bidder.</p>
7.1	<p>Subcontracting may be allowed on transport, local/non-skilled labor under the supervision of the Bidder. The Bidder shall not be relieved from any liability or obligation that may arise from the performance of the Subcontractor.</p>
10.4	<p>The list of on-going contracts (Form No. NPCSF-GOODS-02) shall be supported by the following documents for each on-going contract to be submitted during Post-Qualification:</p> <ol style="list-style-type: none"> 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 <p>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.</p> <p>The Statement of the bidder's Single Largest Completed Contract (SLCC) similar to the contract to be bid (Form No. NPCSF-GOODS-03) shall be supported by the following documents to be submitted during Bid Opening:</p> <ol style="list-style-type: none"> 1. Contract/Purchase Order 2. Certificate of Acceptance; or Certificate of Completion; or Official Receipt (O.R); or Sales Invoice <p>The prospective bidders shall declare its Joint Venture partner during the purchase of bid/tender documents. 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. Failure to do so shall be a ground for disqualification/non-acceptance of its bid.</p>

10.5	<p>Bidders shall also submit the following requirements in their first envelope, Eligibility and Technical Component of their bid:</p> <ol style="list-style-type: none"> 1. Drawings and documents to be submitted with the Bid as specified in Clause GW-12.2 of Section VI - Technical Specifications (GW-General Works) 2. Complete eligibility documents of the proposed sub-contractor, if any
12	The price of the Goods shall be quoted DDP Project Site or the applicable International Commercial Terms (INCOTERMS) for this Project.
14.1	<p>The bid security shall be in the form of a Bid Securing Declaration, or any of the following forms and amounts:</p> <ol style="list-style-type: none"> a) The amount of not less two percent (2%) of ABC, if bid security is in cash, cashier's/manager's check, bank draft/guarantee or irrevocable letter of credit; or b) The amount of not less than five percent (5%) of ABC, if bid security is in Surety Bond.
19.3	<p>The Goods are grouped together in one (1) lot and will be awarded to one (1) Bidder in one complete contract.</p> <p>Partial bid is not allowed. The Goods are grouped in a single lot and the lot shall not be divided into sub-lots for the purpose of bidding, evaluation, and contract award.</p> <p>The Bidders bid offer must be within the ABC of the lot.</p> <p>Bid offers that exceed the ABC of the lot or with incomplete price, shall be rejected.</p>
19.5	If the Bidder opted to submit a Committed Line of Credit (CLC), the bidder must submit a granted credit line valid/effective at the date of bidding.
20.1	<p>Additional documents to be submitted during Post-Qualification:</p> <ol style="list-style-type: none"> a. 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-GOODS-02); b. 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-GOODS-02; c. Drawings and documents to be submitted during post-qualification process as specified in Section VI – Part II (Technical Data Sheets – Electrical Works, EW) <p>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,</p>

	<p>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.</p> <p>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.</p>
20.2	The licenses and permits relevant to the Project and the corresponding law requiring it as specified in the Technical Specifications, if any.
21.2	Notice to Proceed.

SECTION IV

GENERAL CONDITIONS OF THE CONTRACT

SECTION IV – GENERAL CONDITIONS OF CONTRACT**TABLE OF CONTENTS**

<u>CLAUSE NO.</u>	<u>TITLE</u>	<u>PAGE NO.</u>
1.	SCOPE OF CONTRACT.....	1
2.	ADVANCE PAYMENT AND TERMS OF PAYMENT.....	1
3.	PERFORMANCE SECURITY	1
4.	INSPECTION AND TESTS	1
5.	WARRANTY	2
6.	LIABILITY OF THE SUPPLIER	2

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.

Additional requirements for the completion of this Contract shall be provided in the **Special Conditions of Contract (SCC)**.

2. Advance Payment and Terms of Payment

- 2.1. Advance payment of the contract amount is provided under Annex "D" of the revised 2016 IRR of RA No. 9184.
- 2.2. The Procuring Entity is allowed to determine the terms of payment on the partial or staggered delivery of the Goods procured, provided such partial payment shall correspond to the value of the goods delivered and accepted in accordance with prevailing accounting and auditing rules and regulations. The terms of payment are indicated in the **SCC**.

3. Performance Security

- 3.1. Within ten (10) calendar days from receipt of the Notice of Award by the Bidder 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 of RA No. 9184.
- 3.2. The performance bond to be posted by the Contractor must also comply with additional requirements specified in the **SCC**.

4. Inspection and Tests

The Procuring Entity or its representative shall have the right to inspect and/or to test the Goods to confirm their conformity to the Project specifications at no extra cost to the Procuring Entity in accordance with the Generic Procurement Manual. In addition to tests in the **SCC, Section VI (Technical Specifications)** shall specify what inspections and/or tests the Procuring Entity requires, and where they are to be

conducted. The Procuring Entity shall notify the Supplier in writing, in a timely manner, of the identity of any representatives retained for these purposes. All reasonable facilities and assistance for the inspection and testing of Goods, including access to drawings and production data, shall be provided by the Supplier to the authorized inspectors at no charge to the Procuring Entity.

5. Warranty

- 5.1 In order to assure that manufacturing defects shall be corrected by the Supplier, a warranty shall be required from the Supplier as provided under Section 62.1 of the 2016 revised IRR of RA No. 9184.
- 5.2 The Procuring Entity shall promptly notify the Supplier in writing of any claims arising under this warranty. Upon receipt of such notice, the Supplier shall, repair or replace the defective Goods or parts thereof without cost to the Procuring Entity, pursuant to the Generic Procurement Manual.

6. Liability of the Supplier

The Supplier's liability under this Contract shall be as provided by the laws of the Republic of the Philippines.

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

SECTION V

SPECIAL CONDITIONS OF THE CONTRACT

SECTION V – SPECIAL CONDITIONS OF CONTRACT

GCC Clause	
1	<p>Delivery and Documents –</p> <p>The delivery terms applicable to the Contract is DDP delivered to the project site specified in the technical specifications, in accordance with INCOTERMS. Risk and title will pass from the Supplier to the Procuring Entity upon receipt and final acceptance of the Goods at their final destination.</p> <p>Delivery of the Goods shall be made by the Supplier in accordance with the terms specified in Section VI – Technical Specifications. The details of shipping and/or other documents to be furnished by the Supplier are as follows:</p> <p><i>For Goods supplied from within the Philippines</i></p> <p>Upon delivery of the Goods to the Project Site, the Supplier shall notify the Procuring Entity and present the following documents to the Procuring Entity:</p> <ul style="list-style-type: none"> (i) Original and four copies of the Supplier's invoice showing Goods' description, quantity, unit price, and total amount; (ii) Original and four copies of Supplier's factory test/inspection report; (iii) Original and four copies of the certificate of origin (for imported Goods); (iv) Delivery receipt detailing number and description of items received signed by the Procuring Entity's representative at the Project Site; (v) Certificate of Completion/Inspection Report signed by the Procuring Entity's representative at the Project Site; (vi) Original and four copies of the Inspection Receiving Report signed by the Procuring Entity's representative at the Project Site; (vii) Original and four copies of the Manufacturer's and/or Supplier's warranty certificate; and (viii) Documents specified in the Technical Specifications, if any. <p><i>For Goods supplied from abroad:</i></p> <p>Upon shipment, the Supplier shall notify the Procuring Entity and the insurance company by e-mail the full details of the shipment, including Contract Number, description of the Goods, quantity, vessel, bill of lading number and date, port of loading, date of shipment, port of discharge etc. Upon delivery to the Project Site, the Supplier shall notify the Procuring Entity and present the following documents as applicable with the documentary requirements of any letter of credit issued taking precedence:</p>

- (i) Original and four copies of the Supplier's invoice showing Goods' description, quantity, unit price, and total amount;
- (ii) Original and four copies of the negotiable, clean shipped on board bill of lading marked "freight pre-paid" and five copies of the non-negotiable bill of lading ;
- (iii) Original and four copies of Supplier's factory test/inspection report;
- (iv) Delivery receipt detailing number and description of items received signed by the Procuring Entity's representative at the Project Site;
- (v) Certificate of Completion/Inspection Report signed by the Procuring Entity's representative at the Project Site;
- (vi) Original and four copies of the Inspection Receiving Report signed by the Procuring Entity's representative at the Project Site;
- (vii) Original and four copies of the certificate of origin (for imported Goods); and
- (viii) Original and four copies of the Manufacturer's and/or Supplier's warranty certificate including all other documents specified in the Technical Specifications, if any.

For purposes of this Clause the Procuring Entity's Representative at the Project Site is Vice President - Small Power Utilities Group.

Incidental Services –

The Supplier is required to provide all of the following services, including additional services, if any, specified in Section VI. Schedule of Requirements:

- a. performance or supervision of on-site assembly and/or start-up of the supplied Goods;
- b. furnishing of tools required for assembly and/or maintenance of the supplied Goods;
- c. furnishing of a detailed operations and maintenance manual for each appropriate unit of the supplied Goods;
- d. performance or supervision or maintenance and/or repair of the supplied Goods, for a period of time agreed by the parties, provided that this service shall not relieve the Supplier of any warranty obligations under this Contract; and
- e. training of the Procuring Entity's personnel, at the Supplier's plant and/or on-site, in assembly, start-up, operation, maintenance, and/or repair of the supplied Goods.

- f. Additional requirements specified in Section VI – Technical Specifications, if any.

The Contract price for the Goods shall include the prices charged by the Supplier for incidental services and shall not exceed the prevailing rates charged to other parties by the Supplier for similar services.

Spare Parts –

The Supplier is required to provide all of the following materials, notifications, and information pertaining to spare parts manufactured or distributed by the Supplier:

1. such spare parts as the Procuring Entity may elect to purchase from the Supplier, provided that this election shall not relieve the Supplier of any warranty obligations under this Contract; and
2. in the event of termination of production of the spare parts:
 - i. advance notification to the Procuring Entity of the pending termination, in sufficient time to permit the Procuring Entity to procure needed requirements; and
 - ii. following such termination, furnishing at no cost to the Procuring Entity, the blueprints, drawings, and specifications of the spare parts, if requested

The spare parts and other components required are listed in **Section VI (Technical Specifications)** and **Section VII (Schedule of Requirements/Bid Price Schedule)** and the costs thereof are included in the contract price.

The Supplier shall carry sufficient inventories to assure ex-stock supply of consumable spare parts or components for the Goods for the period specified in the Technical Specifications.

Spare parts or components shall be supplied as promptly as possible, but in any case, within three (3) months of placing the order.

Packaging –

The Supplier shall provide such packaging of the Goods as is required to prevent their damage or deterioration during transit to their final destination, as indicated in this Contract. The packaging shall be sufficient to withstand, without limitation, rough handling during transit and exposure to extreme temperatures, salt and precipitation during transit, and open storage. Packaging case size and weights shall take into consideration, where appropriate, the remoteness of the Goods' final destination and the absence of heavy handling facilities at all points in transit.

The packaging, marking, and documentation within and outside the packages shall comply strictly with such special requirements as shall be expressly provided for in the Contract, including additional requirements, if any, specified below, and in any subsequent instructions ordered by the Procuring Entity.

	<p>The outer packaging must be clearly marked on at least four (4) sides as follows:</p> <p>Name of the Procuring Entity Name of the Supplier Contract Description Final Destination Gross weight Any special lifting instructions Any special handling instructions Any relevant HAZCHEM classifications</p> <p>A packaging list identifying the contents and quantities of the package is to be placed on an accessible point of the outer packaging if practical. If not practical the packaging list is to be placed inside the outer packaging but outside the secondary packaging.</p> <p>Transportation –</p> <p>Where the Supplier is required under Contract to deliver the Goods CIF, CIP, or DDP, transport of the Goods to the port of destination or such other named place of destination in the Philippines, as shall be specified in this Contract, shall be arranged and paid for by the Supplier, and the cost thereof shall be included in the Contract Price.</p> <p>Where the Supplier is required under this Contract to transport the Goods to a specified place of destination within the Philippines, defined as the Project Site, transport to such place of destination in the Philippines, including insurance and storage, as shall be specified in this Contract, shall be arranged by the Supplier, and related costs shall be included in the contract price.</p> <p>Where the Supplier is required under Contract to deliver the Goods CIF, CIP or DDP, Goods are to be transported on carriers of Philippine registry. In the event that no carrier of Philippine registry is available, Goods may be shipped by a carrier which is not of Philippine registry provided that the Supplier obtains and presents to the Procuring Entity certification to this effect from the nearest Philippine consulate to the port of dispatch. In the event that carriers of Philippine registry are available but their schedule delays the Supplier in its performance of this Contract the period from when the Goods were first ready for shipment and the actual date of shipment the period of delay will be considered force majeure.</p> <p>The Procuring Entity accepts no liability for the damage of Goods during transit other than those prescribed by INCOTERMS for DDP deliveries. In the case of Goods supplied from within the Philippines or supplied by domestic Suppliers risk and title will not be deemed to have passed to the Procuring Entity until their receipt and final acceptance at the final destination.</p>
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	<p>Intellectual Property Rights –</p> <p>The Supplier shall indemnify the Procuring Entity against all third-party claims of infringement of patent, trademark, or industrial design rights arising from use of the Goods or any part thereof.</p>
2.0	The applicable Terms of Payment for this Contract is Clause 2.2, Item No. 3.
2.2	<p>Advance payment not to exceed fifteen percent (15%) of the contract amount shall be allowed and paid within sixty (60) calendar days from effectivity of the contract and upon the submission to and acceptance by the Procuring Entity of an irrevocable letter of credit or bank guarantee issued by a Universal or Commercial Bank. The irrevocable letter of credit or bank guarantee must be for an equivalent amount, shall remain valid until the goods are delivered, and accompanied by a claim for advance payment.</p> <p>All progress payments shall first be charged against the advance payment until the latter has been fully exhausted.</p> <p>The terms of payment shall be as follows:</p> <p>1) For Supply and Delivery Pay items:</p> <p>(a) On Contract Effectivity: Advance payment of Fifteen percent (15%) of the total Contract Price shall be paid within sixty (60) days from effectivity of the Contract and upon submission of a claim and an irrevocable letter of credit or bank guarantee issued by a Universal or Commercial Bank for the equivalent amount valid until the Goods are delivered and in the form provided in Section VIII- Bidding Forms.</p> <p>(b) On Delivery: Eighty percent (80%) of the Contract Price of the delivered Goods shall be considered for payment, less the total amount of advance payment, if any and other deductions. If the amount is sufficient to fully recoup the advance payment, the remainder after deductions shall be paid to the Supplier within sixty (60) days after the date of receipt of the Goods and upon submission of the documents (i) through (vi) specified in the <u>SCC</u> provision on Delivery and Documents. Otherwise, the total delivery payment shall be charged against the advance payment and the remaining advance payment will be fully recouped from the succeeding claims.</p> <p>(c) On Acceptance: The remaining twenty percent (20%) of the Contract Price of the delivered Goods shall be paid to the Supplier within sixty (60) days after the date of submission of the acceptance and inspection certificate for the respective delivery issued by the Procuring Entity's authorized representative. In the event that no acceptance certificate is issued by the Procuring Entity's authorized representative within forty five (45) days after successful test and commissioning, if required, the Supplier shall have the right to claim payment of the remaining twenty percent (20%) subject to the Procuring Entity's own verification of the reason(s) for the failure to issue documents (vii) and (viii) as described in the <u>SCC</u> provision on Delivery and Documents.</p>

2) For Supply, Delivery, Installation, Test and Commissioning Pay Items:

- (a) On Contract Effectivity: Advance payment of Fifteen percent (15%) of the total Contract Price shall be paid within sixty (60) days from effectivity of the Contract and upon submission of a claim and an irrevocable letter of credit or bank guarantee issued by a Universal or Commercial Bank for the equivalent amount valid until the Goods are delivered and in the form provided in Section VIII- Bidding Forms.
- (b) On Delivery: Eighty percent (80%) of the price of the **delivered Goods**, excluding price for installation, test and commissioning shall be considered for payment, less the total amount of advance payment, if any and other deductions. If the amount is sufficient to fully recoup the advance payment, the remainder after deductions shall be paid to the Supplier within sixty (60) days after the date of receipt of the Goods and upon submission of the documents (i) through (vi) specified in the SCC provision on Delivery and Documents. Otherwise, the total delivery payment shall be charged against the advance payment and the remaining advance payment will be fully recouped from the succeeding claims.
- (c) On Acceptance: The remaining twenty percent (20%) of the price of the **delivered Goods** plus price for installation, test and commissioning shall be paid to the Supplier within sixty (60) days after the date of submission of the acceptance and inspection certificate for the respective delivery issued by the Procuring Entity's authorized representative. In the event that no acceptance certificate is issued by the Procuring Entity's authorized representative within forty five (45) days after successful test and commissioning, the Supplier shall have the right to claim payment subject to the Procuring Entity's own verification of the reason(s) for the failure to issue documents (vii) and (viii) as described in the SCC provision on Delivery and Documents.

3) For Supply, Delivery, Installation, Test and Commissioning Contracts where Installation, Test and Commissioning prices are included in the supply price:

- (a) On Contract Effectivity: Advance payment of Fifteen percent (15%) of the total Contract Price shall be paid within sixty (60) days from effectivity of the Contract and upon submission of a claim and an irrevocable letter of credit or bank guarantee issued by a Universal or Commercial Bank for the equivalent amount valid until the Goods are delivered and in the form provided in Section VIII- Bidding Forms.
- (b) On Delivery: Sixty percent (60%) of the price of the **delivered Goods** shall be considered for payment, less the total amount of advance payment, if any and other deductions. If the amount is sufficient to fully recoup the advance payment, the remainder after deductions shall be paid to the Supplier within sixty (60) days after the date of receipt of the Goods and upon submission of the documents (i) through (vi) specified in the SCC provision on Delivery and Documents. Otherwise, the total delivery payment shall be charged against the advance

	<p>payment and the remaining advance payment will be fully recouped from the succeeding claims.</p> <p>(c) On Acceptance: The remaining forty percent (40%) of the price of the delivered Goods shall be paid to the Supplier within sixty (60) days after the date of submission of the acceptance and inspection certificate for the respective delivery issued by the Procuring Entity's authorized representative. In the event that no acceptance certificate is issued by the Procuring Entity's authorized representative within forty five (45) days after successful test and commissioning, the Supplier shall have the right to claim payment subject to the Procuring Entity's own verification of the reason(s) for the failure to issue documents (vii) and (viii) as described in the <u>SCC</u> provision on Delivery and Documents</p>
3.2	<ol style="list-style-type: none"> 1. The following must be indicated in the performance bond to be posted by the Supplier: <ol style="list-style-type: none"> i. Company Name ii. Correct amount of the Bond iii. Contract/Purchase Order Reference Number iv. Purpose of the Bond: <p>"To guarantee the faithful performance of the Principal's obligation to undertake <u>(Contract/Purchase Order Description)</u> in accordance with the terms and conditions of <u>(Contract No. & Schedule/Purchase Order No.)</u> entered into by the parties."</p> 2. The bond shall remain valid and effective until the duration of the contract <u>(should be specific date reckoned from the contract effectivity)</u> 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 SUPPLIER 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 SUPPLIER 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: <ol style="list-style-type: none"> 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;

	<p>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;</p> <p>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.</p>
4	The inspections and tests that will be conducted are specified in the Technical Specifications.
5	Guarantee for Additional Equipment Warranties are also specified in Section VI - Part I, Technical Specifications, Clause 19.0-General Works (GW) and Clauses 2.5 & 3.8 - Electrical Works (EW)
6	<p>Aside from the Liquidated Damages, the PROCURING ENTITY shall also implement the following additional penalties:</p> <p>1. Penalty for Failure to Meet Transformer Guarantees</p> <p>Aside from the Liquidated Damages, the PROCURING ENTITY shall also impose a penalty in case the supplier fails to meet Transformer Guarantees.</p> <p>The penalty to be imposed to the Supplier shall be in accordance with Section VI - Part I, Technical Specifications, Clauses 1.10.9 and 2.4.7.9 - Electrical Works (EW).</p> <p>2. Penalty for failing to attend the requested maintenance/repair service</p> <p>Aside from the Liquidated Damages and Penalty for Failure to Meet Transformer Guarantees, the PROCURING ENTITY shall also impose a penalty in the event that undue delay is being caused by the Supplier for failing to attend the requested maintenance/repair services within ten (10) calendar days during the warranty period.</p> <p>The penalty to be imposed to the Supplier shall be in accordance with Section VI - Part I, Technical Specifications, Clause 19.0 - General Works (GW).</p>

SECTION VI

TECHNICAL SPECIFICATIONS

SECTION VI

PART I-TECHNICAL SPECIFICATIONS

GW – GENERAL WORKS

AW – ARCHITECTURAL WORKS

CW – CIVIL WORKS

EW – ELECTRICAL WORKS

MW – MECHANICAL WORKS

SECTION VI

**PART I-TECHNICAL
SPECIFICATIONS**

GENERAL WORKS

PART I – TECHNICAL SPECIFICATIONS**GW – GENERAL WORKS****TABLE OF CONTENTS**

<u>CLAUSE NO.</u>	<u>TITLE</u>	<u>PAGE NO.</u>
GW-1.0	PROJECT DESCRIPTION	1
GW-2.0	PROJECT LOCATION	1
GW-3.0	PROJECT DURATION.....	2
GW-4.0	SITE INSPECTION.....	2
GW-5.0	DESIGN AND DUTY CONDITIONS	2
GW-6.0	SUPPLIER'S SCOPE OF WORKS	3
GW-6.1	Hybrid System	4
GW-6.2	Operation and Maintenance	6
GW-6.3	Other Allied Services.....	6
GW-6.4	Design Requirements.....	7
GW-6.5	Solar PV Mounting Structures and Required Civil Works and Installations.....	8
GW-7.0	SPARE PARTS.....	9
GW-8.0	TOOLS AND APPLIANCES.....	10
GW-9.0	FIRE FIGHTING SYSTEM.....	12
GW-10.0	INSTALLATION REQUIREMENTS.....	12
GW-11.0	PACKING, SHIPMENT AND STORAGE.....	14
GW-11.1	Packing/Crating	14
GW-11.2	Shipment/Transport	16
GW-11.3	Storage	16
GW-12.0	DOCUMENTS/DRAWINGS AND INSTRUCTION MANUALS	17
GW-12.1	Drawings Contained in the Tender Document	17
GW-12.2	Drawings and Documents to be Submitted with the Bid	18
GW-12.3	Supplier's/Manufacturer's Drawings.....	18
GW-12.3.1	General and Detailed Drawings and Specifications for Electrical Equipment	19
GW-12.3.2	General and Detailed Drawings and Specifications for Civil works.....	19
GW-12.3.3	As-Built Drawings.....	20
GW-12.3.4	Processing of Drawings/Documents.....	20
GW-12.4	Instruction Manuals	21
GW-12.5	Working Plan.....	23
GW-12.6	Bar Chart.....	23
GW-12.7	Progress Report	23
GW-12.8	Documents for NPC's Records	24



SECTION VI – TECHNICAL SPECIFICATIONS

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GW-13.0	INSPECTION AND TESTS	24
GW-13.1	General.....	24
GW-13.2	Tests at Supplier's Premises.....	25
	GW-13.2.1 Inspection at Supplier's Premises	25
	GW-13.2.2 Factory Tests.....	25
GW-13.3	Pre-Commissioning/Commissioning Test.....	26
	GW-13.3.1 General.....	26
	GW-13.3.2 Pre-Commissioning Test for Supplied Equipment.....	27
	GW-13.3.3 Commissioning Test	27
GW-13.4	Performance Tests.....	27
	GW-13.4.1 Solar PV Power System	28
	GW-13.4.2 ESS Performance Test.....	29
	GW-13.4.3 PEMS Performance Test.....	30
	GW-13.4.4 13.8kV Tie Line.....	30
GW-13.5	Reliability Test (10 days).....	30
GW-13.6	Tests Failures.....	31
GW-13.7	Test Reports/Certificates.....	31
GW-13.8	Waiver of Factory Tests Witnessing/Inspection by NPC for Equipment to be Furnished by the Supplier.....	31
GW-14.0	TRAINING OF NPC PERSONNEL.....	32
GW-14.1	General.....	32
GW-14.2	Operation and Maintenance Training at Site.....	32
GW-14.3	Operating and Configuration Editor Software Program.....	33
GW-15.0	CORROSION PROTECTION AND PAINTING.....	33
GW-15.1	General.....	33
GW-15.2	Treatment for Shipping	34
GW-15.3	Application of Paint.....	34
GW-15.4	Hot Dip Galvanizing.....	35
GW-16.0	QUALITY ASSURANCE REQUIREMENTS.....	35
GW-16.1	General.....	35
GW-16.2	Quality Assurance Program.....	36
GW-16.3	Quality Plan	36
GW-16.4	Records.....	36
GW-16.5	Reporting and Corrective Action.....	37
GW-17.0	MEASUREMENT OF PAYMENT	37
GW-18.0	CERTIFICATE OF COMPLETION AND ACCEPTANCE	37
GW-19.0	GUARANTEE.....	37



PART I – TECHNICAL SPECIFICATIONS

GW –GENERAL WORKS

GW-1.0 PROJECT DESCRIPTION

This specification covers the general technical and associated requirements for the Design, Supply, Delivery, Installation, Testing and Commissioning of Palanan Solar PV - Diesel Hybrid System with Energy Storage System (ESS). Also included in this document are the specifications for, but not limited to, the 13.8kV tie line, solar panels, string inverters, energy storage system, monitoring system, control & instrumentation system, lighting system, lightning protection and grounding system, structural support, appropriate interconnection lines and its appurtenances and metering systems for the safe and reliable operation of the Solar Hybrid Power System.

Other materials and parts which are not specifically mentioned herein but are necessary for the proper assembly, installation, and safe operation of the equipment shall be furnished including special tools and all required spare parts and consumables during the warranty period.

Equipment shall essentially be the standard products of the manufacturer which best meets the applicable international and regulatory standards. The Supplier shall accept full responsibility for its work in the design, installation, performance, qualifications, specifications, documentation, reports, fabrication, corrosion protection, shop testing and materials handling. Field testing and commissioning including the warranty provisions shall comply with the applicable standards and the requirements of this specification.

Workmanship shall be of first-class quality and in accordance with the best modern design practice for the manufacture, installation, assembly and test of all equipment and materials, notwithstanding any omissions from the specifications and drawings. Only qualified technicians shall be employed by the Supplier.

All necessary corrections and deviations from the specifications of the equipment arising either from error in the workmanship or design made by the Manufacturer/Supplier with the resulting extra expenses and related damages shall be solely charged to the account of the Supplier.

GW-2.0 PROJECT LOCATION

The Solar PV-Diesel Hybrid Systems (with ESS) is located in Palanan, Isabela.

Table 1.0 below shows the existing mode of transport from Manila to project site, subject to verification by the supplier.



TABLE 1.0

EXISTING MODE OF TRANSPORT TO PALANAN SOLAR PV PLANT			
PLANT	1	2	3
1. Palanan Solar PV-Diesel Hybrid System, Palanan, Isabela	L Manila to Dingalan Port, Aurora	S-S Dingalan Port, Aurora to Palanan Port, Isabela	L Palanan Port, Isabela to Site
NOTES: L – Land Travel; S – Sea Travel; S-S – Special Trip Sea Travel			

GW-3.0 PROJECT DURATION

The contract period shall be **two hundred fifteen (215) calendar days** reckoned from the receipt of Notice to Proceed inclusive of Twenty (20) unworkable days considered unfavorable for the execution of the works. The equipment shall be delivered, installed, tested and commissioned at the Palanan Solar PV site and Palanan DPP. The Supplier shall be responsible for taking reference to its accessibility, means of transportation and all other factors that could hamper the smooth execution of the contract.

Any and/or all expenses arising through the lack of knowledge of the Supplier regarding the existing conditions of the delivery point shall be his responsibility and no additional payment thereof shall be made by NPC.

GW-4.0 SITE INSPECTION

The Supplier shall be required to conduct site inspection to verify the actual condition of solar plant site, existing NPC power plant and its diesel generators and controls, and 13.8kV tie line route.

Schedule of the site inspection shall be coordinated with the ***DPP Plant-in-Charge of Palanan and/or its duly authorized NPC personnel.***

GW-5.0 DESIGN AND DUTY CONDITIONS**Site Condition and Design Consideration**

The Supplier shall be responsible for visiting the project sites and thoroughly investigate and familiarize himself with all the site conditions, the surrounding area and take particular reference to its accessibility, means of communication and transportation, and all other factors that could hamper the smooth execution of the contract.

Any and/or all expenses arising through the lack of knowledge or understanding regarding the existing conditions of the sites shall be the responsibility of the Supplier and no additional payment thereof shall be made by NPC.



The conditions stated below shall be taken into consideration in the design, manufacture and selection of the equipment and materials to be supplied by the Supplier, unless otherwise specifically indicated in the relevant technical specifications.

Elevation above sea level	: 0 to 10m
Ambient temperature	: 15-40°C
Barometric pressure	: 95.52 - 101.01kPa abs
% Relative humidity	: up to 100%
Design for seismic loads	: Seismic zone factor 0.4
Max. wind velocity	: 330 km/hr

The prevailing atmospheric condition is generally warm and humid.

Plant and equipment may be subjected to both horizontal and vertical seismic induced accelerations of 0.40g. or more depending on:

- a) Natural period and mode of vibration
- b) Damping (inherent or specifically provided)
- c) Manner of failure (ductile or brittle)
- d) Location (at ground level or at a higher level)

The plant and equipment required under this contract shall meet the seismic design requirement for earthquake conditions.

It is evident from the design response spectra that the degree of response varies markedly with the period of vibration. It is essential, therefore, that any equipment, or its supporting structure which has modes of vibration or components with modes of vibration with a natural period longer than 0.1 second be identified.

Provision shall be made for seismic movement by providing seismic movement joints between components which are interconnected and may have different vibratory characteristics. These joints shall be capable of withstanding the sum of the maximum deflection of each component resulting from a design earthquake.

All support and building structures under this contract shall meet the wind velocity requirements specified in the latest edition of NSCP. The recommended wind loading for tie line shall be based on the latest edition of the Philippine Electrical Code and/or other applicable codes and standards.

GW-6.0 SUPPLIER'S SCOPE OF WORKS

General

The scope of works shall cover the Design, Supply, Delivery, Installation, Testing and Commissioning of Solar PV- Diesel Hybrid (with ESS) and the integration of the existing and planned additional supply of gensets in Palanan diesel power plant including the necessary 13.8kV tie line from the solar PV plant.

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 manpower and supervision, high quality works, materials and equipment meeting the requirements of this specification and industry standards.

The Supplier's scope of works under this Contract shall generally consist of provisions stipulated hereunder.

All works and materials which are not specifically mentioned herein but are deemed necessary for the safe and reliable operation of the Palanan Hybrid System shall be performed, identified and furnished by the Supplier at no additional cost to NPC.

GW-6.1 Hybrid System

a) Solar PV Plant

- Design, supply, delivery, installation, testing and commissioning of Solar PV Plant with a total installed capacity of at least 150kW Solar PV System consisting of solar panels, string inverters with PV/Solar Controller, DC boxes/AC combiner box, control and monitoring system, lighting system, lightning protection and grounding system, structural support, interconnection lines and its appurtenances, metering system, harmonic & surge filter, electro-mechanical equipment and all other necessary components and associated auxiliaries;
- Supply, delivery, installation and testing of 225kVA Solar PV Plant transformer complete with the necessary protections and accessories as well as the construction and testing of the corresponding transformer pad;
- Design, supply, delivery and installation of guard post in reference to the material specification requirements in the Civil Bid Drawings;
- Supply, delivery, installation and testing of power, control and instrumentation cables including ground conductors, conduit and other appurtenances required to power and interface the supplied equipment which form part the Solar PV System, Energy Storage System (ESS) and Power and Energy Management System (PEMS);
- Design, supply, delivery, installation and testing of grounding system to be located at Solar PV Plant (SPP), ESS and at the newly installed facility(ies) included in this contract;
- Supply and erection of take-off structure(s) complete with line materials and protection;
- Supply, delivery and installation of perimeter lighting as shown in the Electrical Bid Drawings;
- Design, supply, delivery, installation and testing of 13.8kV overhead tie line for the interconnection and/or integration of the solar PV system to the existing DPP;
- Supply and delivery of all the required and necessary tools and accessories for the safe and reliable operation and maintenance of the Hybrid System; and



- Supply and delivery of all the required spare parts, special tools and appliances including labor and all associated expenses necessary for any repair works in the Solar PV System, ESS and PEMS during the warranty period.

b) Energy Storage System

- Design, supply, delivery, installation, testing, and commissioning of Energy Storage System (ESS) with at least 120 kW power capacity and at least 120 kWh usable energy. The ESS shall consist of battery modules/rack(s), Battery Management System, Power Conversion System with ECS/ESS Controller, control and monitoring system, ESS housing and its corresponding foundation, air conditioning system, lighting system, grounding provision, system/electrical protection, interconnection lines and its appurtenances, metering system and other associated auxiliaries; and
- Supply, delivery, installation and testing of 150kVA Energy Storage System transformer complete with the necessary protections and accessories as well as the construction and testing of the corresponding transformer pad.

c) Power and Energy Management System

- Design, supply, delivery, installation, testing and commissioning of Power and Energy Management System (PEMS) complete with necessary communication equipment/devices such as transmitters, receivers, transceivers, modems, switches, hubs, routers, adapters, connectors and other necessary auxiliaries for the safe and reliable operation/communication between solar PV system, ESS, existing and planned additional installation of genset(s);
- Supply, delivery, installation, testing and commissioning of Hybrid Controller, PV/Solar Controller and ECS/ESS Controller complete with the necessary adapters and appurtenances which is responsible to interface with the major equipment to perform monitoring and control;
- Supply, delivery, installation, testing and commissioning of at least six (6) units of genset Controllers to be interfaced and integrated with the controllers of the existing gensets. Retrofitting/replacement of existing controllers shall be done whenever deemed necessary;
- Supply, delivery, installation and testing of digital metering system complete with necessary protection and instrument transformer(s) for the solar PV system and ESS to measure the system energy generation and utilization as shown in the Bid Drawings. The supplied energy meters shall be integrated with the PEMS via Modbus. Furnish of 13.8kV kilowatt-hour meter, parallel connected to the existing billing meter, including the instrument transformers shall be determined in the Schedule of Requirements; and
- Supply, delivery, installation, testing and commissioning of data communication cables designed to operate and interface all the existing and newly supplied equipment such as controllers, energy meters, gensets, String Inverters, Power Conversion System and other components which are not specifically mentioned into this scope but requires controlling, monitoring and data acquisition.



Table 2.0

SUMMARY OF MAIN EQUIPMENT TO BE SUPPLIED/INSTALLED BY SUPPLIER						
Capacity of Solar PV System (kW)	No. & Capacity of Solar PV Plant Transformer (KVA)	Capacity and Energy of ESS (kW/ kWh)	No. & Capacity of ESS Transformer (KVA)	Power, Control & Instrumentation Cables (Lot)	13.8kV over-head tie line (Lot)	Water Piping System (Lot)
150	1 x 225; 13.8/0.48 kV, 3Ø, 60 Hz	120/120	1 x 150; 13.8kV, 3Ø, 60 Hz	1	1	1

GW-6.2 Operation and Maintenance

- a) Provide at least one (1) year Operation and Maintenance (O&M) and supervision to ensure compliance to warranty requirements with regular diagnostics and monitoring of the supplied equipment/system covering all areas reckoned from the final acceptance date; and
- b) The Supplier shall submit seven (7) sets of hard copy of approved Operation and Maintenance Manual including two (2) sets of electronic copies in DVDs to be submitted ten (10) calendar days after the testing and commissioning. Operation and Maintenance Manuals shall include Parts List and Preventive Maintenance Schedule of all components/equipment during the operating life of the Solar PV power system.

GW-6.3 Other Allied Services

- a) Conduct actual inspection of the project site and make assessment on its physical condition, and determine the extent of the scope of works required for the solar PV power system;
- b) Inspection, testing and commissioning of all major equipment and their auxiliaries for the verification of their compliance to the set minimum functions, features, capabilities, limitations in accordance to technical specifications, contract provisions and guarantees;
- c) Construction of temporary storage facilities for electrical and construction materials, drainage system, perimeter fence, foundations and other civil works, including demobilization, removal of temporary facilities and clean-up work, shall conform with all the requirements stated in Section VI – Part I - CW– Civil Works;
- d) World Meteorological Organization (WMO) compliant automated weather monitoring and logging system with data logger, at least two (2) pyranometers – one shall be installed horizontally and the other is the same as the orientation of the panels, one (1) ambient air thermocouple, one (1) anemometer, and one (1) thermocouple per string (to measure module temperatures) shall be provided for Palanan Solar PV Plant including necessary spares. The location of the Met Mast is subjected for the approval of NPC;



- e) Provide a comprehensive operation and maintenance training at site to NPC plant personnel who will be assigned to operate and maintain the whole hybrid power plant. The training program shall be supported with a training manual related to design application, operation and maintenance, including trouble shooting of the Supplier's supplied equipment and system, as well as the integration of future genset(s), battery modules, PV modules and other relevant equipment necessary for the expansion of DPP, ESS and solar PV system as specified in these documents;
- f) On-call service support system and equipment breakdown during the warranty period as specified in GW-19.0 Guarantee. The Supplier shall have an established service center with experienced personnel that will promptly and efficiently cater the repair and maintenance requirements of the supplied equipment during the warranty period. Supplier shall provide contact details & response/resolution time for service/parts replacement requests;
- g) Supply and delivery of Special Tools and Equipment as specified in the Specifications and as recommended by the manufacturer including toolbox required for start-up, test and commissioning, operation and normal maintenance of Solar PV-Diesel Hybrid System (with ESS). It shall include the supply of back-up copies of control programs (firmware and other configuration software) for the ESS and PEMS;
- h) Supply, delivery, and installation of Job Site Cameras including its mounting support as specified in EW-1.11 Job Site Cameras;
- i) Erection / detail drawings not shown in the bid drawings shall be submitted by the Supplier to NPC for approval; and
- j) The contract shall also include the inventory of trees to be cut, if any.

GW-6.4 Design Requirements

- a) The Supplier is responsible for the design as well as the implementation plan under this contract. The detailed design shall be based on the following minimum requirements:
 - 1. Design Drawings included in this Document;
 - 2. Technical Data Sheet for Solar Panel;
 - 3. Technical Data Sheet for String Inverter;
 - 4. Technical Data Sheet for DC Box/AC Combiner Box;
 - 5. Technical Data Sheet for Cables;
 - 6. Technical Data Sheet for Solar PV Plant and Energy Storage System transformer;
 - 7. Technical Data Sheet for Energy Storage System and its appurtenances; and
 - 8. Technical Data Sheet for Power and Energy Management System and if applicable its appurtenances.
- b) The Solar PV System must be designed for a minimum service life of twenty (20) years;



- c) The Supplier shall provide all the necessary protection for the Solar PV System required by Philippine Electrical Code (PEC) and other applicable regulatory agencies;
- d) The Supplier shall design the structural support of the solar PV system based on the latest National Structural Code of the Philippines (NSCP);
- e) Design standards shall be in accordance with appropriate standards and accepted detailed design practice as required by existing laws and regulations;
- f) Design standards for structures shall consider, among other things, the optimum safety of structures to minimize possible damages from tropical typhoons, cyclones and wind gustiness prevailing in the area;
- g) All proposed designs and methodology of installation provided by the Supplier shall be reviewed and approved prior to its implementation and installation. The Supplier shall provide the said design within seven (7) calendar days after the kick-off meeting and prior installation works. Refer to the list in Section VI, Part II, Technical Data Sheets, Annex H;
- h) The Supplier shall submit drawings and documents for NPC's approval of major materials and equipment such as schematics and wiring diagrams, dimensioned drawings, solar PV system layout, interconnecting diagrams identifying by terminal numbers, among others;
- i) The Supplier shall submit system configuration of the Solar Plant for approval of NPC (e.g. number of solar panels in series/parallel, number of solar panels per string/MPPT/array);
- j) Output and Performance Ratio calculation shall be calculated using the latest version of PVsyst software reckoned from the bid opening date; and
- k) Equipment to be supplied including spares of the same class shall bear the same manufacturer's name and model.

GW-6.5 Solar PV Mounting Structures and Required Civil Works and Installations

- a) Delivery of labor and supervision, materials and supplies, tools, and equipment for the construction of civil works including detailed design of associated civil/structural works for all equipment to be supplied by the Supplier and as specified herein;
- b) The ground mounted array structure shall be arranged to have optimum solar power collection. It shall have adequate strength to support the Solar PV modules at a given orientation;
- c) The metal structures shall be corrosion resistant and designed to allow easy replacement of any module and shall be in line with site requirements. All metal members of the solar PV mounting structures shall be made of hot-dipped galvanized steel compliant with the latest edition of ASTM A123 or as directed by the NPC;



- d) In addition, the materials for mounting structure of the PV system shall conform with the requirements of NPC, as stated in Section VI – Part I – CW– Civil Works;
- e) Minimum clearance between the developed ground level and lowest part of the module structure shall be at least 1.0 meter;
- f) All members of the module structure shall be designed to match the inclination angle of 10°. The structure shall be facing south or as shown in the bid drawings;
- g) The mounting structures shall be designed in consideration of earthquake, wind, dead loading, and other forces that will affect the stability and rigidity of the structures. The structural design shall comply with the requirements stated in GW-5.0 Design and Duty Conditions;
- h) The support structure and related installation shall consider and prevent different metal reaction which will cause degradation to the materials. Appropriate protection and standard method shall be conducted to prevent such cause;
- i) All nuts and bolts for the PV mounting structure, especially the ones to be used to fasten the solar PV panels to the mounting structures, shall be made of good quality stainless steel 304;
- j) The solar PV layout shall take into consideration the optimization of the available land area. The Supplier shall layout the whole hybrid system that shall occupy the property with consideration of the specified capacities of the hybrid system, civil works/structures, and future expansion of the solar plant; and
- k) The Supplier, during construction, shall avoid any interruption to the on-going operations or activities of PALANAN DPP. In case of damage to existing properties/structures during construction/installation, the Supplier, at his own expense, shall restore the damaged properties/structures into equivalent or better conditions prior to the occurrence of the damage of structures/properties with NO ADDITIONAL PAYMENT BY NPC.

GW-7.0 SPARE PARTS

General

The Supplier shall have an established service center with experienced technical personnel that will promptly and efficiently cater the repair and maintenance requirements of the supplied equipment during the warranty period. Supplier shall provide the contact details & response/resolution time for service/parts replacement requests.

Spare parts shall include all the items that are expected to be consumed or replaced during the test and commissioning stage. However, should the

Supplier borrow any items from the supplied Spare Parts during the test and commissioning, a replacement shall be ordered immediately.

All the spare parts shall arrive at plant site before the start of test and commissioning, complete with markings showing the description or code numbers to facilitate identification and retrieval.

All spare parts shall be delivered into storage areas nominated by NPC and the delivery will be deemed to be complete when the packages have been opened by the Supplier, their contents checked by NPC, and articles re-protected and replaced by the Supplier to the satisfaction of such representatives or assembled into units at NPC's option and stored as directed by NPC. Damaged or incorrect item shall be replaced by the Supplier at his own cost.

All bidders are required to submit in their proposal the detailed list of spare parts to be supplied with its corresponding costs. This list is preliminary and subject to changes in order to conform with the final design without any additional cost. The final list of spare parts shall be submitted to NPC for approval not later than one (1) month prior to the delivery of the equipment.

Spare Parts for Solar PV System

Spare Parts for Data Monitoring System as specified in Clause GW-6.3 Other Allied Services item d, shall be supplied. The Supplier shall supply the following:

- a) Two (2) units – Memory Card/Data Storage of maximum capacity dedicated to the supplied data logger.
- b) Three (3) pieces – Wind Anemometers
- c) One (1) piece – Solar Pyranometer
- d) One (1) set – Thermocouple¹ for Solar Module temperature with mounting adhesive/connector.
- e) One (1) piece – Thermocouple with radiation shield for ambient air temperature measurement

GW-8.0 TOOLS AND APPLIANCES

General

The tools and appliances recommended by the manufacturer and are deemed required for the following specific purpose of the equipment to be supplied under this Contract shall be provided. The Supplier shall include the tools that are specified below.

- a) One (1) lot of manufacturer's standard and special tools and instruments required for start-up, test and commissioning, operation, maintenance of the equipment and auxiliaries furnished by the Supplier including all equipment and devices for overhead telecommunication facility.

¹ One (1) thermocouple per String, refer to GW-6.3 item d,



- b) Any special tools or appliances required solely for erection purposes. Special tools are defined as all tools required for installation, assembling, dismantling and adjustment of all the works and usually not available in a standard machine shop or retailing store.

Each tool or appliance is to be clearly marked with its sign for purposes of identifying the function of each tool and the specific item(s) for which it is used. Each set of tools and appliances listed above shall be fitted into a custom built lockable box that is clearly marked with the name of the item or equipment for which they are used and with a list of the tools contained and stamped on a metal tab to be attached on the box.

If the weight of any box, or its size, is such that it cannot be conveniently carried, it shall be supported on steerable rubber-tired wheels. All large tools and wrenches shall be mounted on a suitable shadow board arranged for wall mounting.

Every special tool and instrument shall be accompanied or furnished with maintenance or instruction manuals in English language.

All tools and appliances supplied shall be handed over to NPC in perfect condition at the time of taking over.

All bidders are required to submit in their proposal the detailed list of special tools to be supplied. This list is preliminary and subject to changes in order to conform with the final design without any additional cost. The final list with the corresponding brochures/catalogues shall be submitted to NPC for approval not later than one (1) month prior to the delivery of the equipment.

All brochures/catalogues shall be written in English. If in foreign language other than English, it must be accompanied by a translation of the documents in English. The documents shall be translated by the relevant foreign government agency, the foreign government agency authorized to translate documents, or a registered translator in the foreign bidder's country; and 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.

Tools for Solar PV System

Tools for Solar PV System shall be supplied by the Supplier which shall consist of the following:

1. One (1) unit – Toolbox
2. One (1) set – Insulation Resistance Tester (with rated voltage at 250V/500V/1000V)
3. One (1) set – Earthing Resistor (0 – 1000 ohms)
4. One (1) set – Voltmeter (with a minimum rated voltage of 600VAC and 1.1kVDC)
5. One (1) set – Clamp Meter (with minimum rated current of 500A)
6. One (1) unit – PVC hose, flexible and robust, 20mm Ø, at least 30m length with drum or reel assembly.
7. One (1) unit – Extendable/telescopic panel cleaning pole with squeegee and sponge, at least 12ft (fully extended) length with hose attachment (20mm Ø hose)



Tools for Power and Energy Management System (PEMS) and Energy Storage System (ESS)

Tools for PEMS and ESS shall be supplied by the Supplier which shall consist of the following:

- a) One (1) Desktop computer (Minimum of Intel I7 Processor, 16 GB RAM, 1-TB HDD, 2Ghz, 32" screen size and with the latest pre-installed windows operating system compatible with manufacturer's or supplier's software) needed in programming the PEMS and ESS control setting complete with licensed CD-ROM drive dongles including other digital components that require exclusive programs from the manufacturer with free update throughout the operating life of the equipment. The desktop shall also have an uninterruptable power supply (UPS).
- b) Back-up copies of control programs (firmware and other configuration software)

GW-9.0 FIRE FIGHTING SYSTEM

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 the Underwriter Laboratories/Factory Mutual (UL/FM).

All materials and equipment which are not specifically mentioned herein but necessary for the proper installation and operation of the fire fighting system shall be furnished at no additional cost to NPC.

GW-10.0 INSTALLATION REQUIREMENTS

Prior to installation of the **Solar PV-Diesel Hybrid System** and associated electrical equipment, the Supplier shall submit construction drawings of foundations for all the supplied equipment for NPC's review and approval. The Supplier shall ensure that all relative materials to be used shall be tested in accordance with the requirements specified in the relevant Clauses of the Civil Works Specifications.

The installation of the PV arrays, inverters and other components shall be as per IEC 61173, IEC 62548, IEC 61140, and IEC 62109-1 & 2 standards.



All electro-mechanical equipment and associated structures shall be installed, tested, and commissioned in accordance with the manufacturer's drawings, instruction manuals, and drawings provided thereto. In the event of conflict within these documents, the Supplier shall inform NPC of the conflict in writing for written resolution prior to the execution of the Work.

Materials and equipment shall be handled with care at all times to prevent damage and defects during handling, hauling, packing/crating, loading, transportation, unloading, assembly, erection and any such damage and defects shall be repaired, replaced or otherwise make good by the Supplier to the satisfaction of and at no cost to NPC.

Assembly, erection and installation of all materials, equipment and its associated structures shall be carried out by skilled and qualified personnel with special training and experience in the appropriate trade.

During installation, the Supplier shall provide adequate lifting gears and other protective devices that may be required to prevent damage to the equipment during and after installation. The Supplier shall be responsible for the correct positioning and leveling of the equipment and auxiliaries, and any checking made by NPC during the course of the work shall not relieve the Supplier from his responsibility. The equipment shall be carefully lifted or glided on their respective foundations by using only approved methods and devices on a manner that will prevent damage during erection/installation. They shall be positioned on locations as shown on the drawings.

The equipment shall be set level and checked true to grade and alignment. Foundation bolts/bed plates of the number and sizes required shall be supplied and installed by the Supplier. The cost of which shall be included in the cost for the installation of respective equipment.

Welding works for structural steels and piping system shall be by electric arc process. The procedure, testing and inspection shall conform generally with the relevant approved standards and to the approval of NPC. Weld joint preparations shall be in accordance with approved standard and to NPC's approval. Approval of the welding procedure, etc. shall not relieve the Supplier of his responsibility for correct welding, electrodes and for minimizing distortion in the finished structure and piping systems.

The Supplier shall identify the most convenient access and manner of moving the equipment out of a fixed structure/s. The Supplier shall provide temporary shelter/cover (tarpaulin or equivalent type of cover) on the torn down part until it is properly packed and crated. Any part of fixed structures that has to be torn down or damaged shall be brought back to its original form to the satisfaction of NPC.

The access area identified or used during the removal of any affected existing equipment and facilities shall be utilized in mounting and installation of the new equipment. Any part of fixed structures that has been torn down and used as temporary access during the removal of the existing facilities/equipment may be left open and provided with temporary tarpaulin or equivalent type of cover until the new equipment have been unloaded and installed. Such temporary

access shall be brought back to its original form by the Supplier to the satisfaction of NPC.

GW-11.0 PACKING, SHIPMENT AND STORAGE

GW-11.1 Packing/Crating

The Supplier shall effect proper packing/crating to ensure that the equipment and components are adequately protected from damage during shipment and subsequent storage. Utmost care shall be observed in packing/crating delicate equipment and electronic devices such as control panels, instruments, and other sensitive parts or components.

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 Supplier shall make sure that these parts are re-inserted or reassembled prior to shipment. Other fluids (coolant, fuel oil, lube oil, etc.) shall be drained only if the Supplier deems it necessary.

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

Flanged connections shall be protected by a ½ inch (13mm) or thicker plywood disc, or suitable alternate, bolted to the face of the flange.

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

Butt-weld connections shall be protected by wooden disks that cover the entire weld end area and shall be secured by metal straps and fasteners. Covers, straps or fasteners shall not be welded to equipment.

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

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.

As the shipment may be left in open storage at the designated place, the Supplier shall ensure that the delivered items have appropriate protection from water and other elements. All delicate electrical and mechanical parts susceptible to damage from moisture shall be packed in hermetically sealed container or other approved containers within their packing cases, with all machined surfaces coated with a rust preventive compound. All sealed packages shall include bags of silica or equally moisture absorbing chemical. When electric space heaters or air conditioners are provided for that purpose, these should be wired to the outside of the equipment so that energization



immediately upon receipt is possible without disassembly of crates, etc. This also requires that no combustible material be left inside the equipment.

All equipment belonging to the same system/skid shall be properly marked and packed in the same crate as much as practicable. The Supplier shall not mix equipment and parts of one system with another to avoid confusion during assembly.

Valves, including its bolts, nuts, and washers, shall be separately packed and properly marked according to plant system, size, and number of pieces.

All temperature gauges, pressure gauges, switches, transmitters, and other instruments shall be properly marked and carefully packed so as not to break the associated glass and undue damage to the threaded portion.

All spare parts shall be packed in a sealed container including special and standard tools in their separate sealed toolboxes.

All packages, crate boxes, drums, bags, bundles, or other containers or any loose pieces shall carry the following identification marks on the two (2) sides in black with a stencil proof ink or paint by means of block letters not less than 30mm high, i.e.

NATIONAL POWER CORPORATION

CONTRACT NO. : _____
ITEM NO. : _____
PORT OF DISCHARGE: _____
DESCRIPTION : _____
OF CONTENT : _____
NET WEIGHT : _____ kgs.
GROSS WEIGHT : _____ kgs.
DIMENSION : _____ m³
CRATE NO. : _____

All packages shall be forwarded with a copy of packing list placed inside the package and another copy thereof contained in a waterproof envelope placed outside the package. The packing list shall give all information on the package such as package no., packing appearance, net weight, gross weight, dimension, measurement, and description of the equipment including storage and handling instructions with descriptions for periodic inspection and/or storage maintenance to ascertain that no deterioration will occur during storage.

Prior to shipment, the Supplier shall furnish NPC advance copies of all packing lists and other pertinent documents.



The Supplier shall employ methods that will warrant safe delivery of equipment to its ultimate destination, with careful consideration given to the type of commodity, method of transportation, destination, storage time, and storage facilities at point of destination.

GW-11.2 Shipment/Transport

The Supplier shall be responsible for the sea and land transportation of the equipment, materials and supplies required under this Specification and shall ensure that they are safely and timely delivered to the specified site. Supplier shall be deemed to have visited the site and other area on the route of delivery, including port facilities, inter-island shipping facilities, island transport, access roads and bridges and to have acquainted themselves with all factors that will affect the cost of shipping and freight to Site. Any damages to the roads, bridges, railways, ports, etc. arising out of neglect of Supplier shall be the responsibility of the Supplier. Likewise, any additional claim attributable to Supplier's lack of knowledge or understanding on existing conditions of the site shall not be given due credence.

The Supplier shall ship the materials and equipment on clear commercial bill of lading and the cost of all freight, insurance, shipping, handling, and road transport charges shall be included in the Bid Price.

Upon arrival of equipment and materials at site, NPC and the Supplier or their authorized representatives, shall jointly verify the plant equipment to be stored at site following the steps below:

- a) Inspection and verification of the packing list;
- b) Visual inspection of the condition of the packing and its surfaces; and
- c) Partial opening of the crates and plastic sheet protection of the plant auxiliary equipment and diesel generating sets to verify the content and its physical condition and to check pilferage or damage during shipment and storage.

A record shall be prepared carefully noting all eventual shortages, defects, or damages, signed by the Supplier and concurred by NPC. All shortages and damages noted shall be immediately replaced by the Supplier at his own cost and shall ensure the timely delivery of replacement without affecting the agreed overall project implementation schedule.

Shipment of equipment and materials to be supplied by the Supplier should be through Philippine Flag Carrier. However, a non-Philippine Flag Carrier may be used, provided a certification of its non-availability is issued by the nearest port authority within ten (10) calendar days from the date the goods are ready for shipment.

GW-11.3 Storage

If the equipment and materials to be supplied by the Supplier will not be immediately required for installation at the specified site, the materials and equipment shall be carefully stored and maintained at such place and in such a manner as NPC may direct until such time as they are ready for



installation/erection. If the Supplier desires to use any storage area other than those designated by NPC, he may do so at his own expense and subject to the approval of NPC.

The Supplier shall treat the wooden equipment crates/packages and the soil under the equipment 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. Materials to be used shall be a solution commonly used by licensed companies or entities engaged in pest control or pest eradication. Banned solutions must never be applied. Applications of the solution shall be in accordance with the manufacturer’s recommendation.

The Supplier shall provide temporary shelter/cover such as tarpaulin or equivalent type of cover for protection of the equipment during the storage.

GW-12.0 DOCUMENTS/DRAWINGS AND INSTRUCTION MANUALS

GW-12.1 Drawings Contained in the Tender Document

The drawings contained in relevant section of this tender document shall be the Bid Drawings and/or Reference Drawings which shall be utilized for bidding purposes only unless otherwise stated. They are considered as defining the minimum requirements for the design of the equipment to be furnished and to show the general layout and equipment arrangement which indicate limiting or mandatory dimensions and elevations. However, if such indicated dimensions are found deemed inadequate during the implementation stage, changes or adjustments may be made subject to NPC's review and approval.

Bid drawings which show the work to be done as definitely and in as much detail as possible may be used as guide by the Supplier in the performance of his works. Bid drawings particularly plant layout, equipment layout and piping layout, which require changes or adjustments to suit with actual site conditions or which may be modified in design/details to conform with the configuration of the supplied equipment shall be prepared/submitted by the Supplier for NPC's review and approval. Accordingly, soft copies of said bid drawings may be furnished upon receipt of request by the Supplier for their ready reference/perusal.

Anything mentioned in the specifications and not shown on the drawings, or shown in the drawings but not mentioned in the specifications but which are obviously necessary to make a complete installation shall be considered/included under the Supplier's Scope of Works.

Discrepancies between the drawings and actual field conditions or between drawings and specifications shall immediately be brought to the attention of NPC for proper resolution. All works involving discrepancies shall not be started without NPC's formal approval.

All drawings submitted by the Supplier or by any Sub-Supplier shall contain in the lower right-hand corner, in addition to the Supplier's name with signature, the date, drawing scale, drawing number and title, and contract number as given in the Specification. Drawing Title Blocks per NPC standard specifications shall be provided to the Supplier during the contract stage.

The drawings shall be adequate to demonstrate full compliance with the Contract requirements and provide NPC complete understanding of the equipment and its associated auxiliaries and associated works.

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.

GW-12.2 Drawings and Documents to be Submitted with the Bid

The Supplier shall submit with his Bid the required copies of all the documents specified in Section VI – (Part II) Technical Data Sheets, under the Section IX - Bid Drawings and other documents specified in the relevant Clauses of the bid documents (Refer to Form No. NPCSF-GOODS-01-Checklist of Technical and Financial Envelope Requirements for Bidders, Section VIII-Bidding Forms).

Drawings and other data or information that the Bidders may deem useful in the evaluation of their bids may be submitted with the bid.

GW-12.3 Supplier's/Manufacturer's Drawings

Prior to the procurement of all equipment to be supplied, the Supplier shall submit for NPC's review, approval, and/or reference, five (5) copies of prints of drawings (outline/arrangement drawings of equipment and its auxiliaries, wiring diagrams), plans calculations as required, codes and standards, operation and maintenance instructions, training program, and all other documents necessary for rendering the Works, prior to fabrication, manufacturing and/or purchasing all equipment and materials to be supplied under this Contract. The sequence of submission shall be such that information is available for checking or approval of each drawing or document received.

To provide the basis for programming the checking of the Supplier's drawings, the Supplier shall, within fifteen (15) calendar days from effectivity date of the contract, prepare and submit to NPC for approval a drawing and document lists summarizing the drawings he proposes to submit in accordance with the requirements specified herein, together with the dates on which he proposes to submit such drawings. These lists shall be updated monthly to show the status of the drawings and documents submitted and any additional proposed drawings. NPC shall have the right to require the Supplier to submit additional information as may reasonably be required.

The name and signatures of the Supplier/Manufacturer's designer and approving officer who process the drawing for NPC's approval shall be included in the title block for each drawing/document submitted.

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.

Any manufacturing, test, installation of equipment and appurtenances and 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 consequence to such risks



or in correcting the work already done to conform with the drawings as revised and approved.

The Supplier shall be responsible for any discrepancies, errors or omissions in the drawings and other particulars supplied by him whether such drawings and particulars have been approved by NPC or not, provided that such discrepancies, errors or omissions are not due to inaccurate information or particulars furnished in writing to the Supplier by NPC.

NPC shall have the right to require the Supplier to make any changes to the drawings necessary to make the works conform to the intent of the Contract.

Should an error be found in the Supplier's drawings during approval, or during construction/erection, the correction including any field change considered necessary shall be noted on the drawings and shall be resubmitted for approval.

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. All drawings are preferred in a computer-aided format. However, if unable to comply with this requirement, manual drafted drawings will be acceptable. All CAD produced drawings are to be submitted in AutoCAD formats. All other computer-generated documents are to conform to Microsoft Office.

GW-12.3.1 General and Detailed Drawings and Specifications for Electrical Equipment

Before proceeding with the manufacture/procurement of the equipment, the Supplier shall submit for approval the applicable designs, design computations as required, brochures, detailed specifications or equipment data sheets, general assembly drawings, outline/arrangement drawings, system drawings (flow diagrams), and sufficient sub-assembly drawings, schematic and control wiring diagrams, site training program, test and commissioning procedures, test reports and details to demonstrate fully that all parts will conform with the provisions and intent of the Specifications and with the requirements of their installation, operation and maintenance. The drawings shall show all necessary dimensions and tolerances, field joints, and sub-assemblies in which the equipment will be shipped, terminal boxes and wire sizes for electrical circuits and wiring diagram for power and control circuits.

Formats and symbols for electrical drawings and logic diagram shall be standardized for all the plant systems under this Contract subject to NPC's approval.

GW-12.3.2 General and Detailed Drawings and Specifications for Civil works

The above drawings shall indicate, besides relative calculations and instructions, all data necessary for the design of supporting structures such as dimensions, weights, loads and stresses under operating conditions, dimensions and weights for installation, assembly and maintenance.



In addition, these drawings shall indicate all necessary details such as foundations, anchor, tie rods, raceways for cables and pipes, supports and any other data used in the design of Civil Works.

The structures shall not substantially differ from those shown in the bid drawings.

GW-12.3.3 As-Built Drawings

The Supplier shall provide and keep up to date "As-Built" drawings of all equipment and accessories erected, installed, or modified during the works. These drawings shall show all changes or revisions from original location, sizes and kinds of equipment and accessories, miscellaneous metal works, embedded piping and electrical systems, and other concealed items of work.

Within thirty (30) calendar days after completion of works, the Supplier shall furnish NPC the complete and duly checked and approved "As-Built" drawings in five (5) prints, one (1) reproducible copy of approved quality and one (1) electronic copy in a write-once recordable CD. Such CDs shall be suitable for CD ROM/WRITE drive of computer system.

All drawings shall be clearly marked "As-Built".

All "As-Built" drawings shall be signed and dry-sealed by the Supplier's Professional Mechanical, Electrical or Civil Engineer as applicable.

GW-12.3.4 Processing of Drawings/Documents

All documents and drawings to be prepared by the Supplier for NPC's review and approval shall be on A4 size and A3 size folded to A4 respectively, and submitted to, except otherwise mutually agreed during the implementation stage:

The Manager, Design and Development Department
National Power Corporation
BIR Road corner Quezon Avenue,
Diliman, Quezon City 1100

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 within fourteen (14) calendar days for NPC's review and approval.

Five (5) prints with dark lines on a white background shall be furnished to NPC for each drawing submitted for approval. Two (2) copies will be returned to the Supplier either marked "Approved", "Approved with Corrections Indicated", or "Returned for Corrections". Prints marked "Approved" or "Approved with Corrections Indicated" authorize the Supplier to proceed with the procurement/fabrication, assembly and construction of the works 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 it in five (5) copies each for final approval. Every revision shall be shown by number, date and subject in a revision block.

If minor revisions are made after a drawing has been approved, the Supplier shall incorporate the corrections on the as-built drawings to be submitted by the Supplier. No major revision affecting the design shall be made after a drawing has been marked "Approved" without re-submitting the drawing for formal approval of said revision.

Drawings and documents marked "Noted" without comments are deemed approved. If comments/corrections are indicated thereon, the Supplier shall finalize the drawings/documents and resubmit for NPC review and reference.

Failure of the Supplier to submit the approved "As-Built" Drawings and Operation and Maintenance Manuals to NPC on the respective dates specified in this section, NPC shall withhold Five percent (5%) of contract amount from payments due to the Supplier.

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.

GW-12.4 Instruction Manuals

Supplier shall submit five (5) sets of the draft of Operation and Maintenance Manuals required for all equipment supplied under this Contract, at least forty-five (45) days prior to test and commissioning for NPC review and approval. Upon approval, the supplier shall submit seven (7) final hard copies and one (1) electronic copy of the Operation and Maintenance Manuals.

The distribution of approved manuals are as follows:

	AREAS FOR DISTRIBUTION	QTY
1	Palanan Diesel Power Plant	3
2	Workshop Maintenance Technical Services Division - LOD	2
3	Marinduque/Quezon/N.Luzon Operations Division Office	1
4	Luzon Operations Department Office	1

The Manuals shall include Parts List, and Preventive Maintenance Schedule/ Procedure and Troubleshooting during the life span of the Solar PV System and its components.

The manuals shall be furnished by the Supplier and assembled on standard metric A4 sheets. Drawings and schedules which are to be bound into the manual shall be printed in A3 folded to A4. Covers and binders to be used for the manuals shall be robust and oil-resistant.

Detailed Instruction Manuals shall contain data relevant to the device or system design and its installation, start-up, operation, preventive maintenance, troubleshooting, testing and repair. The descriptions shall not be general or applicable to any type and size of Supplier's equipment but shall be specific with (whenever possible) references to drawings submitted by the Supplier.



The following requirements shall be included but not limited to:

- a) List of all equipment and systems supplied and its accessory components complete with respective descriptions, operating requirements at all processes and ambient conditions, storage requirements, reference codes and standards, Supplier's/manufacturer's specification or technical data sheets supported with illustrative catalogues and brochures as applicable;
- b) Applicable drawings including equipment outline drawings, assembly drawings, system flow diagrams, single line diagram, schematic and control circuit diagrams (alarm and trip), interconnection diagrams of integral devices and other relevant drawings;
- c) Electrical Parts lists itemizing type, number, rating, performance limits, and services required including electric power;
- d) Instrument lists (including switches and probes) itemizing function, set points, type, catalogue number, and range;
- e) Piping Line, size, material, and ANSI class;
- f) Lists of trips and alarms complete with set points;
- g) Operating procedures and instructions on when and how to operate the equipment, including precautions, limitations and set points. Procedures listed in step-by-step sequence shall include start-up, shutdown, normal operation and load variation. Troubleshooting charts and tables shall be used to list likely evidence of malfunction and what could be responsible. The effect of loss of normal power and effect of electrical supply frequency drop shall be addressed;
- h) Preventive Maintenance Schedule for all equipment with servicing procedures including instructions for dismantling and/or replacing components, routine electrical and communication interface checking procedures, performance check and tests, checks for cleaning, lubricating and otherwise caring for equipment. These procedures shall include instrument calibration and maintenance of interlocks and other safety features;
- i) Maintenance instructions with step-by-step procedures for all anticipated equipment repairs including control system troubleshooting, alignment and calibration, assembly and disassembly. Dimension record with clearances and tolerances and torque values for all bolts shall be provided for reference;
- j) Special and standard tools list;
- k) Parts list including ASTM designation (if applicable). The spare parts list shall be in the form of a report that provides sufficient data necessary for computerized information processing. The set of data for a particular piece of equipment shall include, but not limited to the following:
 - 1. Equipment identification number or SPIN
 - 2. Description of part
 - 3. Manufacturer/Supplier part number
 - 4. Manufacturer's drawing number

5. Self-life
6. Ordering lead time
7. Unit cost
8. Weight
9. Quantity required
10. Outline sketch diagram

GW-12.5 Working Plan

The Working Plan to be submitted shall include the organization, working system, temporary yard installation, construction method, overall construction schedule, a list of Construction Equipment/Temporary Facilities to be used, etc.

GW-12.6 Bar Chart

A Bar Chart must be submitted by the Supplier/Contractor within fifteen (15) calendar days from the effectivity of the Contract for NPC review and approval indicating the schedule of various activities for the project such as design, engineering, approval (brochures/drawings), manufacturing, testing, delivery, erection, site test and commissioning.

The "Agreed Bar Chart" shall not be revised or modified without the prior approval/confirmation of NPC or except where extension of the contract period is approved in accordance with relevant provisions of the specification.

If the Works is not being adequately or properly performed in any respect, NPC shall require the Supplier to submit a new "Agreed Bar Chart" providing for the proper and timely completion of the Works covered by this Contract.

The Supplier shall see to it that the "Agreed Bar Chart" is followed as much as possible. The percentage which will be the basis for judgment of the progress of the Works shall be computed in percent of progress in each different item of work and integrated on the "Agreed Bar Chart". The actual value or quantity of work done divided by the value or quantity of the total work, respectively, and multiplied by 100 shall be the Contractor's percentage of accomplishment.

The percentage of accomplishment subtracted from anticipated percentage on the "Agreed Bar Chart" is the percentage the Supplier is behind or ahead in his work.

GW-12.7 Progress Report

The Supplier shall submit to NPC on the seventh (7th) day of every month or as agreed prior to project implementation, written detailed progress report, in an approved form, indicating the stage reached and anticipated completion dates for the design, ordering, procurement, manufacture, delivery and erection of the components. The report should be forwarded promptly so that on receipt by NPC the information is not unduly out of date.

From the commencement of manufacturing works, the Supplier shall provide color photographs of the Works which will be attached to the monthly progress reports. Each photographic print shall bear a printed description, a serial number and the date when taken. Inscriptions shall be in English. Each photograph shall record or illustrate specific events.



GW-12.8 Documents for NPC's Records

The Supplier shall furnish five (5) copies of the following documents for NPC's records:

- a) Material Data, Material Certifications and Test Reports required by governing Codes and Standards; and
- b) Factory/Performance Test Results

GW-13.0 INSPECTION AND TESTS**GW-13.1 General**

The Supplier shall perform at his own expense all tests required to ensure adequacy of material, workmanship and conformance of equipment to the guaranteed data and other requirements of the Specifications and standards.

The Supplier shall submit five (5) copies of test procedures for NPC's review/approval for all equipment covered by the Contract at least thirty (30) calendar days prior to the conduct of actual test.

NPC and/or its duly authorized representatives shall be entitled to attend and witness all applicable tests detailed in the relevant sections. NPC shall be notified by the Supplier thirty (30) days in advance about any tests requiring the presence of NPC or at least sixty (60) calendar days for factory test to be conducted outside the country. NPC's acceptance of the work by waiving the inspection of tests and receipt of the Supplier's Certified Test Reports and Inspection & Testing Certificate shall in no way relieve the Supplier of his responsibility in accordance with the requirement of the Specifications.

Tests not requiring the presence of NPC shall be, in any case, notified in advance. In such case, the Supplier shall then proceed with the tests and shall submit test reports in five (5) copies to NPC at least two (2) weeks after the conduct of the tests.

For inspected or tested goods that fail to conform with the Specifications, the Supplier shall either replace or make any alterations necessary to meet the requirements of the Specifications at no costs to NPC.

During the site test and commissioning period, the Supplier may request NPC to provide plant operations and maintenance personnel to assist in the performance of the required tests under the direct supervision and coordination of the Supplier.

Consumables required during site test and commissioning shall be borne by the Supplier.

The Supplier shall carry out all tests in accordance with the requirements of the Specifications and test procedures duly approved by NPC.



GW-13.2 Tests at Supplier's Premises**GW-13.2.1 Inspection at Supplier's Premises**

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 NPC deems appropriate, progress will be monitored with respect to Milestone Dates in the Contract Schedule and the sequence of events and activities on the Supplier's Detailed Contract Schedule.

GW-13.2.2 Factory Tests

Prior to shipment and final inspection, each equipment supplied by the Supplier shall be given the manufacturer's standard factory test and/or as required in the relevant sections of the technical specifications.

The Supplier 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 NPC. Prior to the witnessing of Factory Test, the Supplier shall remove all faults found and correct all failures noted to the best of his knowledge such that no functional or procedural errors will occur during the test.

At the commencement of the witnessing of Factory Test, all applicable equipment and materials shall be brought together in one place, integrated, and the configuration/set-up at the factory 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 Factory Test and until commencement of commissioning at site.

The Supplier shall immediately advise NPC whenever failures occur, take remedial action subject to NPC's approval, and proceed with the Factory Test as and when directed by NPC. It shall be NPC's prerogative to order a repeat of all such tests that he deems may have been affected by the failure. The Supplier shall ensure that during the test, all hard copies from output devices are 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 Factory Test. Only Supplier's personnel who are needed on the testing of the equipment shall be allowed in the test area.

The Supplier shall also be responsible that an accurate record of tests is kept and each individual test is duly initialed and dated by the Supplier and stamped or marked either "passed" or "failed" with annotations of antecedents and observations concerning the test. For each day of testing, the Supplier shall submit to 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 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.



SOLAR PV POWER SYSTEM

Each equipment/component of the Solar PV System supplied by the Supplier shall be given the manufacturer's standard factory test and in accordance with specified codes and standards.

ENERGY STORAGE SYSTEM

The Energy Storage System as defined in section EW-2.1 shall be given the manufacturer's standard factory test and performance test that shall be submitted to NPC for approval. The ESS shall be tested as a whole system and not by the system's components or sub-systems.

The testing procedures shall perform the required functionalities stated in Section *EW-2.4.3. Power Conversion System/Battery Inverter* including functionalities listed in *EW-2.4.1 Battery Management System*.

POWER AND ENERGY MANAGEMENT SYSTEM

The Power and Energy Management System shall be given manufacturer's standard factory test and performance test in accordance with national codes and standards.

The testing procedures shall perform the required functionalities stated in Section *EW-3.0 Power and Energy Management System and EW-3.2 Technical Requirements*.

GW-13.3 Pre-Commissioning/Commissioning Test**GW-13.3.1 General**

After installation of the equipment and its associated auxiliaries, the Supplier shall notify NPC of the date when the plant is ready for pre-commissioning/commissioning test at site. The timing and duration of the test shall be as mutually agreed by NPC and Supplier and shall be satisfactorily completed as required under the Contract.

The Supplier shall submit Personal Data Sheet of the proposed Commissioning Engineer/s for NPC's evaluation and approval at least one (1) month prior to testing. All tests shall be carried out in accordance with the approved procedures submitted by the Supplier or as directed by NPC.

During the test and commissioning period, the Supplier may request NPC to provide operations and maintenance personnel who shall assist in the performance of the commissioning test under the direct supervision of the Supplier/Commissioning Engineer.

The Supplier shall be responsible in compiling, recording and submitting the test reports to NPC.

Measuring and testing instruments, tools, and devices shall also be furnished by the Supplier. The cost of all tests shall be borne by the Supplier.



GW-13.3.2 Pre-Commissioning Test for Supplied Equipment

The typical Pre-Commissioning Test shall include but not limited to the following:

- a) Alignment of equipment;
- b) Wiring continuity test;
- c) Megger testing of equipment and power cables;
- d) Checking of settings for switches and instrument transmitters;
- e) Calibration of C & I equipment and measuring instruments;
- f) Checking and testing of electrical relays, CT's and PT's;
- g) H.V. test for relevant equipment;
- h) Functional test of all supplied equipment;
- i) Setting/calibration of relays and other protective devices

GW-13.3.3 Commissioning Test

The Commissioning Test shall be carried-out after the Pre-Commissioning Test has been conducted to ascertain its fitness for operation and shall include the following minimum functionalities:

- a) Trial run of individual auxiliary equipment;
- b) Visual and Audible Alarm System;
- c) Human Machine Interface remote functionalities;
 - 1. Database and Security Management;
 - 2. Metering Instrument;
 - 3. Data Logging / Event Recording;
 - 4. Scheduling and Dispatching Functions;
 - 5. Start/stop of Diesel Generator(s) and ESS;
 - 6. Engine Ramp Up/Down Control;
 - 7. Generator Breaker Open/Close Control;
 - 8. Control of Solar PV Array/Inverter or PV Output Curtailment;
 - 9. High level control of ESS functions (i.e. charging, discharging);
 - 10. Emergency Stop;
- d) Voltage and Frequency Regulation;
- e) Diesel Generator Parallel Operation/Synchronization;
- f) Load Sharing;
- g) Generator and ESS Protection;
- h) Automatic Fail over Features/ System Redundancy;
- i) Unit tripping device test;
- j) Test of other control systems safety and operating functions;
- k) Unit load test and load rejection test (at 25%, 50%, 75%, and 100%);
- l) Reliability Test (10days).

Other functionalities that are not listed here but are essential to the operation of the hybrid power plant shall be included in the commissioning test.

GW-13.4 Performance Tests

The performance test shall be carried out during the period of commissioning test of the plant to verify the guaranteed or specified values of the supplied equipment in accordance with the requirements of the Specifications which include the guaranteed power output and others as required or specified in the relevant clauses of the Technical Specifications.

All instruments, materials, and devices necessary to perform the required testing as well as to measure and analyze data shall be furnished by the Supplier. The Supplier shall provide key test personnel who will supervise the tests and collaborate closely with NPC's representatives who are duly designated to participate in the conduct/performance of the test and commissioning.

All tests shall be coordinated with NPC and shall be timed to conform with the grid requirements. Correction factors for variations of test conditions from the specified design conditions shall be stated in the Test Procedure to be submitted by the Supplier for NPC's review and approval.

Performance Test Procedures to be submitted by the Supplier shall include the following:

- a) Introduction;
- b) Purpose of Test;
- c) Procedure for the Test;
- d) Simplified diagrams indicating test envelope, test points and measuring equipment;
- e) Test data and parameters to be measured;
- f) Step by step calculations indicating how the test data are used to arrive at the final results;
- g) Forms to be used; and
- h) Correction curves and other curves or tables to be used in the test (correction curves shall be submitted with the Bid)

Acceptance of the equipment shall be on the basis of the satisfactory results of the performance tests meeting the guaranteed values.

GW-13.4.1 Solar PV Power System

Performance test of the Solar PV Power System shall be carried-out in accordance with the manufacturer's instructions and specified codes and standards.

The test shall be performed and lead by a qualified PV System installer who is knowledgeable regarding PV system and its associated electrical equipment to ensure safety during the conduct of test.

Testing

Testing of PV system should be conducted in accordance with NFPA 70E, Electrical Safety in the Workplace, published by the National Fire Protection Association. To mitigate electrical hazards, workers must employ personal protective equipment commensurate with the electrical energy present, follow proper procedures and use appropriate tools. IEC 62446 requires that the AC circuits be tested first, then the following six DC circuit tests be performed, preferably in this order:

- a) Test continuity of equipment grounding conductors and system grounding conductors (if applicable).

- b) Test polarity of all DC cables and check for correct cable identification and connection.
- c) Test open-circuit voltage [Voc] for each PV source circuit.
- d) Test short-circuit current [Isc] for each PV source circuit.
- e) Test functionality of major system components (main panelboard, controls, inverter, etc.)
- f) DC conductor Insulation resistance test.

Equipment tests which are listed below shall be performed and conducted during performance testing accompanied by the representative/s of NPC. The equipment testing shall be comprised with the following minimum requirements:

- a) Verification of the proper operation of disconnecting means and component connection and disconnection sequences;
- b) Verification that interactive inverters de-energize their outputs to utility grid upon loss of grid voltage;
- c) Verification the automatic function of the inverter to reconnect to the grid once the reference voltage has been restored.

GW-13.4.2 ESS Performance Test

Performance test for the ESS together with the SPP, PEMS, existing gensets, and tie line shall be conducted to test the smooth and satisfactory functioning of Solar PV-Diesel Hybrid System (with ESS) in every aspect and to verify the guaranteed or specified values of the supplied equipment in accordance with the requirements of the Specifications. The performance test shall confirm the compliance of the equipment to the functionalities stated in *EW-2.0 Energy Storage System*, *EW-2.4.3 Power Conversion System (PCS)/Battery Inverter* and *EW-2.4.1 Battery Management System* and other relevant clause stated in the tender. The performance test shall verify the following minimum parameters:

- a. Nominal Rating (kW);
- b. Usable Energy (kWh);
- c. Power Swing(kW);
- d. Reverse Power Swing(kW);
- e. Power Swing Response time(millisecond)
- f. Reverse Power Swing Response Time (milliseconds);
- g. Power factor;
- h. Overloading;
- i. Nominal Charge/Discharge (A);
- j. Maximum Charging Current (A);
- k. Maximum Discharge Current (A);
- l. Nominal Terminal Voltage (V_{DC});
- m. Minimum Operating Voltage (V_{DC});
- n. Maximum Operating Voltage (V_{DC});
- o. Maximum Normal State of Charge (%);
- p. Minimum Normal State of Charge (%);
- q. Round-Trip Efficiency (%);
- r. Battery Management Functionalities; and
- s. ESS Power Consumption.

GW-13.4.3 PEMS Performance Test

Performance test of the PEMS shall confirm the compliance of the equipment and components to the functionalities listed in *EW-3.0 Power and Energy Management System* and other relevant clause stated in the tender.

GW-13.4.4 13.8kV Tie Line

After all the conductors, neutral wire and communication cable are completely strung, the Supplier and NPC shall conduct a joint final inspection from tapping point to receiving end of the line. The Supplier must satisfy NPC that all minimum requirements for 13.8kV, Single Circuit, Steel Pole Tie Line had been met, especially the minimum clearance to ground of the conductor. A continuity test of the line from the tapping point to the receiving end must also be conducted in order to ensure that the entire line is continuous. The decision made by NPC in any defect as found by him shall be final and all the requirements must be complied by the Supplier.

GW-13.5 Reliability Test (10 days)

After the Supplier has notified NPC that the Solar PV-Diesel Hybrid System (with ESS) and associated Tie Line is ready for commercial service provided NPC is satisfied that the plant and tie line is ready for commercial service, the systems with all its associated auxiliaries are required to operate under the normal working conditions of the power plant and within the limits of output specified and operating continuously without major failure for a period of 10 days.

The plant will be operated by the NPC staff under the supervision of the Supplier's Commissioning Engineer during the reliability test period.

The Reliability Test shall be carried out in accordance with the applicable codes and standards and the approved test procedures.

Should any major failure occur in the plant or any portion of the supplied associated equipment due to, or arising from, faulty design, materials, sufficient to prevent safe and full commercial use of the plant, the reliability test shall be considered void and the reliability test period of 10 days shall be recommenced after the Supplier has remedied the cause of defect.

Reliability Test would be considered a failure for any one of the following major causes:

- a) Plant tripping due to above causes;
- b) Failure to start-up/shutdown as and when required according to normal procedure;
- c) Major defects to warrant plant shutdown or interruption for repair which would otherwise affect safety of personnel and/or plant and equipment; and
- d) Failure to respond during the run back or emergency trip when initiated.

In case of the above failure, the reliability test period of ten (10) days shall recommence after the Supplier has remedied the cause of defect.

GW-13.6 Tests Failures

If any equipment or component fails to pass any test, NPC may, direct the Supplier to make any necessary corrections or alterations for defects or order equipment/component replacement, as maybe deemed appropriate. Any and all expenses due to additional tests or retests made necessary by failure of Supplier's supplied equipment/component, i.e. failure to meet the guarantees and other requirements of the specification, shall be borne by the Supplier. The costs of witnessing the Factory Tests by NPC or its representative(s) as a result of re-test to be conducted on the equipment shall also be borne by the Supplier.

If the results of the performance test at site show that the equipment failed to meet the technical specifications and or guarantees, the Supplier shall be given two (2) weeks maximum from the completion date of the performance test to make any necessary corrections or alterations of defects before conducting the retest. The Supplier may request time extension for any corrections subject to NPC's evaluation/approval of corresponding justification for such extension. One (1) retest is allowed only during the required two (2) weeks maximum period including trial runs. If the results of the latest test/retest failed to meet the guarantees, then these results shall become the basis in applying the applicable penalties, if any.

Penalties specified in the relevant sections of the Specifications shall be applied in case tests or retests at site for the solar PV, PEMS, ESS, transformers and associated equipment failed to meet the guaranteed data.

GW-13.7 Test Reports/Certificates

Five (5) certified copies of the reports of all NPC's specified tests and other manufacturer standard tests shall be furnished to NPC within a maximum of fifteen (15) days following the completion of the tests.

Test certificates shall include, in addition to the test results, the following information:

- a) Date of the performance of test;
- b) Equipment data; and
- c) The equipment serial number.

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

GW-13.8 Waiver of Factory Tests Witnessing/Inspection by NPC for Equipment to be Furnished by the Supplier

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

Issuance of the Certificate of Waiver of Tests Witnessing/Inspection for equipment required to be witnessed by NPC or its authorized representative(s) however, shall in no way relieve the Supplier of his responsibility to conform to the approved test procedures and the requirements of the Specifications.



GW-14.0 TRAINING OF NPC PERSONNEL**GW-14.1 General**

The Supplier shall extend all possible assistance and cooperation to NPC regarding the transfer of technology and developing expertise in the area of engineering, operation and maintenance of the Plant.

The cost of training of all involved NPC personnel at Plant Site shall be borne by the Supplier and shall be included in the bid price.

GW-14.2 Operation and Maintenance Training at Site

The Supplier shall conduct training at Plant Site of NPC's personnel who will be assigned to operate and maintain the plant. At least eight (8) NPC Personnel shall participate in the training program. The Supplier shall provide a comprehensive training program related to design application, operation and maintenance, including trouble shooting of the Supplier's supplied system and equipment starting from Start of Pre-Commissioning/Commissioning and thereafter up to the issuance of Certificate of Acceptance.

The contents of the training program shall include but not limited to:

- a) Plant principles in management and practices for operators, technicians and in maintenance personnel; and
- b) Operation and Maintenance training program covering electrical, mechanical and instrumentation and control.

The Supplier shall provide training material in the form of drawings, instructions and/or audio visuals. The training material shall include but not limited to the following topics:

- a) Handling and Storage
- b) Application
- c) Installation, Operation and Maintenance
- d) Environmental Performance
- e) Electrical and Mechanical Performance
- f) Basic Troubleshooting

The following subject shall be discussed thoroughly with SPUG End-users and Technical Services Group:

- a) Basic Solar PV–Diesel Hybrid system features and operation;
- b) Field and remote control operation;
- c) Interrogation for access of event data, status, fault records and metering data;
- d) Fault finding;
- e) Application of protection and control settings/reconfigurations, including integration of supplied controllers; and
- f) Integration of additional equipment for the expansion of the system (DPP, ESS and SPP).

Said training program shall be submitted to NPC for approval.

The timing of the training should be such that the participants will be equipped with sufficient know-how to participate in the pre-commissioning and commissioning tests of the Plant.

During pre-commissioning, commissioning, and performance test period, the Supplier may request NPC to provide operations and maintenance personnel to assist the Supplier in the operation and maintenance of his supplied equipment under the direction of the Supplier for the purpose of on-the-job training.

NPC shall have the right to send to the Site its personnel intended to operate and maintain the equipment supplied under this Contract. The Supplier shall use his staff to instruct these personnel relative to the operation and maintenance of the equipment.

GW-14.3 Operating and Configuration Editor Software Program

All software and configuration editor software program including licenses shall be supplied and included in the cost of the equipment in the Bid Price Schedule. A set of each type of software including licenses plus instruction manuals shall be provided by the Supplier.

GW-15.0 CORROSION PROTECTION AND PAINTING

GW-15.1 General

The Supplier shall apply corrosion protection and painting to all equipment and materials to be furnished in accordance with the minimum requirements specified in this section.

Generally, the equipment shall be shop primed and finish coated in accordance with the Manufacturer's standard practice. An adequate supply of touch-up paint shall be supplied by the Manufacturer/Supplier which shall be used for painting surfaces that will be damaged during transport and installation works including surfaces that show signs of corrosion. Color of final painting shall preferably be similar to the existing final color of the equipment and structures or as approved by NPC.

The Supplier shall be responsible for the adoption of preparation procedures and protective coating systems which are suitable for the environment experienced by the various components/elements of the Plant.

Where a specific coating system is mentioned elsewhere in the Specifications, the Supplier shall accept responsibility for the suitability for such system. The Supplier has the option to nominate an alternative coating system for the approval of NPC.

Within sixty (60) calendar days from the award of the Contract, the Supplier shall submit for the approval of NPC, a full schedule of coating systems including the following information:

- a) Plant item name;
- b) Protective coating systems including number and thickness of coats;

- c) Short list of protective coating manufacturers and applicators;
- d) Surface preparation;
- e) Workshop action; and
- f) Final color schedule which NPC will provide during the Contract stage or as specified in the relevant sections of this Specifications.

GW-15.2 Treatment for Shipping

The various items which do not fall under the paintings or lining specifications in the documents shall be surface treated for shipping.

The various items to be shipped shall be thoroughly cleaned before shipment so as to eliminate dirt, rust and grease, all welding slugs and spatters, and loose metals.

All metallic machined surfaces shall be covered with a protective coating. This coating shall be effective against salty air and shall be easily removable at site.

All iron or steel external surfaces shall be covered with two (2) coats of protective anti-rust paint.

All internal surfaces of tanks shall be coated with an easily washable corrosion preventive compound.

Piping, valves and other parts that have undergone hydraulic tests and which cannot be completely dried should be treated with water-absorbing corrosion inhibitor before the application of protective coating.

GW-15.3 Application of Paint

Before any painting is made, all surfaces must be prepared properly by removing all rusts, scales, welding slugs and spatters, grease and encrustation of any nature. Steel surfaces shall be white blasted in accordance with Steel Structures Painting Council Standard. The various paints to be used shall be of approved quality and type.

No painting shall take place outdoor during the presence of rain, fog, dew or where the surfaces may be otherwise damp; in particular, and no application of paint should be made on plaster surfaces that are not completely dry. No coating shall be applied unless the surface is at minimum of 3°C above dew point.

For successive coats, first coat shall be dried hard before the second coat. The color of successive coats must be sufficiently different to allow easy identification of the sequence of painting of surfaces for control purposes.

Paint shall not be applied to machined surfaces, corrosion resistant materials or linings, unless otherwise specified in the relevant sections of the specifications.

All contact surfaces of field-welded connections shall be masked at a distance of 100mm back from the weld joint and shall be suitably protected against corrosion.



For non-insulated surfaces exposed to high temperature two (2) coats of aluminum modified silicone with a volume solid of 42% + 2% high temperature paint shall be applied.

All other equipment and piping shall be prime coated with 80 microns DFT zinc rich epoxy paint and 80 microns DFT of chlorinated rubber for each intermediate and topcoat.

Exposed fabrication, erection, or shipping marks shall be cleaned off and the areas touched-up shall be painted to match the adjacent surfaces.

For surfaces where blast cleaning and a wash primer are specified, touch-up painting shall include application of the wash primer before the touch-up coats.

Equipment and auxiliaries which are shop-fabricated/assembled and have already been provided with final painting shall no longer require painting at the site except for painted surfaces which have been damaged during transport and/or installation works, shall require touch-up painting. Color of final painting shall be as designated and approved by NPC.

Final tests and inspection shall be carried out by the Supplier to ascertain the correspondence of the paintwork to the prescribed color and treatment. These tests will indicate whether or not the paintwork is correctly applied and is free from wrinkles or roughness which might affect the adhesion of the protective coating.

Should the measured dry film thickness result to less than the specified one, the Supplier shall apply additional paint to the coat inspected or shall increase the thickness of succeeding coat, as applicable, to assure the specified total dry film thickness.

GW-15.4 Hot Dip Galvanizing

The zinc protective coat shall be adherent, smooth and free from discontinuity and imperfections such as bubble, porosity, cracks, or other irregularities of the protective layer.

The thickness of applied layer shall conform with the minimum values as specified in the latest edition of ASTM A123 and/or as directed by the NPC.

GW-16.0 QUALITY ASSURANCE REQUIREMENTS

GW-16.1 General

The Supplier shall have a well-organized Quality Management System which is relevant for the Works covered under the contract to assure that items and services, including subcontracted items and services, will comply with this specification.

Within thirty (30) days of the Effective Date of Contract, the Supplier shall submit six (6) copies of his complete quality control and assurance procedures, and manuals for review and approval by NPC. The manual shall include pro-



forma checklists for all requirements of the Supplier's quality control and assurance program and those called for in this Specification.

GW-16.2 Quality Assurance Program

The Supplier 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; and
- d) Control their measuring and test equipment in accordance with the established procedures for measurements and calibration systems and ensure that such equipment that may be used by Sub-Suppliers to verify work is similarly controlled.

Where installation, test, and commissioning work are involved, the Supplier shall prepare contract-specific quality assurance procedures in agreement with NPC prior to commencement of such works.

The Supplier 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.

GW-16.3 Quality Plan

The Supplier 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 NPC together with the quality plan. Quality plans shall be submitted to NPC for review and approval.

GW-16.4 Records

The Supplier 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.

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.

All records generated during the course of the Contract, including those generated as evidence of effective implementation of the quality assurance program of the Supplier and his Sub-Suppliers, shall be retained by the Supplier 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.



GW-16.5 Reporting and Corrective Action

The Supplier'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.

GW-17.0 MEASUREMENT OF PAYMENT

Measurement of payment for all works shall be based on the requirements specified in the relevant clauses of the technical specifications or the bid price of each item as shown in the Schedule of Requirements. The cost shall cover all works required and described in the pertinent provisions of the specifications and for the satisfactory completion of each work.

GW-18.0 CERTIFICATE OF COMPLETION AND ACCEPTANCE

When all the works and services have been satisfactorily completed as required in the Contract, the Supplier may give notice to this effect to NPC. Such notice shall be deemed to be the basis for NPC to issue a Certificate of Completion in respect of the Works within fifteen (15) days of receipt of such notice. If defects had developed, said defects should have been corrected to be the satisfaction of NPC and have undergone another warranty period reckoned after correction.

The warranty period for the completed works shall commence on the date of issuance of the Certificate of Completion.

After the lapse of the warranty period, provided that there are no defects found and/or pending repair works (including completion of the required Supplier's Service Personnel specified in Clause GW-19.0 as certified by Plant Manager), NPC shall issue the Certificate of Final Acceptance.

The issuance of Final Acceptance Certificate shall entitle the Supplier to Final Payment and to full release of retention money.

GW-19.0 GUARANTEE

The Supplier shall guarantee that he will repair, and/or replace, at his own expense, **equipment and machineries, against defect in design, workmanship and materials** and shall include labor, parts and travel time for necessary repairs at the plant site effective from date of issuance of Certificate of Completion for a period of **twelve (12) months**. However, the manufacturer's warranty against defect in design, workmanship and materials for solar panels array and mounting structure shall be ten (10) years while the Inverters, Batteries, Supervisory, Communications, and Energy Storage System (ESS) shall have a minimum warranty of five (5) years.

The Power and Energy Management System (PEMS) shall also have a minimum warranty of five (5) years including the hybrid controller, PV/solar



controller, ECS/ESS controller and Genset controller. The warranty shall also include the converters, wiring and interfacing of the PEMS.

The Supplier shall provide on-call support for issues beyond the technical capability of NPC personnel as specified in the scope of works. If issues cannot be fixed or solved by telephone support, the Supplier must be able to send to the plant site their appropriate staff within ten (10) calendar days after NPC's notification.

One (1) year Operation and Maintenance (O&M) supervision shall also be provided by the Supplier to ensure compliance to warranty requirements. For a period of one (1) year, the Supplier shall also provide a quarterly diagnostics and monitoring of the supplied equipment/system in all areas during the warranty period at no cost to NPC to perform the following, but not limited to:

- a) Checking/inspection of the installed equipment;
- b) Conduct evaluation and assessment of operating parameters;
- c) Make necessary adjustment/updates on instruments, controls, system configurations and firmware/software;
- d) Perform/supervise necessary cleaning, repair, trouble shooting, parts replacement; and
- e) Provide training and/or informative instructions similar to items "a)" to "d)" to NPC Plant Operation and maintenance Personnel. Such training/instruction shall be conducted (hands on) in such a way that NPC Plant O&M Personnel would be able to perform reliably and satisfactorily

This shall include any maintenance/repair services rendered upon request of NPC in the event of any abnormality occurs within the warranty period. For the minor repairs/replacements/adjustments as determined by the supplier, plant maintenance personnel who had undergone training conducted by the supplier may perform the necessary repairs/replacements/adjustments, if authorized by the supplier through any means of available communications, provided that such repair shall not relieve the supplier of its obligation under the contract if such repair is not done properly.

The applicable guarantee period shall be exclusive of any downtime attributable to the Supplier. In case of equipment downtime occurs during the warranty period due to fault of the Supplier, the downtime hours shall be added to the required warranty period. Hence, the warranty period is extended with the equivalent downtime attributable to the Supplier.

Provided further that the release of the warranty bond/security is without prejudice to the terms provided by GW-19.0 and shall be done after the warranty period plus downtime attributable to Supplier, if any as certified by the concerned end-user. Accordingly, the warranty bond shall be extended.

In the event that undue delay is being caused by the Supplier for failing to attend the requested maintenance/repair services within ten (10) calendar days, a penalty shall be charged to the Supplier as follows:

Penalty = Prevailing electricity rate in pesos per kW-hour x Produced Energy based on the approved Annex H.5² in kWh/day x number of shutdown days counted from 11th day of supplier's receipt to NPC's request without action.

The Supplier guarantees that when the equipment and/or material are placed in operation and/or use, it will perform in the manner as set forth in the Contract.

² Approved Annex H.5 "Computation of Performance Ratio and Annual Yield using PVsyst Software"



SECTION VI

PART I-TECHNICAL SPECIFICATIONS

ARCHITECTURAL WORKS

PART I – TECHNICAL SPECIFICATION**AW - ARCHITECTURAL WORKS****TABLE OF CONTENTS**

<u>CLAUSE NO.</u>	<u>TITLE</u>	<u>PAGE NO.</u>
AW- ARCHITECTURAL WORKS.....		1
AW-1.0	GENERAL ARCHITECTURAL REQUIREMENTS	1
AW-1.1	General	1
AW-1.2	Submission of Drawings	1
AW-1.3	Substitution of Materials	1
AW-1.4	Certification of Materials	2
AW-1.5	Other works which even if not specifically mentioned in the Section and Schedule of Requirements shall be included:	2
AW-1.6	Measurement and Payment.....	3
AW-2.0	GUTTER FOR RAINWATER COLLECTOR.....	3
AW-2.1	General	3
AW-2.2	Materials.....	3
AW-2.3	Workmanship	3
AW-2.4	Measurement and Payment.....	3
AW-3.0	PAINTING AND VARNISHING	4
AW-3.1	General	4
AW-3.2	Inspection of Surfaces	4
AW-3.3	Materials.....	4
AW-3.4	Colors and Samples	5
AW-3.5	Workmanship	6
AW-3.6	Protection	6
AW-3.7	Paint Application.....	7
AW-3.8	Painting Systems.....	8
AW-3.9	Measurement and Payment.....	10
AW-4.0	ROOFING AND SIDING SHEETS.....	11
AW-4.1	General	11
AW-4.2	Materials.....	11
AW-4.3	Workmanship	11
AW-4.4	Measurement and Payment.....	11

PART 1 – TECHNICAL SPECIFICATIONS**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, tin smiting, plumbing, painting, landscaping and masonry work, etc. notwithstanding any omission from these Specifications or drawings.

Materials and structural parts that the Supplier 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 Drawings

In accordance with GW- Supplier's/Manufacturer's Drawings the Supplier shall submit construction drawings for evaluation and approval, within fifteen (15) calendar days from effectivity date of the contract. No work shall be done until after drawings are approved by the NPC. All work must strictly conform to approved drawings.

AW-1.3 Substitution of Materials

The Supplier 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 Supplier 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 Supplier 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 Supplier shall submit to the NPC Representative signed certificates from manufacturer or sole distributor of equipment and materials to be furnished and installed by the Supplier, 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 specifically mentioned in the Section and Schedule of Requirements 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 Supplier shall be guided accordingly by the applicable provisions in the specifications and what is shown in the drawings for each type.

SECTION VI - TECHNICAL SPECIFICATIONS**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 Schedule of Requirements.

Payment shall constitute full compensation for all labor, materials, equipment, tools and incidentals necessary for the completion of each work.

AW-2.0 GUTTER FOR RAINWATER COLLECTOR**AW-2.1 General**

The Supplier shall furnish all labor, materials, and operations including tools, other implements and accessories for the complete installation of gutter as indicated in the drawings.

Installation shall be performed by skilled workmen in accordance with the construction and shop drawings and the manufacturer's standard.

Shop drawings and manufacturer's catalogue showing product standards and technical data will be provided by the Supplier to the NPC Representative for approval.

AW-2.2 Materials

Material for gutter shall be weather, rust free and non-flammable. It shall be metallic plastic sheet. Thickness shall be 2.0mm thick as specified in the drawing.

AW-2.3 Workmanship

Gutter shall be securely fastened on steel support by rivet or as required. Fasteners shall have a maximum distance of 0.50m O.C. along support.

Special care shall be given to the joints, lapping, bolting and setting of closers.

AW-2.4 Measurement and Payment

Measurement and payment for **Gutter Rainwater Collector** will be based on the corresponding contract unit price under architectural work's Schedule of Requirements.

Payment shall be made at the contract unit price, which payment shall cover costs of furnishing all materials and labor including equipment and tools

SECTION VI – TECHNICAL SPECIFICATIONS

required to complete the work and all associated costs including transport to site.

AW-3.0 PAINTING AND VARNISHING**AW-3.1 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 Suppliers, 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-Suppliers, supply dealers or others affected by the construction of this project, the General Supplier shall be held responsible for the co-ordination of all the work.

The Supplier shall examine all sections of this specification and perform all paintings called for therein.

AW-3.2 Inspection of Surfaces

Before starting the work, the Supplier 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 Supplier shall notify the NPC Representative in writing. The NPC Representative will cause these defects to be reminded. The commencing of the work by the Supplier indicates his acceptance of the surfaces to be painted and assumes responsibility for the rectification of any unsatisfactory finishing, resulting from his negligence.

AW-3.3 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.

SECTION VI - TECHNICAL SPECIFICATIONS

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 Supplier 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 Supplier 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-3.4**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-3.5 Workmanship

All work shall be done by skilled workers 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 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-3.6 Protection

The Supplier 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 Supplier 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 Supplier 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 Supplier 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-3.7 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 meet, 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 paint 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 coat; only when using the moist oil type of paints may it be necessary for the previous coat to be hard dry.

The Supplier 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-3.8 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.

SECTION VI – TECHNICAL 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.

Wooden Surfaces

- a) Exterior Parts – Application of coatings such as enamels, varnishes, pigments and solvents on wooden exterior surfaces shall be based on

SECTION VI -- TECHNICAL SPECIFICATIONS

the standards specified in ASTM D1006 for appropriate coatings application.

- b) Surface shall be smoothed down with adhesive; if machine 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.

AW-3.9 Measurement and Payment

Measurement for payment for painting and varnishing will be based on what is required on the Schedule of Requirements.

AW-4.0 ROOFING AND SIDING SHEETS**AW-4.1 General**

The Supplier shall furnish all labor, materials, and operations including tools, other implements and accessories for the complete installation of roofing sheets wherever indicated in the drawings.

Installation shall be performed by skilled workmen in accordance with the construction and shop drawings and the manufacturer's standard.

Shop drawings and manufacturer's catalogue showing product standards and technical data will be provided by the Supplier to the NPC Representative for approval.

AW-4.2 Materials

Material for roofing shall be weather, rust free and non-flammable. It shall be corrugated metallic plastic sheet. Thickness shall be determined as specified in the drawing that shall range from 2.0 to 2.5mm thick. Bended sheets such as flat barge caps, flashings, ridge rolls, capping and moldings that serve as its accessory components shall have the same composition with the roofing and siding sheets of which minimum thickness base metallic plastic shall be 1.5mm. Gutters likewise shall have the same material composition with base metallic plastic thickness of 2.0mm unless otherwise specified in the drawing commonly as stainless.

AW-4.3 Workmanship

Roofing and siding sheets shall be securely fastened on steel purlins and channels by hook or stove bolts or self-drilling screws or as required. Fasteners shall have a maximum distance of 0.30m O.C. along purlins.

Special care shall be given to the joints, lapping, bolting and setting of closers.

AW-4.4 Measurement and Payment

No separate measurement and payment will be made for **Roofing and Siding Sheet**. The entire cost thereof shall be included in the pay item as shown in the Schedule of Requirements.

SECTION VI

PART I-TECHNICAL SPECIFICATIONS

CIVIL WORKS

SECTION VI – TECHNICAL SPECIFICATIONS**CW – CIVILWORKS****TABLE OF CONTENTS**

<u>CLAUSE NO.</u>	<u>TITLE</u>	<u>PAGE NO.</u>
CW-1.0	GENERAL CONSTRUCTION FACILITIES	1
CW-1.1	Scope	1
CW-1.2	Moving-in.....	1
CW-1.3	Supplier's Camp Facilities	1
CW-1.4	Water Supply.....	1
CW-1.5	Sewerage Disposal and Sanitation	1
CW-1.6	Fire Protection.....	2
CW-1.7	Construction Power	2
CW-1.8	Camp Security.....	2
CW-1.9	Construction Material Storage	2
CW-1.10	Removal of Camp and Construction Facilities	3
CW-1.11	Measurement and Payment.....	3
CW-2.0	CARE OF WATER DURING CONSTRUCTION.....	3
CW-2.1	Scope.....	3
CW-2.2	Drainage and Dewatering.....	3
CW-2.3	Measurement and Payment.....	3
CW-3.0	ENVIRONMENTAL REQUIREMENTS FOR CIVIL WORKS.....	4
CW-3.1	Scope.....	4
CW-3.2	General Conditions.....	4
CW-3.3	Measurement and Payment.....	5
CW-4.0	SITE GRADING	5
CW-4.1	Scope.....	5
CW-4.2	Clearing, Grubbing and Miscellaneous Work.....	5
	CW-4.2.1 Clearing and Grubbing.....	5
	CW-4.2.2 Miscellaneous Works	6
CW-4.3	Grading	6
	CW-4.3.1 General.....	6
	CW-4.3.2 Classification of Materials.....	6
	CW-4.3.3 Stripping.....	6
	CW-4.3.4 Excavation and Fill.....	6
	CW-4.3.5 Slides	7
	CW-4.3.6 Slip-Outs	7
CW-4.4	Disposal	8
CW-4.5	Sources of Fill Materials	8
CW-4.6	Environmental Requirements	8
CW-4.7	Measurement and Payment.....	8
	CW-4.7.1 Clearing and Grubbing.....	8
	CW-4.7.2 Miscellaneous Works	8
	CW-4.7.3 Stripping.....	8

SECTION VI – TECHNICAL SPECIFICATIONS

LuzP21Z1221Se

	CW-4.7.4	Grading Excavation.....	9
	CW-4.7.5	Grading Fill.....	9
CW-5.0		STRUCTURAL EXCAVATION, FILL AND BACKFILL.....	9
CW-5.1		Scope.....	9
CW-5.2		Materials.....	9
	CW-5.2.1	Structural Excavation	9
	CW-5.2.2	Structural Fill.....	10
	CW-5.2.3	Special Foundation, if any.....	10
	CW-5.2.4	Structural Backfill	10
CW-5.3		Construction.....	11
	CW-5.3.1	Excavation	11
	CW-5.3.2	Structural Foundation Fill	12
	CW-5.3.3	Special Foundations.....	12
	CW-5.3.4	Backfill	12
CW-5.4		Measurement and Payment.....	13
	CW-5.4.1	Structural Excavation	13
	CW-5.4.2	Structural Foundation Fill	13
	CW-5.4.3	Special Foundations.....	13
	CW-5.4.4	Structural Backfill	13
	CW-5.4.5	Trench Excavation and Backfill for Sewerage, Drainage and Water Supply Pipes and Cable Trench.....	13
CW-6.0		CONCRETE	14
CW-6.1		Scope.....	14
CW-6.2		Class of Concrete.....	14
CW-6.3		Materials.....	14
	CW-6.3.1	Cement	14
	CW-6.3.2	Reinforcing Steel.....	14
	CW-6.3.3	Water	14
	CW-6.3.4	Aggregates.....	14
	CW-6.3.5	Formwork.....	15
CW-6.4		Storage of Materials	15
	CW-6.4.1	Cement and Aggregates	15
	CW-6.4.2	Reinforcing Steel.....	15
CW-6.5		Concreting.....	16
	CW-6.5.1	General	16
	CW-6.5.2	Formwork Construction	16
	CW-6.5.3	Placing Reinforcement	17
	CW-6.5.4	Mixing Concrete	17
	CW-6.5.5	Placing Concrete.....	17
	CW-6.5.6	Finishing Concrete	18
	CW-6.5.7	Removal of Forms.....	18
	CW-6.5.8	Curing and Protection	18
	CW-6.5.9	Sampling and Testing of Concrete	18
	CW-6.5.10	Tolerances and Repair for Concrete Construction.....	19
	CW-6.5.11	Second Stage Concrete	19
CW-6.6		Measurement and Payment.....	20
CW-7.0		REINFORCING STEEL.....	20
CW-7.1		Description	20
CW-7.2		Material Requirement	20
	CW-7.2.1	Bar Reinforcement	20

SECTION VI – TECHNICAL SPECIFICATIONS

LuzP21Z1221Se

	CW-7.2.2	Sampling.....	20
CW-7.3		Construction Requirement.....	20
	CW-7.3.1	Order List for Bent Bars.....	20
	CW-7.3.2	Fabrication.....	21
	CW-7.3.3	Protection of Material.....	21
	CW-7.3.4	Placing and Fastening Reinforcement & Miscellaneous Material (ACI-301).....	21
	CW-7.3.5	Splicing.....	23
CW-7.4		Measurement and Payment.....	24
CW-8.0		STRUCTURAL STEEL	24
CW-8.1		General.....	24
	CW-8.1.1	Submittals.....	24
	CW-8.1.2	Delivery and Storage.....	24
CW-8.2		Materials.....	25
	CW-8.2.1	Steel.....	25
	CW-8.2.2	Bolts, Nuts and Washers:.....	25
	CW-8.2.3	Accessories:.....	26
CW-8.3		Execution.....	26
	CW-8.3.1	Fabrication.....	26
	CW-8.3.2	Welding of Structural Steel Work:.....	26
	CW-8.3.3	Shop Painting.....	26
	CW-8.3.4	Erection.....	27
	CW-8.3.5	Tests and Inspections.....	27
CW-8.4		Measurement and Payment.....	28
CW-9.0		REINFORCED CONCRETE FOUNDATION AND ASSOCIATED STRUCTURES FOR EQUIPMENT AND OTHER COMPONENT (DESIGNED/CONSTRUCTED BY SUPPLIER).....	28
CW-9.1		Scope.....	28
CW-9.2		Design and Construction.....	28
CW-9.3		Measurement and Payment.....	29
CW-10.0		DRAINAGE SYSTEM AND APPURTENANT STRUCTURES	29
CW-10.1		Scope.....	29
CW-10.2		Materials.....	29
	CW-10.2.1	Non-Reinforced Concrete Drainage Pipes.....	29
	CW-10.2.2	Reinforced Concrete Drainage Pipes.....	29
	CW-10.2.3	PVC Pipes.....	30
	CW-10.2.4	Concrete Covered Rectangular Ditch.....	30
	CW-10.2.5	Bedding Material.....	30
CW-10.3		Construction.....	30
	CW-10.3.1	Trench Excavation and Backfill.....	30
	CW-10.3.2	Concrete Canal.....	31
	CW-10.3.3	Appurtenant Structures.....	31
CW-10.4		Pipe Installation.....	31
	CW-10.4.1	General.....	31
	CW-10.4.2	Non-Reinforced and Reinforced Concrete Drainage Pipes.....	31
CW-10.5		Measurement and Payment.....	32
	CW-10.5.1	Concrete Rectangular Ditch.....	32
	CW-10.5.2	Concrete Drainage Pipes and PVC Pipes.....	32
	CW-10.5.3	Appurtenant Structures.....	32
	CW-10.5.4	Bedding.....	32

CW-11.0	PERIMETER FENCE	32
CW-11.1	Scope	32
CW-11.2	Materials.....	33
	CW-11.2.1 Cement and Reinforcing Steel.....	33
	CW-11.2.2 Concrete Hollow Blocks (CHB).....	33
	CW-11.2.3 Fine and Coarse Aggregates and Water	33
	CW-11.2.4 Galvanized Barbed Wire	33
CW-11.3	Construction.....	33
CW-11.4	Measurement and Payment.....	35
	CW-11.4.1 Perimeter Barbed Wire Fence.....	35
CW-12.0	SECLUSION FENCE	35
CW-12.1	Scope	35
CW-12.2	Materials.....	35
	CW-12.2.1 Cement and Reinforcing Steel.....	35
	CW-12.2.2 Heavy Galvanized Cyclone Wire	35
	CW-12.2.3 Fine/Coarse Aggregates and Water	36
	CW-12.2.4 G.I. Pipes	36
	CW-12.2.5 Structural Steel	36
CW-12.3	Construction	36
CW-12.4	Measurement and Payment.....	36
	CW-12.4.1 Seclusion Fence Including Vehicular and Pedestrian Gate	36
CW-13.0	STEEL POLE WITH CROSS-ARMS AND BRACES	37
CW-13.1	Description	37
CW-13.2	Pole Requirements.....	37
CW-13.3	Pole Erection.....	37
CW-13.4	Measurement and Payment.....	38

TECHNICAL SPECIFICATIONS

CW – CIVILWORKS

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 Supplier's construction equipment, setting up of the Supplier's camp and the disposition of the Supplier's various facilities at the end of the Contract.

CW-1.2 Moving-in

The Supplier 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 Supplier shall submit 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 Supplier's Camp Facilities

The Supplier 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 Supplier deems necessary for maintaining health, peace and order in the camp and work areas. The areas that may be used by the Supplier within the plant site shall be designated by the NPC.

The Supplier shall provide, maintain and operate, such camps and facilities as are necessary for the housing, feeding and accommodation of his employees.

CW-1.4 Water Supply

The Supplier 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 Supplier 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 Supplier 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 Supplier 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 Supplier's operation, the Supplier 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 Supplier shall indemnify NPC against all liabilities, claims, damages and/or lawsuits arising thereto.

CW-1.7 Construction Power

The Supplier 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 Supplier choose 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 Supplier 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 Supplier 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 Supplier 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 Supplier, 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 Supplier. 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 Supplier's Construction Facilities. The entire cost thereof shall be included in the various pay items in the Schedule of Requirements.

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 Supplier 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 Supplier shall be responsible for dewatering foundation areas so that work can be carried out on a suitably dry condition. The Supplier 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 Supplier 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 Schedule of Requirements 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 Supplier shall ensure compliance with the applicable environmental and safety regulations, as well as ECC conditions, during installation/construction of this project through the implementation of measures that 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).
- 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 Supplier's compliance to the foregoing. The entire cost thereof shall be included in the various pay items in the Schedule of Requirements.

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 Supplier 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 Supplier shall perform clearing and grubbing on the project site. 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.

CW-4.2.2 Miscellaneous Works

Where shown on the drawings or if not shown but directed by the NPC, the Supplier 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 based on unclassified material that Supplier 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 Supplier as a basis for additional compensation over and above the contract unit prices.

Any over-excavation performed by the Supplier for any purpose or reason, except as may be ordered by the NPC, shall be at the Supplier's expense and

any excess of excavation shall be refilled, where required, with approved materials that shall be furnished, placed and properly compacted at the expense of the Supplier.

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 Schedule of Requirements.

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 17.24MPa. In no case shall filling and compaction work to be done without the presence of NPC's inspectors. The Supplier shall be held liable for any structural instability or damage that might result in consequence to non-compliance of this requirement. The Supplier 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 Supplier 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 Supplier. 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 Supplier shall rebuild such portion of the fill. In the case it is determined that the slip-outs was caused through the fault of the Supplier, the rebuilding of the fill shall be performed by the Supplier 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 by the Supplier. 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 Supplier at no cost to NPC. The Supplier 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 Supplier 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 Supplier.

CW-4.6 Environmental Requirements

All construction activities to be performed by the Supplier shall be in accordance with the restrictions stated in the approved Environmental Clearance Certificate (ECC) and the conditions set forth in Clause 3.0 – Environmental Requirements for Civil Works.

CW-4.7 Measurement and Payment**CW-4.7.1 Clearing and Grubbing**

Measurement for payment for Clearing and Grubbing shall be made on a lot basis. Corresponding cost hereof shall be included in the unit bid price of Site Development item in the Schedule of Requirements.

CW-4.7.2 Miscellaneous Works

Measurement for payment for miscellaneous works such as demolition, restoration, etc., shall be made on a lot basis unless otherwise specified in the Schedule of Requirements. 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-4.7.3 Stripping

Unless otherwise specified in the Schedule of Requirements, 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 Schedule of Requirements.

CW-4.7.4 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 Schedule of Requirements, 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-4.7.5 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 Schedule of Requirements, 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 Supplier 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 Supplier shall determine his/her 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 Supplier 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

SECTION VI – TECHNICAL SPECIFICATIONS

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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 Supplier 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 Supplier 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 Supplier 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 Supplier 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 Supplier 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 Supplier 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 Supplier as stated in CW-5.3.1b.

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-5.2.3.

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 cm² 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

No separate measurement and payment will be made for Structural Excavation. Corresponding cost hereof shall be included in the unit bid price of relevant item(s) in the Schedule of Requirements.

CW-5.4.2 Structural Foundation Fill

No separate measurement and payment will be made for Structural Fill. Corresponding cost hereof shall be included in the unit bid price of relevant item(s) in the Schedule of Requirements.

CW-5.4.3 Special Foundations

No separate measurement and payment will be made for Special Foundations. Corresponding cost hereof shall be included in the unit bid price of relevant item(s) in the Schedule of Requirements.

CW-5.4.4 Structural Backfill

No separate measurement and payment will be made for Structural Backfill. Corresponding cost hereof shall be included in the unit bid price of relevant item(s) in the Schedule of Requirements.

CW-5.4.5 Trench Excavation and Backfill for Sewerage, Drainage and Water Supply Pipes and Cable Trench

No separate measurement and payment will be made for trench excavation and backfill for all sewerage, drainage and water supply pipes. The entire cost thereof shall be included in the various pay items in the Schedule of Requirements.

CW-6.0 CONCRETE**CW-6.1 Scope**

In accordance with the specifications contained in this section, the Supplier 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 Supplier 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 Supplier 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 of 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 Supplier 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 Supplier 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 Supplier 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 Supplier 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 Supplier's expense.

SECTION VI – TECHNICAL SPECIFICATIONS

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The expense of making and curing all concrete specimens including the materials comprising the concrete specimens shall be borne by the Supplier. The cost of shipping and testing the concrete shall likewise be at the expense of the Supplier.

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 Supplier 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 Supplier 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

No separate measurement and payment will be made for concreting works that are associated to various construction and/or installation/erection works. The corresponding cost thereof shall be included in the unit bid price of relevant pay item(s) in the Schedule of Requirements.

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 reinforcement steel 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 Supplier shall notify the NPC in sufficient time in advance to permit sampling and testing before shipment is made. Three (3) samples from each size 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 Supplier 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 Supplier 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 Supplier.

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 6mm Φ to 20mm Φ inclusive	D=6d
Bars 25mm Φ and 28mm Φ	D=8d
Bars 32mm Φ 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 mm Φ . 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 Supplier 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 Supplier 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 Supplier.

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:

<u>Splice Type</u>	<u>Grade 40 Min.Lap</u>	<u>But Not Less Than</u>
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 (1 1/2) turns or by butt-welding unless otherwise shown on the drawings.

CW-7.4 Measurement and Payment

No separate measurement and payment will be made for reinforcing steel. The corresponding cost thereof shall be included in the various pay items in the Schedule of Requirements.

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 Supplier 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, scale 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 Steel Work:

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 high quality workmanship 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 bolt holes.

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 Supplier 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 Testing¹: 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

No separate measurement and payment will be made for Structural Steel. The corresponding cost thereof shall be included in the various pay items in the Schedule of Requirements.

CW-9.0 REINFORCED CONCRETE FOUNDATION AND ASSOCIATED STRUCTURES FOR EQUIPMENT AND OTHER COMPONENT (DESIGNED/CONSTRUCTED BY SUPPLIER)

CW-9.1 Scope

In accordance with the specification contained in this section, the Supplier shall design and furnish all materials, labor, equipment and tools to construct all reinforced concreting and relevant works based on the approved drawings or as directed by NPC.

CW-9.2 Design and Construction

The design and construction of reinforced concrete foundations and other elements for equipment and related component to be furnished by the Supplier shall be the responsibility of the Supplier. Reinforced concrete foundations shall be designed based on the actual weights, dimensions and relevant design parameters of the equipment and structures subject to NPC's evaluation and approval. No foundation and structural elements shall be constructed unless its design is duly approved in writing by NPC.

The minimum design parameters to be considered by the Supplier are as follows:

1. Compressive strength of concrete shall be 20.7 MPa at 28 days
2. Reinforcing steel shall conform to Philippine National Standards grade DSB 275
3. Compacted sand and gravel bedding shall be 150 mm thick
4. Soil bearing capacity shall be subject to the Supplier's determination and verification at the site
5. Wind velocity: 270 kph
6. Concrete pad or pedestal shall extend 150 mm beyond the equipment skid/base on all sides or at least 50 mm beyond the base plate of equipment supports
7. Top of foundations/pedestals shall be 300 mm above the finished ground elevation

¹Not applicable on non-critical structures/joints and as directed/required by NPC Design Engineer.

8. Anchor bolt materials shall be A325 with nuts and washers. Sizes and number of anchor bolts shall be designed to safely withstand all forces acting on the equipment/structures. Anchor bolts and other embedded items shall be properly and securely installed prior to the placing/pouring of concrete.

All works and materials shall be constructed, installed and/or erected to conform with the relevant sections of this Specifications and in accordance with the generally accepted engineering techniques and methodologies.

CW-9.3 Measurement and Payment

Unless otherwise indicated in the Schedule of Requirements, no separate measurement and payment will be made for the design and construction of reinforced concrete foundation and/or other structural elements of the equipment and their related components. The entire cost of furnishing of all materials, labor, equipment and tools for the entire works shall be included in the item as specified in the schedule of requirements.

CW-10.0 DRAINAGE SYSTEM AND APPURTENANT STRUCTURES

CW-10.1 Scope

In accordance with the specifications contained herein, the Supplier 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 Supplier shall also construct or install, where required, 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. as well as joints and connections as may be required to complete the system.

CW-10.2 Materials

CW-10.2.1 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-10.2.2 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-10.2.3 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-10.2.4 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-5.0.

CW-10.2.5 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-10.3 Construction**CW-10.3.1 Trench Excavation and Backfill**

Trench excavation and backfill work shall be done in accordance with the pertinent provisions of Section CW-5.0.

CW-10.3.2 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-10.3.3 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-10.4 Pipe Installation**CW-10.4.1 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 Supplier at his expense.

CW-10.4.2 Non-Reinforced and Reinforced Concrete 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 joining 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

SECTION VI – TECHNICAL SPECIFICATIONS

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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-10.5 Measurement and Payment**CW-10.5.1 Concrete Rectangular Ditch**

No separate measurement and payment will be made for rectangular ditch and other channels. The entire cost thereof shall be included in unit bid price of relevant item(s) in the Schedule of Requirements.

CW-10.5.2 Concrete Drainage Pipes and PVC Pipes

No separate measurement and payment will be made for concrete drain pipes, and perforated PVC pipes in place and accepted. Corresponding cost hereof shall be included in the unit bid price of relevant item(s) in the Schedule of Requirements.

CW-10.5.3 Appurtenant Structures

Measurement and payment for appurtenant structures like open RC canal, septic tank, oil water separator, drain pit, catch basin, 50mm dia. and 100mm uPVC shall be included in the unit bid price of specified in the Schedule of Requirements.

CW-10.5.4 Bedding

No separate measurement and payment will be made for Sand Bedding for Pipes, and item, Concrete Cradle for Pipes. Corresponding cost hereof shall be included in the unit bid price of relevant item(s) in the Schedule of Requirements.

CW-11.0 PERIMETER FENCE**CW-11.1 Scope**

In accordance with the specifications contained herein, the Supplier shall furnish all labor, materials, equipment and tools for the construction of perimeter fence with to the length or extent shown on the drawing or as established in the field.

CW-11.2 Materials**CW-11.2.1 Cement and Reinforcing Steel**

Cement and reinforcing steel shall conform to the requirements set forth in Section CW-6.0 – Concrete. Class of concrete shall be 20.7MPa or as shown on the drawings.

CW-11.2.2 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-11.2.3 Fine and Coarse Aggregates and Water

Fine and coarse aggregates and water shall conform to the requirements stated in CW-6.0 – Concrete.

CW-11.2.4 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.

CW-11.3 Construction

- a. Excavation, backfilling and concreting work shall be in accordance with the applicable provisions of Section CW-5.0 – Structural Excavation, Fill and Backfill and Section CW-6.0 – Concrete, respectively.

- b. CHB Construction

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.

Cutting and Patching – Cutting and patching of masonry required to accommodate the work of other trades shall be performed by masonry mechanics.

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.

c. **Mortar Proportions**

- 1) 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.
- 2) 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.
- 3) All horizontal reinforcement shall be tied to vertical reinforcement.

d. **Fabrication and installation of vehicular and pedestrian gates shall conform to the requirements of the drawings or as directed by the NPC.**

e. **All welding work shall conform to the Specifications for Welded Highway and Railway Bridges of the American Welding Society (AWS).**

Galvanized surfaces to be painted, in addition to being cleaned with mineral spirits or other solvents, will require surface treatment to which paint will adhere. The galvanized surfaces, therefore, shall be coated with a solution of 7.5 grams of copper sulfate to a liter of water, allowing the coating to remain on the surface of at least twelve (12) hours, and dusting off with stiff brushes.

Surfaces to be painted shall be clean, dry, smooth and free from dust, rust, grease or oil. Sufficient time shall be allowed between coats of paints to insure complete drying but in no case less than 24 hours. No painting shall take place during the presence of rain, fog, dew or where the surfaces may otherwise be damp. All work shall be done in a high quality workmanship manner, leaving finished surfaces free from runs and sags.

CW-11.4 Measurement and Payment**CW-11.4.1 Perimeter Barbed Wire Fence**

Unless otherwise specified in the Schedule of Requirements, measurement for payment shall be based on the number of linear meters of perimeter barbed wire fence including barbed wire installed, vehicular and pedestrian gates constructed and accepted.

Payment for perimeter barbed wire fence shall be made at the corresponding contract unit price for perimeter barbed wire fence, shown on the Schedule of Requirements, which payment shall include the cost of furnishing all labor, materials, equipment and tools necessary for the construction of seclusion fence including reinforced concrete posts, CHB wall and footing, excavation and backfill.

CW-12.0 SECLUSION FENCE**CW-12.1 Scope**

In accordance with the specifications contained herein, the Supplier shall furnish all labor, materials, equipment and tools and shall construct the seclusion fence including vehicular and pedestrian gate to the length or extent shown on the drawings or as established in the field.

CW-12.2 Materials**CW-12.2.1 Cement and Reinforcing Steel**

Cement and Reinforcing steel shall conform to the requirements set forth in the Section CW-6.0 – Concrete. Class of concrete shall be 20.7MPa or as shown on the drawings.

CW-12.2.2 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 of 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.

At the option of NPC, Heavy Galvanized Cyclone wire delivered to the site shall be tested. One roll from every fifty (50) rolls or fraction thereof shall be taken at random as a sample for test purposes, except in no case shall less than two (2) samples be tested. To determine compliance with the requirements of this specification, the test specimens for each of the test specified shall be taken from the outside end of the sample rolls representing

SECTION VI – TECHNICAL SPECIFICATIONS

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the lot. If any specimen tested fails to meet the requirements of this specification, the roll represented by the specimen shall be rejected and two (2) additional rolls shall be tested, both of which shall meet the requirements in every respect, otherwise the lot represented by the sample may be rejected.

CW-12.2.3 Fine/Coarse Aggregates and Water

Fine and coarse aggregates and water shall conform to the requirements stated in Section CW-6.0 – Concrete.

CW-12.2.4 G.I. Pipes

Galvanized iron pipes for the seclusion fence and gates shall conform to ASTM A120-68A.

CW-12.2.5 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-12.3 Construction

- a) Excavation, backfilling and concreting work shall be in accordance with the applicable provisions of Section CW-5.0 – Structural Excavation, Fill and Backfill and Section CW-6.0 – Concrete.
- b) Fabrication and installation of the heavy galvanized cyclone wire seclusion fence and gate shall be in accordance with the drawings or as directed by the NPC.
- c) All welding work shall conform to the Specification for Welded Highway and Railway Bridges of the American Welding Society (AWS).

CW-12.4 Measurement and Payment**CW-12.4.1 Seclusion Fence Including Vehicular and Pedestrian Gate**

Unless otherwise specified in the Schedule of Requirements, measurement for payment shall be based on the number of linear meters of seclusion fence including pedestrian gate constructed and accepted.

Payment for seclusion fence shall be made at the corresponding contract unit price for seclusion fence, shown on the Schedule of Requirements, which payment shall include the cost of furnishing all labor, materials, equipment and tools necessary for the construction of seclusion fence including reinforced concrete posts, CHB wall and footing, excavation and backfill.

CW-13.0 STEEL POLE WITH CROSS-ARMS AND BRACES**CW-13.1 Description**

This specification covers the technical and associated requirements for the supply and erection of steel pole complete with cross arms and braces.

CW-13.2 Pole Requirements

The poles shall be manufactured and supplied with the required holes, rigging accessories, insulator attachment plates, lugs for bolted steps, guying attachments, ground clamps complete with bolts, nuts, washers and miscellaneous fittings, whenever necessary, and shall have the following properties of steel poles:

Description	40' (12.20 m)	35' (10.65 m)	30' (9.15 m)	25' (7.62 m)
Steel Material	ASTM A572	ASTM A572	ASTM A572	ASTM A572
Tip Diameter	200 mm	200 mm	200 mm	150 mm
Butt Diameter	320 mm	300 mm	260 mm	240 mm
Thickness	4 mm	4 mm	4 mm	4 mm
Shape	Octagonal	Octagonal	Octagonal	Octagonal
Minimum Yield Strength	345 MPa	345 MPa	345 MPa	345 MPa

The tip and butt shall be covered with plate similar to body thickness.

Cross arm and brace members, if required in the Bid Drawings, shall be of the same material as pole body and shall conform to NPC's general arrangement drawings. The strength of the attachment of cross arms to the body shall be sufficient to develop the full capability of the cross arm.

Hole location and diameters for steel poles and cross-arms/braces shall be referred to EEICD drawings.

All structural steel, bolts, nuts and washers shall be hot-dip galvanized after fabrication in accordance with ASTM A123 with minimum zinc thickness of 85 microns. Exposed welds shall be mechanically cleaned.

CW-13.3 Pole Erection

The Supplier shall use standard and accepted practice and method of erecting the poles depending on their location. The Supplier shall excavate holes for poles setting to a depth indicated below:

Depth of Pole Setting					
Length of Poles		In Earth		In Rock	
Meter	Feet	Meter	Feet	Meter	Feet
12.20	40	1.80	5.9	1.22	4.0
10.67	35	1.65	5.4	1.22	4.0
9.15	30	1.52	5.0	1.22	4.0
7.62	25	1.40	4.6	1.22	4.0

All holes shall be dug in the correct locations and shall be large enough to provide for the use of tamping bars all around the poles to the full depth of the holes.

All poles shall be set truly vertical and exact in alignment. After the poles have been set and aligned properly, the holes shall be backfilled with materials consisting of 20% sand AND 80% gravel. The gravel and sand material shall be filled around the holes and compacted thoroughly at 30 cm (12 inches) layer by tamping tools before placing the next 30 cm layer of gravel and sand, until the backfill material reaches the ground surface level. Materials from the excavated holes shall be placed and tamped around the poles to a height of 30 cm. (12 inches) above ground line and shall be spread sloping radially outward until it intersects with the ground surface.

The cross-arms and hardware shall be assembled and installed properly in accordance with the drawings. All nuts and locknuts shall be adequately tightened.

Braces such as flat and x-braces, shall be attached where required. The braces shall be attached by the Supplier in accordance with the drawings. All nuts shall be tightened adequately.

CW-13.4 Measurement and Payment

Measurement for payment for steel pole shall be based on the total quantity of steel pole supplied, erected and accepted by NPC.

Measurement for payment for cross-arms and braces shall be on lot basis of cross-arms and braces supplied, installed to the respective poles and accepted by NPC.

Payment will be made at the contract unit price for the items, Steel Pole and; Steel Cross-arms and Braces in the Schedule of Requirements, which payment shall constitute full compensation for furnishing of all materials, labor and hardware and accessories necessary to complete the items.

SECTION VI

PART I-TECHNICAL SPECIFICATIONS

ELECTRICAL WORKS

EW 1.0 – SOLAR PV SYSTEM

EW 2.0 – ENERGY STORAGE SYSTEM

**EW 3.0 – POWER AND ENERGY
MANAGEMENT SYSTEM**

EW 4.0 – LIGHTING SYSTEM

EW 5.0 – GROUNDING SYSTEM

**EW 6.0 – SWITCHYARD EQUIPMENT AND
APPURTENANCES**

EW 7.0 – 13.8KV TIE LINE

SECTION VI

PART I-TECHNICAL SPECIFICATIONS

ELECTRICAL WORKS

EW 1.0 – SOLAR PV SYSTEM

PART I – TECHNICAL SPECIFICATIONS**EW – ELECTRICAL WORKS****EW – 1.0 – SOLAR PV SYSTEM****TABLE OF CONTENTS**

<u>CLAUSE NO.</u>	<u>TITLE</u>	<u>PAGE NO.</u>
EW-1.0	SOLAR PV SYSTEM	1
EW-1.1	Technical Specifications of the PV Components.....	1
EW-1.2	Solar PV Modules	1
EW-1.3	String Inverters.....	2
EW-1.4	DC Boxes.....	3
EW-1.5	AC Combiner Boxes	4
EW-1.6	SPP Digital Energy Meter	5
EW-1.7	DC and AC Switches	6
EW-1.8	Power Cables and Accessories	7
EW-1.9	Grounding and Surge Protection.....	7
EW-1.10	Solar PV Plant (SPP) Transformer.....	8
	EW-1.10.1 General.....	8
	EW-1.10.2 Technical Requirements.....	8
	EW-1.10.3 Design Requirements	10
	EW-1.10.4 Design and Construction Features	12
	EW-1.10.5 Fittings and Accessories	14
	EW-1.10.6 Equipment and Marking.....	14
	EW-1.10.7 Standard and Common Tools.....	15
	EW-1.10.8 Tests	15
	EW-1.10.9 Failure to Meet Guarantees.....	16
	EW-1.10.10 Data and Documentation Requirements	16
EW-1.11	Job Site Cameras.....	17
	EW-1.11.1 Technical Characteristics.....	17
	EW-1.11.2 Technical Requirements.....	18
EW-1.12	Measurement of Payment	18



PART I – TECHNICAL SPECIFICATIONS**EW – ELECTRICAL WORKS****EW-1.0 SOLAR PV SYSTEM****EW-1.1 Technical Specifications of the PV Components**

This section provides the definition, functional/performance requirements, technical specifications and standards for the Solar PV modules, Mounting structures, Inverters, AC and DC switches and protections, etc.

EW-1.2 Solar PV Modules

- a) Rated Capacity of the Solar PV Power Plant shall be based on the AC side.
- b) The modules to be supplied shall have the same manufacturer and model for all installations required in this document, including required number of spares.
- c) The Solar PV modules shall be crystalline silicon type. The Supplier shall provide PV modules of the same type, brand, capacity and specifications to avoid mismatch losses. PV modules shall have a minimum efficiency of 19%.
- d) The Solar PV modules shall be designed, manufactured and tested in accordance with, but not limited to, the latest issue of the following codes and standards:

IEC	61215	Crystalline silicon (c-Si) terrestrial PV modules – Design qualification and type approval
IEC	61730-1	PV module safety qualification – Requirements for construction
IEC	61730-2	PV module safety qualification – Requirements for testing
IEC	61701	Salt mist corrosion testing of photovoltaic (PV) modules

A copy of the type qualification/test certificates of the PV module issued by authorized international organization in accordance with the abovementioned standards shall be submitted during post-qualification. Use of other standards shall be subject to the approval of the National Power Corporation.

- e) Solar PV Module shall be manufactured by a Tier 1 category listed by Bloomberg New Energy Finance. The bidder shall submit a copy of the Latest list of Tier 1 manufacturer by Bloomberg New Energy Finance



latest report during post-qualification reckoned from the bid opening date.

- f) The Solar PV modules shall be mounted on structures that are specified in this document and shall comply with NPC requirements.
- g) In accordance with EN 50380 - Datasheet and nameplate information for photovoltaic modules, each module shall carry the following minimum information:
 - 1. Name and logo of original manufacturer or supplier
 - 2. Type designation and serial number
 - 3. Maximum system voltage
 - 4. Rated nominal power (P_{max}) at STC
 - 5. Short circuit current (I_{sc}) at STC
 - 6. Open circuit voltage (V_{oc}) at STC
 - 7. Voltage at maximum power point (V_{max}) at STC
 - 8. Current at maximum power point (I_{max}) at STC
- h) Protective devices against surges at the PV module shall be provided. By-pass diodes shall be provided in the PV modules.
- i) Module Junction box shall be designed for long life outdoor operation and compliant to IP65 protection or approved equivalent.
- j) The manufacturer of the Solar PV module shall be **ISO 9001 and ISO 14001** certified. A copy of the valid ISO certification shall be submitted during post-qualification.
- k) The SPV modules shall have one make / model. Its outputs shall be within the tolerance of +/- 3% in each string to avoid array mismatch losses.

EW-1.3 String Inverters

- a) Each string inverter shall have at least one (1) Maximum Power Point Tracker (MPPT). The MPPTs shall automatically operate the Solar PV plant. It shall be microprocessor/microcontroller-based to minimize power losses and maximize energy utilization.
- b) The inverter shall match the solar PV plant capacity while achieving optimum system efficiency. The total harmonic distortion shall not be more than 5%.
- c) The efficiency of the inverter shall not be less than **95% at rated capacity**.
- d) The inverter shall be equipped with a Modbus Interface.
- e) Inverter shall be transformerless and IP65 degree of protection and shall comply with IEC 60529/UL50E. Climatic category shall comply with IEC60721-3-4 or IEC 60068.



- f) The furnished inverters shall have built-in or installed controller or control functionalities that has provisions for integrations with higher levels of control/management systems.
- g) The string inverters shall be of the grid-interactive type. It shall have protection against overvoltage and unintentional islanding that detects islanding conditions and automatically disconnects the system from the grid. The solar PV system will be automatically reconnected to the grid when the power has been restored.
- h) The string inverters shall conform with, but not limited to, the latest issue of the following codes and standards.

IEC	62109-1	Safety of power converters for use in photovoltaic power systems – General Requirements
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IEC	62109-2	Safety of power converters for use in photovoltaic power systems – Particular Requirements for inverters
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IEC	62116	Utility-interconnected photovoltaic inverter – Test procedure of islanding prevention measures
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A copy of the certification and approvals in accordance with the abovementioned standards shall be submitted during post-qualification. Use of other standards shall be subject to the approval of the National Power Corporation.

- i) The inverter shall be rated for outdoor operation. It shall be placed away from direct sunlight and shall be provided with necessary housing or protection, if necessary, to ensure its maximum service life.
- j) The inverter shall be able to provide logged data on power generated per period (configurable). The inverter shall have a minimum display parameters of AC output power, AC output voltage, AC output current, frequency, PV Array voltage, PV Array current (A), AC energy yield and Events/Errors.
- k) The inverter load ratio shall be within 0.9 – 1.1 otherwise within the limits recommended by the manufacturer of the string inverter to avoid under and oversizing of the inverter.
- l) Inverters shall have output curtailment functionalities. In the event that the Solar PV system production is at optimum, the energy storage batteries are fully charged, and the load demand is low, the inverter shall be able to control its output to match the prevailing demand.

EW-1.4 DC Boxes

- a) The DC Boxes shall be dust proof, vermin and waterproof and sturdy and shall have at least IP65 Protection. It shall be mounted on the PV module support structures.



- b) The DC Boxes shall have suitable cable entry points fitted with cable glands of appropriate sizes for both incoming and outgoing cables. Proper markings shall be provided on the bus bar for easy identification and cable ferrules shall be fitted at the cable termination points. The bus bars shall be made of copper of appropriate capacity with adequate safety factor.
- c) The DC Boxes shall have suitable arrangement for the following:
 - 1. Incoming DC cables from the solar array
 - 2. DC isolation switch/circuit breaker per String
 - 3. At least type II DC surge protection device (SPD)
 - 4. Outgoing DC cables to the string inverter
 - 5. Provision for earthing
- d) The DC Boxes shall be permanently marked and labeled. It shall have swinging doors or covers and shall be accessed by a lock or other approved means.
- e) If the string inverters have a built-in DC protection/disconnect switch and DC SPDs (at least type II) per string, the Supplier may opt to supply a separate DC combiner box, DC SPDs and disconnects.
- f) The DC circuit breakers shall be Compact with Thermal Magnetic Trip Unit Type, Miniature Circuit Breaker (MCB). Rating of the circuit breakers shall be appropriate for the proposed design of the supplier. The rating of the breaker shall be verified by NPC for approval.

EW-1.5 AC Combiner Boxes

- a) The AC Combiner box shall be dust proof, vermin proof, waterproof, sturdy and shall be IP65 rated.
- b) The AC Combiner box shall have suitable cable entry points fitted with cable glands of appropriate sizes for both incoming and outgoing cables. Proper markings shall be provided on the bus bar for easy identification and cable ferrules shall be fitted at the cable termination points. The bus bars shall be made of copper of appropriate capacity with adequate safety factor.
- c) The AC combiner box shall have suitable arrangement for the following:
 - 1. Incoming cables from each string inverter
 - 2. AC circuit breakers of each string inverter
 - 3. Main AC circuit breaker
 - 4. At least type II AC surge protection devices (SPD)
 - 5. Digital Metering System
 - 6. Outgoing cables to the low voltage side of the SPP Transformer
 - 7. Provision for earthing
- d) The AC combiner box shall be permanently marked and labeled. It shall have swinging doors or covers and shall be accessed by a lock or other approved means.



- e) The AC combiner box shall be provided with digital metering system with display window capable to measure single and three phase electrical parameters through respective control switches. It shall be able to interface with the hybrid controller. Digital meter to be used shall meet the minimum specifications requirement stated in EW-1.6 SPP Digital Energy Meter.
- f) The supplier shall provide adequate surge protection devices. If the string inverters have a built-in AC SPDs (at least type II), the Supplier may opt to supply a separate AC SPDs per inverter in the AC combiner box.
- g) The AC circuit breakers shall be Compact with Thermal Magnetic Trip Unit Type, Molded Case Circuit Breaker (MCCB). Rating of the circuit breakers shall be appropriate for the proposed design of the supplier. The rating of the breaker shall be verified by NPC for approval.

EW-1.6 SPP Digital Energy Meter

This specification covers the technical and associated requirements for the SPP digital energy meter including instrument transformer and accessories required for the electric generating plants.

EW-1.6.1 Technical Characteristics and Requirements

The SPP digital energy meter shall be furnished and installed by the Supplier as shown on the bid drawings complete with housing and associated metering instruments transformers (current transformers) of appropriate burden and accuracy and other accessories for outdoor metering purposes. It shall be capable to measure the power generated and received by the Solar PV Plant. It shall be designed to operate continuously for the normal life of the meter. The digital energy meter shall meet the following minimum requirements:

ITEM	DESCRIPTION	REQUIREMENTS
1	Number of Wires	4
2	Voltage, V	120-480
3	Current Range	Class 10
4	Frequency, Hz	60
5	Register Type	LCD
6	Soft Switches	Available
7	LCD Display	Programmable
8	The Kilowatt-hour meter to be provided is certified and approved by ERC	Yes
9	Communication Port for Kilowatt-hour meter	To be Provided
10	Metering Current Transformer	
	a. Application (Indoor/Outdoor)	Outdoor
	b. Insulation type	Full cast epoxy resin
	c. Primary rated current, A	250



	d. Secondary rated current for all windings, A	5
	e. No. of cores	One (1) core Secondary CT
	f. CT ratio	250:5 A
	g. Accuracy class	0.3 or better
	h. Burden, VA	2.5
	i. BIL, kV	10

The SPP digital energy meter shall have but not limited to the following features:

1. Pilferage proof
2. Tamper Proof
3. Wrong Wiring Alarm
4. Current Flow display
5. Can withstand the temperature of -20°C to +70°C and Humidity of up to 95% non-condensing
6. With back light display
7. With built-in battery for LCD display and back-up battery
8. TOU Programmable Ready
9. Measure display (Energy, RMS voltage & current per phase, Reactive & Apparent Power, Power factor, Frequency, Calendar, Time and etc.)

The Solar PV Plant (SPP) digital energy meter with the required metering instruments shall be enclosed by the distribution panel/AC combiner box or, if needed, by a separate enclosure for proper protection and safety against water droplets, dust, exposure of energized conducting material and the like without additional cost to NPC.

For SPP digital energy meter, communication ports shall be provided or available in the energy meter exclusively intended for electronic reading, hence reading the data determined from the computer remotely from the meter. Electronically gathering of data can logged parameters to the computer such as instantaneous parameters, billing information, load survey, events or tampers, transactions, etc.

EW-1.7 DC and AC Switches

a) DC Side

1. Each string of the Solar PV shall be provided with a circuit breaker for isolation and maintenance purposes. Circuit breakers shall be listed for use in DC circuit and shall have the appropriate voltage, current and interrupting capacity ratings.
2. DC Circuit breakers shall be sized to carry not less than 125 percent of the total rated short circuit current of the string/array.

b) AC Side

1. Main Circuit Breaker of appropriate rating shall be provided for connection and disconnection of Solar PV plant and the grid.



2. Each inverter shall be provided with circuit breakers. The rating of the circuit breakers shall be based on the output rating of the inverter.

EW-1.8 Power Cables and Accessories

- a) Power cables of adequate current and voltage insulation rating shall be required for the interconnection of:
 - Modules/panels within the PV array
 - PV array and Inverter
 - Inverter
 - AC combiner box
- b) DC Power cables shall be suitable for outdoor installation, stranded copper/aluminum conductor, UV resistant, flame retardant, halogen free crosslinked type insulation.
- c) AC Power cables shall be suitable for outdoor installation with adequate abrasion, UV and water resistance. It shall have polyvinyl chloride insulation and covered with tough protective sheath of nylon complying to UL standard or any equivalent. It shall be THHN/THWN-2 type with sizes intended for its use.
- d) Size of all cables shall be selected to keep the voltage drop and losses to the acceptable minimum level. The permissible voltage drop on the DC side shall be $\leq 1\%$ at full power.
- e) The ampacity of the conductors shall be equal to or greater than the rating of the overcurrent protection device.
- f) DC Cables shall be terminated with tinned copper end-ferrules to prevent fraying and breaking of individual wire strands. A marking near the terminals to indicate the destination of each cable shall be provided for future maintenance. It shall be designed for heavy duty operation, 1.1kV grade, insulated and stranded copper conductor. Its insulation shall be UV and moisture resistant. MC4 connectors shall conform with EN 50521 and Philippine Electrical Code
- g) AC conductor shall be either of Class 1 or Class 2 of plain or metal-coated annealed copper or plain aluminum alloy, or of class 5 plain or metal-coated copper in accordance with IEC 60228. AC conductors shall be constructed and tested in accordance IEC 60227 Part I & II.
- h) All cables installation shall be provided with protective raceway. Proper cable management shall be observed to ensure maximum service life of the cables.

EW-1.9 Grounding and Surge Protection

- a) The Solar PV power system & structures shall be grounded properly using adequate number of earthing kits. All metal casing or shielding, PV module frame and mounting structure of the Solar PV power system shall be grounded to ensure safety. Grounding materials/equipment



and design shall comply in accordance to governing standards and regulations in grounding system (PEC, NEMA, IEC and IEEE standards).

- b) All grounding and lightning conductors shall observe safe distance to prevent any damage to the equipment and property.
- c) The Solar PV power system shall be provided with lightning & surge protection. The purpose of this protection is to reduce the over voltage to a tolerable value before it reaches the PV or other sub-system components. Lightning and surge materials/equipment shall comply in accordance to governing standards and regulations, (PEC, NEMA, IEC and IEEE standards).
- d) The specification of lightning and surge protection shall provide optimum filtering in relation with the specification required by the proposed inverter and PV panels. The surge protection device must be compact and shall comply in accordance to the UL 1449 3rd edition testing, ANSI/IEEE C62 and ANSI/IEEE Std. 1100-1999.
- e) Surge protection device shall be marked with a short circuit current rating and shall not be installed at a point on the system where the available fault current is in excess of that rating.
- f) The Solar PV power plant shall be provided with an automatic ground-fault protection device or system. The ground – fault protection shall be capable of detecting a ground fault, providing an indication of the fault, interrupting the flow of fault current and automatically disconnects the conductors and/or shuts off the inverter for that portion faulted array.

EW-1.10 Solar PV Plant (SPP) Transformer

EW-1.10.1 General

This specification covers the technical and associated requirements for the SPP transformer and accessories for use in electric generating plants. The rating of this transformer is specified in the **Technical Data Sheets** and in **GW –6.0 Supplier's Scope of Works**. The supplied transformer shall be in accordance with the latest revision of IEEE Std. C57.12.00.

EW-1.10.2 Technical Requirements

The supplied SPP transformer for Palanan Solar PV Plant shall meet the following minimum requirements:

ITEM	DESCRIPTION	REQUIREMENTS
1	Type of Cooling	ONAN
2	Insulation	Mineral Oil with its electrical and chemical characteristics is compliant with IEC and is Polychlorinated Biphenyls (PCB) free



3	Type	Two-winding Transformer
4	Audible Sound Level	Refer to Table specified under EW-1.10.3.8
5	Vector Group	YNd11
6	Temperature	
	a. Ambient Temperature	40°C
	b. Temperature Rise	65 °C
7	Winding Connection	
	• H-Winding	Wye with Neutral Grounded
	• X-Winding	Delta
8	Insulation Level	
	a. Nominal Voltage Level, kV	
	▪ H-winding	13.8
	▪ X-winding	0.48
	b. Highest Voltage Level, kV	
	▪ H-winding	15
	▪ X-winding	1.2
	c. Basic insulation level, kV	
	▪ H-winding	95
	▪ X-winding	30
9	Winding Material	100% Copper
10	Bushing Material	Porcelain
11	% Impedance at Rated kVA	Manufacturer's Data
12	Efficiency	
	a. At 100% load	By Supplier
	b. At 75% load	By Supplier
13	Tap Changer	No-Load
14	Taps	
	a. H-Winding	13.8 kV \pm 2 x 2.5%
	b. X-Winding	N/A
15	Transformer Losses	
	a. No-Load Loss, W	By Supplier
	b. Load Loss, W	By Supplier
16	Tolerances	
	a. No-Load & Load Loss	Not more than 10% of the manufacturer's specified value
	b. Total Loss	Not more than 6% of the manufacturer's specified value
	c. Impedance	\pm 10% of the manufacturer's specified value
17	Ground Terminal Connection	Suitable for 100 mm ² copper conductor



18	Weight of oil, kg	By Supplier
19	Total Weight, kg	By Supplier
20	Test and Experience Requirements	
20.1	Test Requirements ¹	
	a. Routine Test to be performed	Yes
	b. Certified Design and Routine Test Reports to be submitted	Yes

EW-1.10.3 Design Requirements**EW-1.10.3.1 Rating**

The transformer rating specified in the Technical Data Sheets shall be the basis of the Supplier'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.

EW-1.10.3.2 Voltage

The transformer to be supplied shall be designed to withstand the over voltages for the duration of voltage excursions which may be expected as a result of full load rejection of the inverters.

EW-1.10.3.3 Frequency

Frequency for operation shall be 60 Hz.

EW-1.10.3.4 Overload Requirement

The overload rating and operation shall be in accordance with all cyclic loading duties as specified in IEC 60076-7. 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 Supplier shall specify these limitations in his proposal.

EW-1.10.3.5 Short Circuit Withstand Capability

The transformer shall withstand the mechanical and thermal stresses produced by external short-circuit currents specified in IEEE Std. 57.12.00 (latest revision)

EW-1.10.3.6 Transformer Loss Evaluation

Depending on the requirement stated in the Technical Data Sheets, the Supplier is required to fill-in all the information for the transformer losses in the Technical Data Sheets for the SPP transformer and station service/dry-type 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 Test Report of a licenser instead of the Supplier's Manufacturer shall not be accepted.



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.

EW-1.10.3.7 Impedance and Reactance

The impedance and reactance shall be stated in the Proposal.

EW-1.10.3.8 Audible Sound Level

Sound levels decibels (dB) at rated voltage and frequency for liquid immersed SPP transformer shall be as below. The average sound level of the transformer shall not exceed these values when measured in accordance with the conditions outlined in the latest ANSI/IEEE C57.12.90 or IEC 60076-10 for oil-immersed transformers or ANSI/IEEE C57.12.91 or IEC 60726 for dry-type transformers.

Equivalent Two-winding, kVA	Average Sound Level, dB
1-50	48
51-100	51
101-300	55
301-500	56
750	57
1000	58
1500	60
2000	61
2500	62

EW-1.10.3.9 Tolerances

The transformer shall be designed and manufactured with tolerances in accordance with applicable ANSI/IEC/IEEE standards.

EW-1.10.3.10 Electrical Insulating Oil

The Supplier shall furnish oil with quality suitable as an insulant and coolant for transformers. The oil shall be new napthenic based mineral oil meeting the requirements of the latest ASTM D3487 (Specification of Mineral Insulating Oil Used in Electrical Apparatus).

Insulating liquid must not contain more than 2PPM of Polychlorinated Biphenyl (PCB), classified as "PCB free". The Supplier shall submit a certification from the manufacturer of the transformer that the transformer oil does not contain PCB and the laboratory analysis shall be conducted in a DENR-Accredited Laboratory.

The Supplier shall state the commercial name and specifications of the oil to be furnished. NPC reserves the right in the future to use any oil which meets



the above specifications and the use of such oil shall not affect the Supplier's guarantee.

EW-1.10.4 Design and Construction Features

EW-1.10.4.1 General

The transformer design, manufacture and assembly shall minimize vibration and shall prevent damage by inherent vibration and stress during operation, transportation and short circuits.

EW-1.10.4.2 Cores

Cores for the transformers shall be constructed of the highest quality, non-aging high permeability grain oriented silicon steel. The steel shall be in thin laminations, annealed after cutting and rolled to ensure smooth surface at the edges.

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

Both sides of each sheet shall be insulated with a durable, heat resistant insulation. The cores shall be held firmly by core clamp and brace 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.

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.

EW-1.10.4.3 Windings

Windings for transformer shall be of the best modern design of conductor having constant cross-section and uniform insulation or graded insulation as required. The coils shall be wound and supported in a manner to provide sufficient oil ducts which will be maintained without constriction.

End coils shall have extra insulation. Coils shall be made up, shaped and braced to provide for expansion and contraction due to temperature changes in order to avoid abrasion of insulation and provide rigidity to resist movement and distortion caused by abnormal operating conditions.

Adequate barriers shall be provided between windings and core and between high and low voltage windings. End coils shall have extra protection against abnormal line disturbances. Permanent current-carrying joint for splices shall be welded or brazed, properly formed and finished, and insulated to conform to the basic insulation.

Winding conductor shall be free from scars, burrs and splinters and shall be uniformly insulated.



The completed assembly of core and coils shall be vacuum dried, immediately impregnated and immersed in dry oil. They shall be adequately braced to withstand ocean shipment, short-circuit forces and earthquakes.

EW-1.10.4.4 Bushing

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. The bushings of the same rating shall be interchangeable.

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.

Bushings shall have the continuous current-carrying capacity necessary to carry the full 65°C temperature rise. The bushings shall also be capable of carrying overload currents as required by EW-1.10.3.4.

The terminal pads shall be of high conductivity bronze or copper and shall be plated with hot flowed electro silver or electro-tin. Whenever a larger terminal pad is required for higher current rating, the mounting holes shall conform to NEMA Standards.

The HV and LV terminations of the SPP transformer shall be fitted with suitable insulating shroud. The insulating shrouds shall be manufactured through dip moulding process and shall be made from flexible polyvinyl chloride (PVC) material, suitable for low voltage to high voltage applications. The insulating shroud shall be flame retardant, conforming with the UL 94 Standards. They shall be type tested for electric strength in accordance with IEC 60243-1 or approved equivalent standards.

EW-1.10.4.5 Gasket

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 over compression of gaskets. All bolted transformer tank or accessory openings shall be gasketed.

EW-1.10.4.6 Tank

The transformers shall be housed in a steel tank with all permanent joints molded, backed up by a sturdy steel structure as required to obtain the desired rigidity and strength. The material shall be of high grade steel plate having good welding qualities. All seams, flanges, lifting and jacking lugs, braces and other parts attached to the tank shall be welded. No rivets shall be used. The cover shall be bolted type. The tank shall be able to withstand an internal pressure with oil at operating level.

All openings such as joint between the case and cover, bushings, insulation mountings, etc., shall have welded on flanges to provide gaskets surfaces and



allow for bolt holes. No bolts shall pass to the inside of the case and cover. Flanges shall have gaskets which will remain oil-tight and will not deteriorate under severe conditions. The tank with radiator fitted shall be tested for leaks before painting.

EW-1.10.4.7 Radiators

Radiators, if to be provided, shall be bolted to the main transformer tank and readily detachable. Isolation valves shall be fitted to the tank to permit radiator removal without draining the main tank. Separate filling plugs, air bleed plugs and drain plugs shall be fitted to each radiator section. Radiators shall be galvanized externally prior to etching and painting. Particular attention shall be given to their internal cleaning and painting to ensure that the radiators arrive in a serviceable condition. All radiators shall be completely sealed with blanking plates and neoprene seals for transport. They shall be thoroughly dried before shipment.

EW-1.10.4.8 Hardware

All energized hardware, i.e., bolts, nuts and washers shall be made of tinned copper alloy material such as silicon bronze or equivalent. All other hardware shall be hot-dip galvanized.

EW-1.10.5 Fittings and Accessories

The following transformer accessories shall be included:

- a) HV Bushing
- b) Oil Level Indicator
- c) Oil Sampling Plug
- d) Oil Drain Valve
- e) Oil Temperature Indicator
- f) Pressure Relief Valve
- g) Lifting Lugs
- h) Anchor Bolts
- i) Earthing Terminals
- j) HV/LV Insulating Shroud

EW-1.10.6 Equipment and Marking

The transformer shall be provided with a stainless steel nameplate in accordance with the latest standard of IEC60076-1, fitted in a visible position showing the information indicated below. The entries on the plate shall be indelibly marked.

- a) Kind of transformer
- b) Number of this standard
- c) Manufacturer's name
- d) Manufacturer's serial number
- e) Year of manufacture
- f) Number of phases
- g) Rated power (in kVA or MVA)
- h) Rated frequency (in Hz)
- i) Rated voltages (in V or kV) and tapping range
- j) Rated currents (in A or kA)



- k) Connection symbol
- l) Short circuit impedance (in %Z)
- m) Type of cooling (i.e. OA, ONAN, etc.)
- n) Insulation voltage (withstand voltages)
- o) Insulating liquid
- p) Temperature rise (in °C)
- q) Total mass, kg
- r) Mass of insulating oil

The minimum recommended dielectric strength of oil filling the transformer shall also be engraved on this plate. The rating plate and any other instructions or designations shall be in the English language.

EW-1.10.7 Standard and Common Tools

The Manufacturer of transformer shall provide standard/common tools for use in the installation/maintenance of transformer.

EW-1.10.8 Tests

All tests shall be performed as per latest revision of ANSI C57.12.90 Factory Test shall include, but not limited to the following:

EW-1.10.8.1 Routine Test

- 1. Ratio, Polarity and Phase Relation Test
- 2. No Load Losses and Excitation Current at rated Voltage and Frequency
- 3. Induced Potential Test (Low-frequency Dielectric Test)
- 4. Mechanical (Leak Test)

EW-1.10.8.2 Design Test

- 1. Winding Resistance Measurement Test
- 2. Impedance Voltage and Load Loss Measurement
- 3. Temperature Rise
- 4. Lightning Impulse
- 5. Audible Sound Level
- 6. Mechanical (Lifting & Moving Devices, Pressure Test)

EW-1.10.8.3 Miscellaneous Test

- 1. Insulation Power Factor
- 2. Insulation Resistance
- 3. Short Circuit Capability

EW-1.10.8.4 Site Test

The Supplier shall perform all tests specified by the equipment Manufacturer, applicable standards and as necessary to verify the proper operation of the equipment in the presence of NPC representatives.

- 1. Check level and alignment of the installed transformer;
- 2. Check tightness of connections and fastenings;
- 3. Check proper grounding;

4. Check oil level monitors, nameplate, vent plugs;
5. Check wire and cable connections;
6. Check cable glands and entrance;
7. Check on the proper installation of transformer accessories;
8. Winding resistance;
9. Insulation Resistance;
10. Transformer Turns Ratio; and
11. Dielectric Test.

EW-1.10.9 Failure to Meet Guarantees

Depending on the requirement stated in the Technical Data Sheets, the transformer will be tested for compliance with the Manufacturer's guaranteed losses. If the transformer losses, as determined by test, at rated voltage, frequency and 100% rated kVA exceed the guaranteed total losses, the excess in losses shall be evaluated at the following rated cost and the resulting amount shall be deducted from the contract price.

$$S = 2 [(N_{L-L}) (N_{LM} - N_{LG}) + (L_L) (L_{LM} - L_{LG})]$$

Where:

- S = Amount to be deducted from the Contract Price
- N_{L-L} = Price in Php/Watt for the no-load losses as stated in the Technical Data Sheets
- N_{LM} = Measured no-load losses expressed in Watt
- N_{LG} = Guaranteed no-load losses as stated on the Technical Data Sheets
- L_L = Price in Php/Watt for the load losses as stated in the Technical Data Sheets
- L_{LM} = Measured load losses expressed in Watt
- L_{LG} = Guaranteed load losses as stated on the Technical Data Sheets

When the excess of the total losses reaches five percent (5%), NPC shall have the right to reject the transformer for which such excess is verified during the factory acceptance test.

Successful Bidder shall promptly provide NPC one (1) original and three (3) certified copies of all test data and reports on the transformer.

EW-1.10.10 Data and Documentation Requirements

The following documents shall be submitted after award of contract for NPC's review and approval prior to procurement and installation of the supplied equipment and materials:

1. Outline drawings of transformer and accessories showing the following:
 - a) General Dimensional Drawing
 - b) Sectional Drawing
 - c) Nameplate Drawing



- d) Marshaling box with connection diagram
2. Description and instructions covering the installation, operation and maintenance of the transformer and accessories;
3. Duly signed Routine Test Results; and
4. Field Test to be Performed and Certified Test and Inspection Reports duly signed and witnessed by NPC representative

EW-1.11 Job Site Cameras

This specification covers the supply, delivery and installation of job site cameras for the use in monitoring and documenting the construction of Solar PV Plant and Energy Storage System.

The materials to be furnished shall be in accordance with, but not limited to, the latest issues of the Applicable Codes and Standards, including all addenda, in effect at time of purchase order unless otherwise stated herein.

EW-1.11.1 Technical Characteristics

The job site cameras to be supplied shall be DC supply operated and battery-operated cameras. It shall be designed to monitor the construction of SPP, ESS and access areas for a routine documentation.

At least two (2) sets of job site cameras must be installed before works shall be done in the project sites. Exact placement/location of cameras shall be approved by NPC.

The Supplier shall define the focusing ranges and allowable minimum distance in accordance with the layout at site.

In normal operation, the job site camera provides monitoring of the construction sites. For full coverage of the cameras, the job site cameras shall be installed in an elevated area within the site while is out of reach of the construction equipment. It shall include supports and mounting poles (if required) for the ease of the installation.

The job site cameras must have the functionality and adaptability in the construction site. It shall have a 100% reliability without affecting the implementation.

The Supplier shall ensure that the job site cameras they supply, functions correctly and safely. In principle, the installation shall follow that latest modern engineering practice, ensure optimum functionality of supply and ensure the safety of the construction staff.

Job site cameras shall be subject to the approval of NPC.

All job site cameras shall meet the technical requirements in the specifications. It shall have a dust proof and weather resistant protective enclosure complying with the technical requirements.



EW-1.11.2 Technical Requirements

The supplied Job Site Cameras shall meet the following minimum technical requirements:

	DESCRIPTION	NPC REQUIREMENTS
1	Type	Time-Lapse Camera
2	Quantity	As specified in the TDS and SOR
3	Control Display	Thin-Film-Transistor (TFT) Liquid Crystal Display (LCD)
4	Image Sensor Resolution	At least 1.3 Megapixel CMOS
5	View Angle	At least 110 degrees
6	Still Image Resolution	1280 x 720
7	Time Lapse Interval	15 minutes/ User-programmable
8	Battery Type	Standard AA or AAA Sized Alkaline Batteries
9	Battery Life	At least 120 days of image recording
10	Additional Batteries (Spare)	To Be Provided
11	Enclosure	IP64 compliant
12	Storage Memory	SDHC
13	Storage Capacity	32 GB
14	Additional Storage per camera (Spare)	At least one (1)

When the installation of the job site cameras is completed, the operation and safekeeping shall be turnover to NPC.

The Supplier shall provide sufficient number of spare alkaline batteries to operate the construction cameras through the entire contract duration. In case of contract extension, the required additional batteries shall also be provided until contract completion at no additional cost to NPC.

EW-1.12 Measurement of Payment

Measurement of payment for all electrical works shall be based on the bid price of each item as shown in the Schedule of Requirements – Electrical Works, Section VII of the Bid Document. The cost of each item shall cover all works required and described in the pertinent provisions of the specifications.

SECTION VI

PART I-TECHNICAL SPECIFICATIONS

ELECTRICAL WORKS

EW 2.0 – ENERGY STORAGE SYSTEM

PART I – TECHNICAL SPECIFICATIONS**EW – ELECTRICAL WORKS****EW – 2.0 – ENERGY STORAGE SYSTEM****TABLE OF CONTENTS**

<u>CLAUSE NO.</u>	<u>TITLE</u>	<u>PAGE NO.</u>
EW-2.0	ENERGY STORAGE SYSTEM	1
EW-2.1	Definition of Terms	1
EW-2.2	Scope of Works	2
EW-2.3	Site Conditions.....	3
EW-2.4	Energy Storage System (ESS).....	3
	EW-2.4.1 Battery Management System (BMS).....	3
	EW-2.4.2 Battery Modules/Batteries.....	4
	EW-2.4.3 Power Conversion System (PCS) / Battery Inverter	5
	EW-2.4.4 ESS Control System (ECS) / ESS controller.....	5
	EW-2.4.5 ESS Digital Energy Meter.....	5
	EW-2.4.6 ESS Housing.....	7
	EW-2.4.7 ESS Transformer	8
EW-2.5	Warranty	17
EW-2.6	Track Record.....	17
	EW-2.6.1 ESS Manufacturer.....	17
	EW-2.6.2 Battery Manufacturer.....	17
EW-2.7	Measurement of Payment.....	17



PART I – TECHNICAL SPECIFICATIONS

EW – ELECTRICAL WORKS

EW-2.0 ENERGY STORAGE SYSTEM

This section provides the definition, scope of works, functional/ performance requirements, technical specifications, and standards for the Energy Storage System (ESS).

EW-2.1 Definition of Terms

- a) **State of Charge (SoC)** is the level of charge of a battery system/module measured from 0%. 0% SoC refers to a fully discharged battery and 100% SoC refers to a fully charged battery.
- b) **Depth of Discharge (DoD)** is the level of charge of the battery system/module measured from 100% SoC. 100% DoD refers to a fully discharged battery and 0% DoD refers to a fully charged battery.
- c) **Maximum Normal State of Charge (MaxNSoC)** is the SoC at which the ESS can be charged at maximum rate (i.e. prior to taper/trickle charge).
- d) **Minimum Normal State of Charge (MinNSoC)** is the SoC specified by the ESS/battery manufacturer at which the ESS can inject power to the interconnection point at full rated power. At MinSoC, the ESS must be able to inject full power for at least 5 seconds.
- e) **Usable Range of SoC** is the range between MaxNSoC and MinNSoC.
- f) **Usable Energy** is the kWh capacity available of the Usable Range of SoC.
- g) **State of Health (SoH)** is an indicator of the remaining capacity of the battery system/module to deliver the required Usable Energy. It shall reflect remaining life, in equivalent full cycles of the battery, and indicate if the battery system/ module need replacement.
- h) **Beginning of Life (BoL)** is the instance that ESS begins operation during conduct of Commissioning Tests.
- i) **End of Life (EoL)** is defined as the instance where the Usable Energy falls below the required value as determined by the SoH indicator and/or a performance test.
- j) **Cycle Lifetime** is the number of full charge and discharge cycles between the EoL and BoL at nominal C rating @25°C.
- k) **Power Conversion System (PCS)** refers to the subsystem of the ESS that contains inverter(s), power electronics, circuit breakers, transformers, switchgears and safety systems required for the ESS to inject and absorb electricity between the interconnection point (e.g. busbar) and the battery system.



- l) **ESS Control System (ECS) / ESS controller** refers to the control system of the ESS.
- m) **Battery Management System (BMS)** refers to the sub-system of the ESS that monitors and controls the battery units and ensures proper charge and discharge of the battery modules.
- n) **Battery modules** are the smallest modules/ unit of energy storage that is user replaceable without the use of specialized tools and equipment. They are made of individual battery cells connected together in series/parallel or combination thereof.
- o) **Energy Storage System (ESS)** refers to the system responsible for the storage and discharge of electricity depending on the power system requirements. It is composed of the following sub systems:
 - Battery Management System
 - Battery Modules / Batteries
 - Power Conversion Systems / Battery Inverter
 - ESS Control System / ESS Controller
 - ESS Transformer

EW-2.2 Scope of Works

The general scopes of work are enumerated below. Additional details are provided in the relevant sections of the tender.

- a) All services, materials, and equipment necessary for the proper installation, maintenance, and operation of the ESS. (e.g. ESS housing, ESS transformer, communication, control and power cabling, cable trays, conduits, connection hardware, safety, and protection equipment, etc.).
- b) The ESS shall be supplied and integrated as a complete operational equipment/system consisting of its appurtenances, tools, sub-systems, firmware, and software; including all items not specifically mentioned but are essential to the proper operation of the ESS as required herein. **The BMS, batteries and its racks shall be supplied together under one brand/manufacturer.**
- c) Back-to-back guarantee/warranty with equipment manufacturer(s). Supplier shall provide/extend all warranties provided by the manufacturer to NPC. In case the supplier is unable to rectify/remedy defects in the product, they shall shoulder all expenses that the manufacturer may levy to remedy/rectify the defects.
- d) Complete documentation:
 - Design and as-built drawings.
 - Installation, Operation and Maintenance Manuals
 - Electrical circuit diagrams
 - Performance Monitoring Test, Factory and Site Acceptance Test procedures.
 - Back-up copies of control programs (firmware and other configuration software)



- Other relevant documents (if any).

- e) Training of plant and technical services personnel regarding ESS as part of the plant as specified in *GW-14.0 Training of NPC Personnel*.

EW-2.3 Site Conditions

- a) Environmental Conditions (refer to Section VI – GW 5.0, Design & Duty Conditions)
- b) The ESS housing shall have a footprint/area adequate to house all the major and appurtenant equipment of ESS (considering clearance requirements from adjoining equipment and structures). It shall be installed within the SPP premises. Refer to Section IX – Reference Drawings, Proposed Equipment Layout for the allocated space for the ESS.

EW-2.4 Energy Storage System (ESS)

The ESS shall mainly function as **grid stabilization equipment** by providing ancillary services. It shall support the operation of the whole power plant by providing buffer power in the event there is power and/or frequency fluctuations (e.g. Power output of the solar plant suddenly drops due to shading caused by cloud formation).

It shall have a power rating of (*refer to Section VI -- GW 6.0 Supplier's scope of works*) (continuous) and a usable energy of at least (*refer to Section VI – GW 6.0 Supplier's Scope of Works*).

Bi-directional (Import and Export) Digital Energy Meter(s), Class 0.3 or better shall be provided to account for energy import and export to and from the ESS. It shall be connected to the 3-phase, 60Hz bus in between the ESS main distribution panelboard and the ESS transformer.

The operating and output voltages of the ESS and PCS respectively shall depend on the Equipment to be supplied by the Supplier. However, the high voltage side of the ESS transformer shall be 13.8kV (line to line).

Roundtrip efficiency of the ESS must be at least 80%. Efficiency shall include/account the energy utilized by the air-conditioning system, lighting, BMS, PCS, ECS/ESS Controller, PEMS and ESS transformer.

Detailed specifications of its components are provided in the succeeding sections.

EW-2.4.1 Battery Management System (BMS)

The BMS shall control and monitor all battery module parameters. e.g. SoC/DoD, string/module voltage, current, temperature, impedance (or equivalent parameter to indicate the "health" of the battery modules).

SoH data shall be available while the ESS is in operation and shall be revalidated by a performance test to be conducted at least once a year (or as the need arises).



The BMS shall automatically control the charge/discharge of all batteries including cell balancing, equalization and other maintenance and safety functions/procedures to ensure proper operation of the battery system. The same function can be triggered manually if necessary.

- a) The BMS must be capable of keeping the operational history of individual battery modules. Operation of the battery module shall be managed individually to account for different module characteristics. Minimum parameters to be logged are as following:
- Module voltage
 - Module current
 - Replacement history of battery module
 - Module faults/alarms
 - Module temperature
 - State of Charge (SoC) / Depth of Discharge (DoD)
 - State of Health
- b) The bidder/manufacture shall specify the MinNSoC and MaxNSoC as defined in EW-2.1 of this section.

EW-2.4.2 Battery Modules/Batteries

- a) Usable Energy of the batteries shall be at least (*refer to Section VI – GW-6.0 Supplier's scope of works*) within the warranty period. Testing shall be performed during factory acceptance, commissioning and at least once a year, or as the need arises (i.e. performance test) to ascertain the amount of usable energy. Bidder/manufacture shall provide all test procedures subject to review and approval of the National Power Corporation.
- b) Batteries shall have a minimum cycle lifetime of at least 4000 cycles @ nominal C-rate @25°C. The nominal C-rate of the battery to be supplied shall be 1C or higher. **It shall self-discharge for not more than 10% of its capacity per month.** The remaining cycles shall be translated into the SoH indicator parameter. This model shall be implemented in the BMS and shall be validated and adjusted (if necessary) during the conduct of annual performance tests.
- c) Acceptable battery chemistries are Lithium Manganese Oxide (LiMn2O4–LMO) and Lithium Nickel Manganese Cobalt Oxide (LiNiMnCoO2 - NMC) or blended NMC/LMO.
- d) Battery Modules shall be self-contained, modular and user replaceable without the need for specialized equipment. For purposes of transport and installation, gross weight of each battery module shall not exceed 60kgs.
- e) Each battery module (if possible, each cell) shall be equipped with overcharge, short circuit, and thermal runaway protection. Each battery rack shall be protected by fuse and/or by DC circuit breaker against electrical fault, this also serves as the main disconnecting means for repair and maintenance.
- f) Batteries must be compliant to IEC 62619 or UL 1642. Test certificate of the batteries shall be submitted during post-qualification.

EW-2.4.3 Power Conversion System (PCS) / Battery Inverter

- a) The PCS shall have the following functionalities:
- Parallel operation;
 - Capable to provide ancillary services;
 - Provide Short Circuit Current sufficient to trigger circuit breakers and other protection devices for duration of not less than 50ms;
 - Provision of reactive power;
 - Frequency Control. The nominal system frequency shall be 60Hz and shall be maintained within the limits of 59.7Hz and 60.3Hz during normal conditions based from **Philippine Distribution Code 2017**;
 - Voltage Control; and
 - Fault ride through with programmable voltage and duration.
- b) The PCS shall have a nominal power rating (net of ESS auxiliary power requirements) with 120% overload capability of at least ten (10) minutes.
- c) PCS must be able to perform Power Swing necessary to compensate for sudden loss of generation from either the diesel generators or the solar PV plant.
- d) The PCS shall have the capability to support the changes in power direction of the battery (from charge to discharge and vice versa) within 200ms.

EW-2.4.4 ESS Control System (ECS) / ESS controller

- a) The ECS / ESS controller shall serve as the interface between the Master/Hybrid controller and the ESS. It shall ensure that the ESS is able to respond to the commands of the Master/Hybrid controller in performing all its functional requirements as specified herein.
- b) The ECS / ESS controller shall be equipped with its own control interface that can display the status of the ESS and its components. The interface must be capable of monitoring operational and maintenance history of the ESS (of the SoC and "health" of each battery module).

EW-2.4.5 ESS Digital Energy Meter

This specification covers the technical and associated requirements for the ESS digital energy meter including instrument transformer and accessories required for the electric generating plants.

EW-2.4.5.1 Technical Characteristics and Requirements

The ESS digital energy meter shall be furnished and installed by the Supplier as shown on the bid drawings complete with housing and associated metering instrument transformers (current transformers) of appropriate burden and accuracy and other accessories for indoor metering purposes. It shall be capable to measure the power generated and received by the ESS. It shall be designed to operate continuously for the normal life of the meter. The digital energy meter shall meet the following minimum requirements:



ITEM	DESCRIPTION	REQUIREMENTS
1	Number of Wires	4
2	Voltage, V	120-480
3	Current Range	Class 10
4	Frequency, Hz	60
5	Register Type	LCD
6	Soft Switches	Available
7	LCD Display	Programmable
8	The Kilowatt-hour meter to be provided is certified and approved by ERC	Yes
9	Communication Port for Kilowatt-hour meter	To be Provided
10	Metering Current Transformer	
	a. Application (Indoor/Outdoor)	Indoor
	b. Insulation type	Full cast epoxy resin
	c. Primary rated current, A	By Supplier
	d. Secondary rated current for all windings, A	5
	e. No. of cores	One (1) core Secondary CT
	f. CT ratio	By Supplier
	g. Accuracy class	0.3 or better
	h. Burden, VA	2.5
	i. BIL, kV	10

In extreme cases, the Supplier shall furnish, if necessary, indoor type potential transformer with accuracy rating of 0.3 or better. The transformer shall have appropriate voltage ratio which is suitable for ESS digital energy meter and ESS AC voltage system. All costs associated with the supply and installation of such transformer shall be to the account of the Supplier.

The ESS digital energy meter shall have but not limited to the following features:

1. Pilferage proof
2. Tamper Proof
3. Wrong Wiring Alarm
4. Current Flow display
5. Can withstand the temperature of -20°C to +70°C and Humidity of up to 95% non-condensing
6. With back light display
7. With built-in battery for LCD display and back-up battery
8. TOU Programmable Ready
9. Measure display (Energy, RMS voltage & current per phase, Reactive & Apparent Power, Power factor, Frequency, Calendar, Time and etc.)



The ESS digital energy meter with the required metering instruments shall be enclosed by the distribution panel or, if needed, by a separate enclosure for proper protection and safety against water droplets, dust, exposure of energized conducting material and the like without additional cost to NPC.

For ESS digital energy meter, communication ports shall be provided or available in the energy meter exclusively intended for electronic reading, hence reading the data determined from the computer remotely from the meter. Electronically gathering of data can logged parameters to the computer such as instantaneous parameters, billing information, load survey, events or tampers, transactions, etc.

EW-2.4.6 ESS Housing

- a) The ESS shall be self-contained in its own free-standing housing/ enclosure. It shall be supported with a suitable foundation. The ESS housing shall have a footprint/area adequate to house all the major and appurtenant equipment of ESS (considering clearance requirements from adjoining equipment and structures). The ESS housing/enclosure shall be made in accordance with the following specifications and fixtures:

Container Frame	-	Steel Frame (Galvanized with painting)
Walls	-	50mm polyisocyanurate insulation with double-sided 0.45mm pre-painted GI sheet
Roof	-	25mm polyisocyanurate insulation with pre-painted GI sheet roof and interior ceiling
Flooring	-	Plain cement plastered painted floor finish
Door	-	Steel door

The ESS housing shall have appropriate thermal insulation and shall be designed in accordance with the latest edition of the NSCP. It shall have a minimum rating of IP56 and 2-hour fire rating.

- b) The ESS shall be equipped with its own redundant air conditioning system suitable for 240VAC, 1 ϕ , 60Hz system to control and maintain the temperature required inside the battery compartment. It shall be tropicalized and can operate automatically. It shall be configurable and programmable to be able to reboot and operate itself with automatic switchover, whenever there is a fault on the first ACU, without human intervention (e.g. manual switching of ACU/s).
- c) The ESS auxiliary panel board feeder shall be tapped from the AC bus of the ESS-MDP for auxiliary loads. Refer to PalSPV-BDE-17.001 for ESS single line diagram.
- d) The ESS shall have adequate protection to prevent unauthorized access to the ESS.



SECTION VI – TECHNICAL SPECIFICATIONS

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- e) The ESS shall have a sufficient interior lighting for maintenance and servicing purposes.
- f) ESS shall be equipped with emergency stop buttons inside and outside the housing.
- g) ESS housing together with its enclosed non-current carrying metal such as main and sub distribution panel, if applicable, and other metal frame shall be connected to ground and protected from any unexpected electricity leakage.

EW-2.4.7 ESS Transformer**EW-2.4.7.1 General**

This specification covers the technical and associated requirements for the ESS transformer and accessories for use in electric generating plants. The rating of this transformer is specified in the **Technical Data Sheets** and in **GW-6.0 Supplier's Scope of Works**. The supplied transformer shall be in accordance with the latest revision of IEEE Std. C57.12.00.

EW-2.4.7.2 Technical Requirements

The supplied ESS transformer for Palanan Energy Storage System shall meet the following minimum requirements:

ITEM	DESCRIPTION	REQUIREMENTS
1	Type of Cooling	ONAN
2	Insulation	Mineral Oil with its electrical and chemical characteristics is compliant with IEC and is Polychlorinated Biphenyls (PCB) free
3	Type	Two-winding Transformer
4	Audible Sound Level	Refer to Table specified under EW-2.4.7.3.8
5	Vector Group	YNd11
6	Temperature	
	a. Ambient Temperature	40°C
	b. Temperature Rise	65 °C
7	Winding Connection	
	▪ H-Winding	Wye with Neutral Grounded
	▪ X-Winding	Delta
8	Insulation Level	
	a. Nominal Voltage Level, kV	
	▪ H-winding	13.8
	▪ X-winding	By Supplier
	b. Highest Voltage Level, kV	
	▪ H-winding	15



	▪ X-winding	By Supplier
	c. Basic insulation level, kV	
	▪ H-winding	95
	▪ X-winding	By Supplier
9	Winding Material	100% Copper
10	Bushing Material	Porcelain
11	% Impedance at Rated kVA	Manufacturer's Data
12	Efficiency	
	a. At 100% load	By Supplier
	b. At 75% load	By Supplier
13	Tap Changer	No-Load
14	Taps	
	a. H-Winding	13.8 kV \pm 2 x 2.5%
	b. X-Winding	N/A
15	Transformer Losses	
	a. No-Load Loss, W	By Supplier
	b. Load Loss, W	By Supplier
16	Tolerances	
	a. No-Load & Load Loss	Not more than 10% of the manufacturer's specified value
	b. Total Loss	Not more than 6% of the manufacturer's specified value
	c. Impedance	\pm 10% of the manufacturer's specified value
17	Ground Terminal Connection	Suitable for 100 mm ² copper conductor
18	Weight of oil, kg	By Supplier
19	Total Weight, kg	By Supplier
20	Test and Experience Requirements	
20.1	Test Requirements ¹	
	a. Routine Test to be performed	Yes
	b. Certified Design and Routine Test Reports to be submitted	Yes

EW-2.4.7.3 Design Requirements**EW-2.4.7.3.1 Rating**

The transformer rating specified in the Technical Data Sheets shall be the basis of the Supplier's guarantee as to performance and temperature rise. The

¹ Test Report of a licenser instead of the Supplier's Manufacturer shall not be accepted.



ratings indicated are based on actual load requirements at the service and operating conditions specified herein.

EW-2.4.7.3.2 Voltage

The transformer to be supplied shall be designed to withstand the over voltages for the duration of voltage excursions which may be expected as a result of full load rejection of the inverters.

EW-2.4.7.3.3 Frequency

Frequency for operation shall be 60 Hz.

EW-2.4.7.3.4 Overload Requirement

The overload rating and operation shall be in accordance with all cyclic loading duties as specified in IEC 60076-7. 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 Supplier shall specify these limitations in his proposal.

EW-2.4.7.3.5 Short Circuit Withstand Capability

The transformer shall withstand the mechanical and thermal stresses produced by external short-circuit currents specified in IEEE Std. 57.12.00 (latest revision).

EW-2.4.7.3.6 Transformer Loss Evaluation

Depending on the requirement stated in the Technical Data Sheets, the Supplier is required to fill-in all the information for the transformer losses in the Technical Data Sheets for the ESS transformer and station service/dry-type 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.

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.

EW-2.4.7.3.7 Impedance and Reactance

The impedance and reactance shall be stated in the Proposal.

EW-2.4.7.3.8 Audible Sound Level

Sound levels decibels (dB) at rated voltage and frequency for liquid immersed ESS transformer shall be as below. The average sound level of the transformer shall not exceed these values when measured in accordance with the conditions outlined in the latest ANSI/IEEE C57.12.90 or IEC 60076-10 for oil-immersed transformers or ANSI/IEEE C57.12.91 or IEC 60726 for dry-type transformers.



Equivalent Two-winding, kVA	Average Sound Level, dB
1-50	48
51-100	51
101-300	55
301-500	56
750	57
1000	58
1500	60
2000	61
2500	62

EW-2.4.7.3.9 Tolerances

The transformer shall be designed and manufactured with tolerances in accordance with applicable ANSI/IEC/IEEE standards.

EW-2.4.7.3.10 Electrical Insulating Oil

The Supplier shall furnish oil with quality suitable as an insulant and coolant for transformers. The oil shall be new napthenic based mineral oil meeting the requirements of the latest ASTM D3487 (Specification of Mineral Insulating Oil Used in Electrical Apparatus).

Insulating liquid must not contain more than 2PPM of Polychlorinated Biphenyl (PCB), classified as "PCB free". The Supplier shall submit a certification from the manufacturer of the transformer that the transformer oil does not contain PCB and the laboratory analysis shall be conducted in a DENR-Accredited Laboratory.

The Supplier shall state the commercial name and specifications of the oil to be furnished. NPC reserves the right in the future to use any oil which meets the above specifications and the use of such oil shall not affect the Supplier's guarantee.

EW-2.4.7.4 Design and Construction Features**EW-2.4.7.4.1 General**

The transformer design, manufacture and assembly shall minimize vibration and shall prevent damage by inherent vibration and stress during operation, transportation and short circuits.



EW-2.4.7.4.2 Cores

Cores for the transformers shall be constructed of the highest quality, non-aging high permeability grain oriented silicon steel. The steel shall be in thin laminations, annealed after cutting and rolled to ensure smooth surface at the edges.

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

Both sides of each sheet shall be insulated with a durable, heat resistant insulation. The cores shall be held firmly by core clamp and brace 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.

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.

EW-2.4.7.4.3 Windings

Windings for transformer shall be of the best modern design of conductor having constant cross-section and uniform insulation or graded insulation as required. The coils shall be wound and supported in a manner to provide sufficient oil ducts which will be maintained without constriction.

End coils shall have extra insulation. Coils shall be made up, shaped and braced to provide for expansion and contraction due to temperature changes in order to avoid abrasion of insulation and provide rigidity to resist movement and distortion caused by abnormal operating conditions.

Adequate barriers shall be provided between windings and core and between high and low voltage windings. End coils shall have extra protection against abnormal line disturbances. Permanent current-carrying joint for splices shall be welded or brazed, properly formed and finished, and insulated to conform to the basic insulation.

Winding conductor shall be free from scars, burrs and splinters and shall be uniformly insulated.

The completed assembly of core and coils shall be vacuum dried, immediately impregnated and immersed in dry oil. They shall be adequately braced to withstand ocean shipment, short-circuit forces and earthquakes.

EW-2.4.7.4.4 Bushing

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. The bushings of the same rating shall be interchangeable.



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.

Bushings shall have the continuous current-carrying capacity necessary to carry the full 65°C temperature rise. The bushings shall also be capable of carrying overload currents as required by EW-2.4.7.3.4

The terminal pads shall be of high conductivity bronze or copper and shall be plated with hot flowed electro silver or electro-tin. Whenever a larger terminal pad is required for higher current rating, the mounting holes shall conform to NEMA Standards.

The HV and LV terminations of the ESS transformer shall be fitted with suitable insulating shroud. The insulating shrouds shall be manufactured through dip moulding process and shall be made from flexible polyvinyl chloride (PVC) material, suitable for low voltage to high voltage applications. The insulating shroud shall be flame retardant, conforming with the UL 94 Standards. They shall be type tested for electric strength in accordance with IEC 60243-1 or approved equivalent standards.

EW-2.4.7.4.5 Gasket

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 over compression of gaskets. All bolted transformer tank or accessory openings shall be gasketed.

EW-2.4.7.4.6 Tank

The transformers shall be housed in a steel tank with all permanent joints molded, backed up by a sturdy steel structure as required to obtain the desired rigidity and strength. The material shall be of high grade steel plate having good welding qualities. All seams, flanges, lifting and jacking lugs, braces and other parts attached to the tank shall be welded. No rivets shall be used. The cover shall be bolted type. The tank shall be able to withstand an internal pressure with oil at operating level.

All openings such as joint between the case and cover, bushings insulation mountings, etc., shall have welded on flanges to provide gaskets surfaces and allow for bolt holes. No bolts shall pass to the inside of the case and cover. Flanges shall have gaskets which will remain oil-tight and will not deteriorate under severe conditions. The tank with radiator fitted shall be tested for leaks before painting.

EW-2.4.7.4.7 Radiators

Radiators, if to be provided, shall be bolted to the main transformer tank and readily detachable. Isolation valves shall be fitted to the tank to permit radiator removal without draining the main tank. Separate filling plugs, air bleed plugs



and drain plugs shall be fitted to each radiator section. Radiators shall be galvanized externally prior to etching and painting. Particular attention shall be given to their internal cleaning and painting to ensure that the radiators arrive in a serviceable condition. All radiators shall be completely sealed with blanking plates and neoprene seals for transport. They shall be thoroughly dried before shipment.

EW-2.4.7.4.8 Hardware

All energized hardware, i.e., bolts, nuts and washers shall be made of tinned copper alloy material such as silicon bronze or equivalent. All other hardware shall be hot-dip galvanized.

EW-2.4.7.5 Fittings and Accessories

The following transformer accessories shall be included:

- a) HV Bushing
- b) Oil Level Indicator
- c) Oil Sampling Plug
- d) Oil Drain Valve
- e) Oil Temperature Indicator
- f) Pressure Relief Valve
- g) Lifting Lugs
- h) Anchor Bolts
- i) Earthing Terminals
- j) HV/LV Insulating Shroud

EW-2.4.7.6 Equipment and Marking

The transformer shall be provided with a stainless steel nameplate in accordance with the latest standard of IEC60076-1, fitted in a visible position showing the information indicated below. The entries on the plate shall be indelibly marked.

- a) Kind of transformer
- b) Number of this standard
- c) Manufacturer's name
- d) Manufacturer's serial number
- e) Year of manufacture
- f) Number of phases
- g) Rated power (in kVA or MVA)
- h) Rated frequency (in Hz)
- i) Rated voltages (in V or kV) and tapping range
- j) Rated currents (in A or kA)
- k) Connection symbol
- l) Short circuit impedance (in %Z)
- m) Type of cooling (i.e. OA, ONAN, etc.)
- n) Insulation voltage (withstand voltages)
- o) Insulating liquid
- p) Temperature rise (in °C)
- q) Total mass, kg
- r) Mass of insulating oil



The minimum recommended dielectric strength of oil filling the transformer shall also be engraved on this plate. The rating plate and any other instructions or designations shall be in the English language.

EW-2.4.7.7 Standard and Common Tools

The Manufacturer of transformer shall provide standard/common tools for use in the installation/maintenance of transformer.

EW-2.4.7.8 Tests

All tests shall be performed as per latest revision of ANSI C57.12.90 Factory Test shall include, but not limited to the following:

EW-2.4.7.8.1 Routine Test

1. Ratio, Polarity and Phase Relation Test
2. No Load Losses and Excitation Current at rated Voltage and Frequency
3. Induced Potential Test (Low-frequency Dielectric Test)
4. Mechanical (Leak Test)

EW-2.4.7.8.2 Design Test

1. Winding Resistance Measurement Test
2. Impedance Voltage and Load Loss Measurement
3. Temperature Rise
4. Lightning Impulse
5. Audible Sound Level
6. Mechanical (Lifting & Moving Devices, Pressure Test)

EW-2.4.7.8.3 Miscellaneous Test

1. Insulation Power Factor
2. Insulation Resistance
3. Short Circuit Capability

EW-2.4.7.8.4 Site Test

The Supplier shall perform all tests specified by the equipment Manufacturer, applicable standards and as necessary to verify the proper operation of the equipment in the presence of NPC representatives.

1. Check level and alignment of the installed transformer;
2. Check tightness of connections and fastenings;
3. Check proper grounding;
4. Check oil level monitors, nameplate, vent plugs;
5. Check wire and cable connections;
6. Check cable glands and entrance; and
7. Check on the proper installation of transformer accessories.
8. Winding resistance
9. Insulation Resistance
10. Transformer Turns Ratio
11. Dielectric Test



EW-2.4.7.9 Failure to Meet Guarantees

Depending on the requirement stated in the Technical Data Sheets, the transformer will be tested for compliance with the Manufacturer's guaranteed losses. If the transformer losses, as determined by test, at rated voltage, frequency and 100% rated kVA exceed the guaranteed total losses, the excess in losses shall be evaluated at the following rated cost and the resulting amount shall be deducted from the contract price.

$$S = 2 [(N_{L-L}) (N_{LM} - N_{LG}) + (L_L) (L_{LM} - L_{LG})]$$

Where:

- S = Amount to be deducted from the Contract Price
- N_{L-L} = Price in Php/Watt for the no-load losses as stated in the Technical Data Sheets
- N_{LM} = Measured no-load losses expressed in Watt
- N_{LG} = Guaranteed no-load losses as stated on the Technical Data Sheets
- L_L = Price in Php/Watt for the load losses as stated in the Technical Data Sheets
- L_{LM} = Measured load losses expressed in Watt
- L_{LG} = Guaranteed load losses as stated on the Technical Data Sheets

When the excess of the total losses reaches five percent (5%), NPC shall have the right to reject the transformer for which such excess is verified during the factory acceptance test.

Successful Bidder shall promptly provide NPC one (1) original and three (3) certified copies of all test data and reports on the transformer.

EW-2.4.7.10 Data and Documentation Requirements

The following documents shall be submitted after award of contract for NPC's review and approval prior to procurement and installation of the supplied equipment and materials:

1. Outline drawings of transformer and accessories showing the following:
 - a) General Dimensional Drawing
 - b) Sectional Drawing
 - c) Nameplate Drawing
 - d) Marshaling box with connection diagram
2. Description and instructions covering the installation, operation and maintenance of the transformer and accessories;
3. Duly signed Routine Test Results; and



4. Field Test to be Performed and Certified Test and Inspection Reports duly signed and witnessed by NPC representative

EW-2.5 Warranty

The ESS including but not limited to the Battery Management System, Battery Modules/Batteries, Power Conversion System(s)/Battery Inverter, ESS Control System/ESS controller, and ESS transformer shall have a minimum warranty of five (5) years. This warranty shall be covered by a back-to-back warranty arrangement with the manufacturer. The supplier shall submit its warranty agreement with the manufacturer that stipulates the scope and responsibilities of each party. Both parties (bidder and manufacturer) shall be equally and severally liable for failure of either party to perform warranty obligations.

Batteries shall be tested at least once a year (or as the need arises) to ascertain the usable energy of the ESS within the warranty period. If at any time during the warranty period the ESS fails to deliver the required usable energy, the supplier/manufacturer shall repair or replace the defective components to ensure the required performance standards are met. All costs associated with the warranty shall be to the account of the supplier/manufacturer.

EW-2.6 Track Record**EW-2.6.1 ESS Manufacturer**

Manufacturer of the ESS should have current (working) install base of more than 1MW. Bidder shall provide a list of reference project(s) with contact details for verification purposes. (fill-out form in Section VI – Technical Specifications – Part II Technical Data Sheet – Annex C).

EW-2.6.2 Battery Manufacturer

Manufacturer of the batteries should be ISO 9001/14001 certified and have at least five years of experience in production of Li-ion cells as given by EW-2.4.2 (c). Offered battery model must have a current (working) install base of at least 1MWh. Bidder shall provide a list of reference project(s) with contact details for verification purposes. (fill-out form in Section VI – Technical Specifications – Part II Technical Data Sheet – Annex D)

EW-2.7 Measurement of Payment

Measurement of payment for all electrical works shall be based on the bid price of each item as shown in the Schedule of Requirements – Electrical Works, Section VII of the Bid Document. The cost of each item shall cover all works required and described in the pertinent provisions of the specifications.



SECTION VI

PART I-TECHNICAL SPECIFICATIONS

ELECTRICAL WORKS

EW 3.0 – POWER AND ENERGY MANAGEMENT SYSTEM

PART I – TECHNICAL SPECIFICATIONS**EW – ELECTRICAL WORKS****EW – 3.0 – POWER AND ENERGY MANAGEMENT SYSTEM****TABLE OF CONTENTS**

<u>CLAUSE NO.</u>	<u>TITLE</u>	<u>PAGE NO.</u>
EW-3.0	POWER AND ENERGY MANAGEMENT SYSTEM	1
EW-3.1	General	1
EW-3.2	Technical Requirements	1
EW-3.3	Cuaming Diesel Power Plant Genset Controller Data	3
EW-3.4	Scope of Works	4
EW-3.5	Communication Interface and Monitoring System	6
EW-3.6	Aerial Cable Installation	8
EW-3.6.1	Cable Type	8
EW-3.6.2	Cable Construction	9
EW-3.6.3	Cable Specifications	9
EW-3.6.4	Communication Equipment	9
EW-3.6.5	Site Survey	10
EW-3.6.6	Joint-use Poles	10
EW-3.6.7	Aerial Pathways and Spaces	10
EW-3.6.8	Clearances	11
EW-3.6.9	Cabling/Splicing Hardware	12
EW-3.6.10	Grounding, Bonding and Protection	12
EW-3.6.11	Building Entrance Protection	14
EW-3.6.12	Protectors	15
EW-3.6.13	Testing Procedures and Criteria	15
EW-3.6.14	Maintenance and Restoration	16
EW-3.6.15	Routine Maintenance	16
EW-3.6.16	Demand Maintenance	17
EW-3.6.17	Restoration Procedures in Case of Emergency	17
EW-3.6.18	Documentation	19
EW-3.7	PEMS and Communication Architectural Diagram	19
EW-3.8	Warranty	20
EW-3.9	Measurement of Payment	20



PART I – TECHNICAL SPECIFICATIONS

EW – ELECTRICAL WORKS

EW-3.0 POWER AND ENERGY MANAGEMENT SYSTEM

EW-3.1 General

This part specifies the minimum requirements for the design, manufacture, factory wiring, programming, transport, delivery, installation, testing and commissioning of the Power and Energy Management System (PEMS). It shall be able to monitor, supervise and control the gensets, solar PV plant, the ESS and plant auxiliaries/instrumentation. All materials and parts which are not specifically mentioned herein but are necessary for the proper installation, assembly and operation of the equipment shall be furnished at no additional cost to NPC.

The Supplier shall have the complete system responsibility for the proper design and functioning of the system from manufacture until system acceptance. All the system engineering software and on-line system shall be supplied whether specifically detailed herein or not. It is not NPC's intent to specify all the technical requirements nor to set forth those requirements adequately covered by applicable codes and standards. Adherence to all applicable codes and standards is required. The Supplier shall furnish high quality equipment meeting the requirements of this specification and industry standards.

The system shall provide reliable and timely information data and control functions required for efficient operation of the hybrid power plant. The required system shall have the operational speed, computing power, adequate input/output storage capacity and self-diagnostic/analysis capability to meet the requirements as detailed in this specification.

EW-3.2 Technical Requirements

The PEMS covered by this specification shall include all equipment including software necessary for secure and reliable operation of the whole system. The system shall consider provisions for future expansion of the plant capacity.

The proposed PEMS shall be composed of but not limited to the following subsystems:

- a) **Hybrid Controller** is the main controller and shall communicate and interface with the other controllers.
- b) **Genset Controller** is an automatic controller that has all necessary functions for control and protection of generator sets.
- c) **Solar/PV Controller** controls and manages the output and operation of Solar/PV inverters.



- d) **ESS Control System (ECS) / ESS controller** supervises the operation of the Battery Management System (BMS) and Power Conversion System (PCS).
- e) **Data Logger** is primarily for the purpose of storing data of the entire grid's operation and maintenance, especially of the string inverter(s) through Solar/PV Controller.

Design Requirements

1. The PEMS shall be an automated/programmable Hybrid Plant Management System with pre-configured settings for hybrid system. It shall not require specialized programming knowledge or skills to set or modify desired operating conditions. It shall be composed of a hybrid controller, genset controller(s), solar/PV controller, and energy storage system controller.
2. The hybrid controller shall interface and communicate with the genset controller(s), solar/PV controller and the ESS controller. The Hybrid controller shall communicate with and store data in the Data Logger. The Hybrid controller shall allow remote accessing of the data stored in the data logger thru the Human Machine Interface (HMI).
3. The PEMS shall be responsible for the dispatch of the Solar PV Plant, Diesel Generators and the ESS. Dispatch strategy shall maximize PV penetration. Under the condition of protecting the gensets, the available irradiation and load demand, the PEMS shall optimize the generated power of the solar plant while considering the constraints (e.g. individual minimum genset loading, genset availability, SoC of the ESS) and shall regulate and stabilize the grid by dispatching the ESS and/or available compatible genset.
4. PEMS shall have the capability to export operating data, including faults and other abnormal conditions to an external media for review and archive purposes.
5. The PEMS shall perform the following functionalities but not limited to the list below:
 - a) Scheduling and Dispatching
 - b) Start/stop of Diesel Generator(s) and ESS
 - c) Engine Ramp Up/Down Control
 - d) Generator Breaker Open/Close Control
 - e) Diesel Generator Parallel Operation/Synchronization
 - f) Visual and Audible Alarm System
 - g) Control of Solar Photovoltaic Array/Inverters
 - h) High level control of ESS functions (i.e. charging, discharging)
 - i) Automatic Fail over Features/ System Redundancy.
 - j) Data Logging / Event Recording
 - k) Load Balancing and Distribution
 - l) Database Management
 - m) Metering Instrument
 - n) Voltage and Frequency Regulation



SECTION VI – TECHNICAL SPECIFICATIONS

6. The PEMS shall also have the capability to display and store the following information in real time or other user configurable time periods:
 - a) Total system demand in kW & in kVAr
 - b) Energy output in kWh
 - c) System voltage, frequency, and power factor.
 - d) Power/Energy output and operating status of all generating units including the Solar PV Array and the ESS in kW and kWh
 - e) Alarms for faults and other abnormal operating conditions for the Generator sets, Solar PV plant and ESS for Generating units, ESS and Solar PV plant.
7. The PEMS shall be able to monitor the entire grid thru the HMI. For manual control mode of the plant, a control panel shall be provided. The panel shall be capable of start and stop sequence and emergency shut down. Further, in certain case, hardwired controls are provided to ensure grid safety and/or operability in the event of PEMS failure.
8. The Supplier shall be responsible for preparation of programs and turning over the complete operational system to NPC. The Supplier's configuration responsibilities shall include, but not limited to the following functions: all plant control system functions, equipment safety, protection, man-machine interface functions, operator training for setting parameters and overall system configuration and testing. Configuration of settings for each and between functional controllers shall be made and tested by the Supplier/Manufacturer at their facilities. Any modification(s) done by the Supplier to the system default settings of the new controller(s) shall inform NPC in writing.
9. The system shall be designed to monitor and diagnose its own performance. The PEMS shall prompt alerts to notify the operator of any equipment and/or sub-systems with abnormalities/errors. The monitoring and diagnostic functionality shall cover, but not limited to the following peripheral failure, I/O failure, peripheral memory error, main memory error, CPU failure, scan overruns, controller errors, loss of communication.
10. The Supplier shall provide all hardware and cabling necessary to provide redundant, fail-safe communications between the subsystems of the PEMS. Failure of any component in the system shall not cause loss of control of more than one component in the system and must not cause a total system failure.

EW-3.3**Palanan Diesel Power Plant Genset Controller Data**

Unit / Rated Capacity	Make and Model	Remarks
163kW	Woodward	Under Maintenance
260kW Dale Perkins	Woodward	Operational



100kW FG Wilson	Power Wizard 1.1	Operational
160kW FG Wilson	Power Wizard 2.1	Operational
300kW Cummins	CompAmp IntelliCompact	Operational
300kW Cummins	CompAmp IntelliCompact	Operational

EW-3.4 Scope of Works

- a) The supplier shall provide at least six (6) units of genset controllers, one (1) unit ESS controller, one (1) unit Solar/PV controller and one (1) hybrid controller per plant. The supplied controllers shall be brand new and able to interface with each other. **The genset controllers shall be of the same brand/manufacturer and model.**
- b) The communication interface and protocol within the **PEMS (Hybrid, ESS, Genset and Solar/PV Controllers)** shall be well-established depending on the preference of the Supplier/Manufacturer to function as designed ensuring proper connectivity and reliable transfer of data/information (i.e. command, alarm, status, etc.). The connection between these controllers shall not cause any malfunction for the safe and continuous operation of the power plant. The same shall apply for the communication between the **ECS/ESS controller and the ESS (PEMS and BMS).**
- c) The communication interface and protocol between the **existing genset controller and the supplied genset controller** shall be well-established depending on the preference of the Supplier. However, the Supplier shall ensure that the connection provides reliable transfer of information (data, command, etc.) and that the connection between these controllers shall not cause any malfunction to the safe operation of the gensets. The use of appropriate converters and/or relays is allowed between these devices if necessary.
- d) The communication interface and protocol between each **inverter and the Solar/PV controller** shall utilize Modbus TCP. The use of alternative communication protocol with appropriate converters and/or gateways maybe allowed subject to the approval of NPC. Necessary converter and/or gateway devices shall be supplied to ensure safe and reliable transfer of information.
- e) The supplier shall provide all necessary converters and other appurtenances and accessories to ensure the reliability of the communication between these devices and components. The supplier shall ensure that the converters shall not cause any lag time when transforming the signals given to and from the equipment. **Refer to figure 1 in this section.**
- f) The communication link between the Solar FV Plant and the PEMS shall utilize **copper wires used to transfer data only.** Refer to EW-3.5 Communication Interface and Monitoring System, Item c) Communication Cable for specifications.
- g) The PEMS shall have control and remote monitoring functionalities that is accessible locally (within the power plant) and remotely through computer or mobile phones (via internet/GPRS).



- h) The PEMS shall be modular, expandable, and flexible to accommodate potential expansion of ESS, additional PV arrays (inverters) and additional gensets without the need of special programming skills. These additional components for future expansion purposes projects can be from different manufacturers and can have different brands and models compared to the existing NPC components and the selected components of the Supplier. The PEMS shall be able to reliably communicate to such independent components.
- i) Supplier shall provide all necessary cable, connectors, interfaces, software, licenses and other equipment and devices to ensure interoperability of all components of the entire power plant.
- j) The supplier, with minimum configuration as possible, shall install and integrate the supplied controllers to the existing controls of gensets to take-over the following functionalities, except that the protection system shall remain and under the supervision of existing genset controller(s):
1. Start and Stop of Genset
 2. Engine Ramp Up/Down Control
 3. Generator Breaker Open/Close Control
 4. Synchronization

If major configuration is unavoidable to ensure the performance of the required functionalities and may potentially void the existing warranty, the supplier shall submit an explanation of the reasons and ramification of the change to NPC for approval/consideration.

In the case that the genset(s) is/are no longer bounded by any kind of warranty, the replacement of the existing controller(s) by the new controller(s) maybe permitted provided that it will not degrade the performance and cause any malfunction to the equipment. The Supplier shall seek clearance in writing to NPC prior to take any action for this specific work item.

Notwithstanding the above, the supplier shall ensure that any changes will not affect the operation of the gensets.

- k) The supplier shall include in the training the integration and installation including trouble shooting of all the controllers associated to PEMS.
- l) The supplier shall provide two (2) complete units/sets of Human Machine Interface (HMI) of the same brand and model. One (1) unit/set shall be installed inside the ESS and the other unit/set inside the control room.
- m) The HMI shall have adequate security features to prevent accidental and unauthorized modification of operating parameters.
- n) Bidder shall inspect the existing power plant to determine the full extent of the project. Integration methodology shall be submitted together with the proposal(s) for approval of NPC during contract implementation.



- o) All other works necessary but not specifically mentioned and detailed in the scope of works shall be done for the complete, safe, and reliable operation of the Power and Energy Management System (PEMS).
- p) The controllers to be used in PEMS shall have a track record that indicates the exact make and model being offered are used for at least three (3) Hybrid Systems that are currently working and are in actual operation.¹

EW-3.5 Communication Interface and Monitoring System

a) Communication Interface

1. The communication link shall be able to support real time data logging, event logging, supervisory control, operational modes and set point editing.
2. It shall have appropriate communication interfaces to be provided by the Supplier between various units installed at different locations that report data for power generated on demand with options for daily, monthly, and yearly data.
3. The tie line shall be designed to include the communication cable and its necessary interfaces and auxiliaries. The appropriate communication interface to be installed in the solar PV plant shall be properly connected. Also, the appropriate communication interface for the PEMS/PV Controller shall be installed at the DPP. These interfaces together with their auxiliaries and the communication cable shall provide reliable two-way communication between the inverters and the Solar/PV controller or the PEMS.
4. The communication link between the SPP/PV Controller and PEMS shall use a robust technology over a copper wire dedicated for two-way data communication only.

a) Control System

1. The Solar PV Plant shall be designed as grid-interactive system with line protection and fail-safe system. It shall be equipped with all necessary instrumentation to provide adequate monitoring and control of the system under all operating conditions.
2. The Supplier shall provide Solar PV Plant monitoring system. The monitoring system shall have a data logging capability to record major operating parameter (e.g. kW, kWh, V, A, pf, frequency, etc.)

b) Communication Cables

¹ Refer to Annex E



SECTION VI – TECHNICAL SPECIFICATIONS

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1. Control cables of adequate size, impedance and insulation shall be required for establishing communication and control between equipment.
2. All communication cables shall be marked accordingly, or color coded depending on application and/or connection.
3. Connection of cables shall follow the standard/acceptable colors for the ease of installation and maintenance purposes. Ethernet cables shall follow the color coding for connections as well as other communication cables, as applicable.
4. All cables, in general, shall conform to IS-1554 part 1; ISO/IEC 11801 and other relevant standards.
5. The control cables shall be appropriate for its intended fields of application ensuring maximum performance and of the following specifications but not limited to the following:
 - RS-485 cables shall be heavy duty or for industrial use, stranded copper conductor, polyethylene insulated with a minimum of 90% shielding coverage of braid or a combination of braid-foil shielding materials for maximum performance. Likewise, it shall be Flame Retardant Low Smoke (FRLS) PVS type jacketed. It shall be multi-conductor, multi-pair with low capacitance.
 - Ethernet cables shall be capable to support different applications. Its construction shall be multi-conductor, multi-pair shielded twisted pairs of stranded copper conductors with polyethylene insulation. The outer jacket material shall be flame retardant PVC material.
 - Balanced twisted-pair cable shall be rated for outdoor installation on telecommunication and data processing systems applications. It shall be UV-resistant and watertight/waterproof and shall not use hazardous substances.

c) Data Monitoring

1. The data monitoring system shall include both Data Management Monitoring System and Weather Observation System which shall have one-collecting device with a display monitor which is capable of monitoring and controlling the solar farm parameters such as PV array energy production, actual AC/DC voltages and currents at inputs and outputs of the inverters, daily and accumulated energy generated, climate conditions and faults in the SPV system, at solar plant site.

2. The system shall also have the capability for calculating the average of the data collected every hour, day and month.
3. Following parameters shall be measured and stored continuously:
 - Solar module temperature/s
 - Ambient temperature
 - Solar irradiation/insolation
 - Wind speed
 - DC current and voltages
 - Power output of the solar arrays
 - Power output of gensets
 - Power plant load
 - User selectable time period of cumulative energy production for PV array
 - System faults
 - Any other parameter considered necessary for the SPV system based on prudent practice
4. For solar irradiance monitoring, Class 1 or better integrating pyranometer shall be provided, with the sensor mounted in the plane of the SPV array.
5. Data Logger shall record these parameters for study of various environmental and grid parameters on energy generated by the solar PV system.

EW-3.6 Aerial Cable Installation

General

This part specifies the minimum requirements for aerial cable installation of communication cables including route planning on obtaining the best location for construction, installation, maintenance, cable placing and ensuring the optimum design is met.

All factors, including but not limited to location, support structures, cable materials, intended use, loading and protection among others, shall be considered in the design. Also, all materials and parts which are not specifically mentioned herein but are necessary for the proper installation, assembly and operation of the equipment shall be furnished at no additional cost to NPC.

EW-3.6.1 Cable Type

The Supplier shall use balanced-twisted pair data cable in establishing the communication link between the PEMS (DPP) and the SPP. The cable shall be for communication and not manufactured for use in power lines. The link is intended to transfer mainly data between devices and components within the entire power plant.



It is important to note that the resistance of the cable, the limitations of the terminating devices and pair loading are major factors in establishing the communication link. These factors shall be given importance by the Supplier.

EW-3.6.2 Cable Construction

The mechanical and electrical properties of the cable is important in selecting cable for communication. The Supplier is expected to choose the best suited cable for this contract.

The balanced twisted-pair cable shall be intended for use in coastal areas to minimize or prevent deterioration. It shall consist of solid annealed bare copper with color-coded PIC insulation. It shall have aluminum shield with outer protection (jacket) of black polyethylene.

The use of high-strength support strand of galvanized steel is also required.

EW-3.6.3 Cable Specifications

The cable shall have at least the following minimum requirements:

Type	Balanced-twisted pair
Conductor Size	24 AWG
Number of Copper Pairs	Minimum of 16 pairs
Operating Temperature Range	-30 to +80 degrees Celsius
Shielded	Yes; foil and screen
Insulation	PIC/PE; color-coded
Outer Jacket	Black Polyethylene/PVC
Application	Outdoor aerial installation
Flame Retardant	Required
Support Strand	Required; At least 6.4mm diameter; Galvanized Steel

The conductors shall be assembled with twists to minimize crosstalk.

The use of Support strand is required which can be provided separately or in the use of reinforced cable also known as "Figure 8" cable.

EW-3.6.4 Communication Equipment

The Supplier shall use all equipment best suited for the application and as required. Transmitters, receivers (transceivers), modems, routers, switches, hubs, etc. shall be able to operate properly as integrated. They shall allow smooth and reliable transfer of data or communication between each device in both the power plants.

All equipment to be supplied and installed shall be compatible for the application and that the primary purpose of the communication link is to transfer real time data.



EW-3.6.5 Site Survey

The Supplier shall conduct a thorough and proper site survey in order to assess the existing conditions as well as the future conditions that may arise in the area. This is in order to resolve and avoid any possible problems and to properly determine the location of the facilities to be installed.

During this survey, the Supplier shall prepare the field survey report consisting of but not limited to measurements from structures that can affect the installation and operation of the facility, the construction details of such structures, soil conditions, area restrictions and other field conditions that may affect the route.

The Supplier is expected to utilize the same poles used in the tie line to support the communication link. However, alternate route may be considered if this route is exposed to extreme factors causing unsafe working environment, right-of-way problems, etc.

EW-3.6.6 Joint-use Poles

The Supplier shall determine the existing pole adequacy to support the proposed cables by physically inspecting and determining its loading capabilities. Included in the physical inspection are pole's integrity, presence of anchors and guys, grounding, existing cables and in-pole equipment, clearances, obstructions and pole height, class, etc.

EW-3.6.7 Aerial Pathways and Spaces

The Supplier shall ensure that the telecommunication facility is compliant to but not limited to the following minimum requirements:

1. Choice of poles, span lengths and sags shall be determined by the specifications written herein with consideration to all other design parameters and in accordance with the latest edition of Outside Plant Design Reference Manual and other related applicable laws and standards.
2. Pole to building attachment shall be done in a solid terminating point or in a dislodged portion of the building's masonry or framework. The use of either U or plate wall strap is required to attach the cables into the building.
3. The use of flying cross is required for aerial installations over intersections where placing poles is prohibited or cannot be done.
4. All clearances that are required for communication equipment and between poles, conflicting plants, etc. shall be considered. Minimum vertical, horizontal and mid span clearances between communication cables and other utility lines shall be properly implemented as stated in EW-3.6.8 Clearances or in the latest edition of NESC. Radial clearances shall also be maintained.
5. Pole lines shall be designed and installed without exceeding the 60% of the rated breaking strength of the cable support strand. Support strands shall have higher rating of zinc coatings to prevent or minimize deterioration caused by highly corrosive environment.



6. Support strands for aerial installation shall be of at least 6.4mm in diameter.
7. Anchors and guys shall be installed to all corner poles and as necessary. For poles wherein installing of guys is prohibited or rendered ineffective, the use of push braces is required.
8. Appropriate guy attachment hardware shall be used depending on requirement and need.
9. Storm guying is also recommended to be installed for pole lines or section of pole lines wherein expected to be severely affected by storms especially those that exceeds the 1.6km distance and no head guys are installed. Installation of two-way or four-way storm guy is depending on the intervals within the section requiring storm guys.
10. Guy and anchor rod sizes and configurations shall be chosen appropriately considering all design parameters and calculations in accordance with the latest edition of Outside Plant Design Reference Manual (OSPDRM) or other relevant and applicable laws and standards.

EW-3.6.8 Clearances

The Supplier shall install and maintain the minimum recommended separation/clearances from other utilities.

The communication cable must be clamped or banded to the poles with stainless steel straps. Drilling of holes to the steel pole for a bolt attachment is prohibited.

The communication cables shall be installed with appropriate clearance to the energized power cables for at least 43 inches from the lowest sag. The following clearance to the ground as per NESC shall be implemented:

Type of Location	Neutral or Comm.	Grounded Span Guy	TPX	7.2/12.5 kV	14.4/25 kV	19.9/35 kV
Railroads	23.5 ft		24.0 ft	26.5 ft		
Trucks Over 8 Feet	15.5 ft		16 ft	18.5 ft		
Water - No Sailboats	14.0 ft		14.5 ft	17.0		
Over fields, orchards, forest, etc.	15.5 ft		16.0 ft	18.5 ft		
Pedestrians Only	9.5 ft		12.0 ft	14.5 ft		
Oversized Vehicles - greater than 14 feet in height (x = known height of the oversized vehicle)			X + 1.5 ft		X + 2 ft	X + 4.5 ft
Vertical Clearance Over Buildings						
Accessible			10.5 ft		11.0 ft	13.5 ft
Non-accessible			3.0 ft		3.5 ft	12.5 ft



All vertical clearances shall be measured at midspan clearances or between the lowest sags of the communication cable and other utilities/structure. Midspan clearances shall be at least 75% of the clearance required at the pole or in accordance with the latest applicable standard.

Radial Clearances shall also be maintained at least 1.4 meters (4.5 ft) horizontal and 3.2 meters (10.5 ft) vertical clearance from antennas, signs, pole structures, storage tanks and chimneys.

The Supplier shall comply with all the applicable standard/regulations regarding all the types of clearances required.

EW-3.6.9 Cabling/Splicing Hardware

The Supplier shall ensure that cable splices are properly done, maintained and protected in order to provide reliable operation of the system.

Cabling hardware can be metallic or non-metallic. These shall be designed to provide security and protection to cables and splices, strain relief and allow cable re-entry.

Splice closures and covers used by the Supplier shall be classified and in accordance depending on its purpose and intended use.

The Supplier may opt to employ any splicing methodology for twisted-pair cable. However, waterproof protection shall be used in these splices.

EW-3.6.10 Grounding, Bonding and Protection

The Supplier shall properly ground, bond and protect the cables and equipment to avoid hazards to people, property and the system. Proper grounding and bonding enhance the reliability of equipment and improve the signal integrity in a transmission medium by minimizing transient voltages that can induce unwanted signal into the system. These transient voltages are commonly external to telecommunication system.

OSPs shall have protective measures against the presence of lightning stroke currents, voltage induction exceeding 300Vac, accidental contacts to power lines operating at more than 300V line to ground and ground potential rise (GPR) above 300V.

Grounding and Bonding shall be in accordance, but not limited to, the following minimum requirements:

1. A bond between power and telecommunication plant shall be established using at least 6AWG bonding conductor.
2. Cable shields shall be bonded to maintain its electrical continuity.
3. Telecommunication support strand cables shall also be bonded to a power system at a given interval depending on the power voltages involved. Such bonding to power facilities shall be carefully done by qualified personnel.



4. Bonding of support strands to ground or separate cables or wires together at every .40km, at each crossover and at each branch.
5. Bonding of cable shields to support grounds shall be done at frequent intervals. Shielded cables shall be bonded between the shield and the support strand at every splices, terminals, and load points. If the shielded cable is exposed to lightning, it shall be bonded at every 0.40km to the support strand.
6. As much as possible, telecommunications cable shall be crossed on jointly used or occupied poles rather in the mid-span. A Vertical Down Lead (VDL) shall be used to connect the cable support strand to the Multiground Neutral (MGN) of MGN-type power lines. In MGN system, grounding requirements shall also be referred to EW-7.0 13.8kV Tie Line. However, for cases where aerial runs are installed on a joint-used pole with a non-MGN system, a separate VDL shall be placed dedicated for the telecommunication system with at least 0.40km interval.
7. Both the cable shield and support strand shall always be bonded with the MGN when using the same poles (joint use or joint occupancy). Bonding shall be done on every pole that carries a VDL where transformers, capacitors and other types of power equipment that draws load current are connected. If the joint use/occupancy is longer than 0.8km, the bond shall be made at every 0.4km. Also refer to NESC for additional requirement for certain support strands that are exposed to possible power contact, induction, and lightning.
8. For cases when the ampacity of the support strand is not enough for system grounding conductors, additional bonds must be made at every 0.20km.
9. For joint use/occupancy with non-MGN electrical supply circuits, cable shields shall be grounded by bonding them to a telecommunications ground system.
10. For underground or direct buried cable dips in aerial cable runs there is no special protection required at junctions of aerial cables and short underground or direct-buried plastic sheathed cable dips.
11. For aerial to underground transitions, when the aerial cable is exposed to lightning and is connected to a single underground cable that runs for 305m or more before paralleling with other cables, the aerial cable shield at the last pole shall be grounded while the shield and support strand shall be bonded to an MGN VDL, if this exists, otherwise use a telecommunications ground rod.
12. In aerial-to-underground transition or expansion, exposed cables shall have:
 - a) Established and maintained continuity of all metallic cable elements
 - b) Metallic and non-metallic splice cases bonding and lead sleeves shall be connected to PB's grounding system at every PB installed.
 - c) Cables with plastic sheaths do not need to be bonded at pull-through PBs.



EW-3.6.11 Building Entrance Protection

The Supplier shall electrically protect all exposed telecommunication cables containing metallic components at the building entrance such as the following:

1. All exposed telecommunication cables that contain metallic components require electrical protection at the building entrance. Metallic sheath and strength members of all cables entering the building must be connected to the Telecommunications Main Grounding Busbar (TMGB).
2. Install protectors for metallic pairs as well as fuse links, if needed
3. All entrance cable shields shall be closely grounded to the building entrance as much as possible.
4. Splice cases of entrance cables shall be made of fire-resistant material.
5. A minimum of 6AWG copper ground wire shall be used to ground the protector or protected cable terminal to the TMGB.
6. Bond together the protector ground, power ground and interior metallic water pipe system, if there is any.
7. Insulating joints or isolation gaps shall be used as necessary on corrosion-prone areas.
8. Telecommunications grounding and bonding shall not be attached to any cathodic protection system because this system is used for protection against galvanic corrosion of such structures by constantly sending low current to metallic ducts.
9. Sheaths of shields of all OSP cables shall be bonded of 6AWG copper wire or bonding ribbon to the telecommunications grounding system for low-risk areas to corrosion.
10. Isolation gaps for cables that are exposed to lightning or have power contact shall be installed by bonding the OSP sides of shields or sheaths and isolating them from the telecommunications grounding system.
11. In highly corrosive areas, insulating joints or isolation gaps shall be installed on all cables entering a building.
12. If isolation gaps are used, the following shall be made:
 - a) Bridge the isolation gaps on exposed cables using decoupling capacitors to minimize the coupling noise.
 - b) Bond the metallic sheath components and metallic strength members of all entering cables by 6 AWG copper conductor or bonding ribbon. Cables and all metal elements must be isolated from all grounded objects and equipment on the OSP side of the insulating joint.
 - c) Locate insulating joints near the entry point as much as possible.
 - d) Bond the metallic sheath components and metallic strength members of all cables to TMGB with a minimum of 6AWG on the building side of the insulating joint.



- e) For cases where insulating joints are not present, bond the entrance cable metallic sheath components and metallic strength members to the TMGB using 6 AWG copper wire or bonding ribbon.

EW-3.6.12 Protectors

The Supplier shall install protectors as applicable and needed. The use of fused and/or fuseless protector housing is recommended provided that:

- a) For fuseless protector housing, installation of fuse link is required between the exposed plant and the protector to minimize the hazard of fire and shock. Fuseless protectors which are voltage-limiting devices shall only be used with fusible link which is a current-limiting device
- b) For fused protector housing, it is required to be installed in the event that there is no fuse link provided and/or a portion of service wire uses the same trench with power lines operating beyond a line to ground voltage of 300V.
- c) For fuse links, the protector stubs of internal protector wiring shall be at least two gauges finer (larger AWG) than the entrance cable. A minimum of 0.6m of fuse link is required to be installed in conjunction with fuseless protectors for exposed OSPs to power.
- d) All exposed circuits entering the building shall have protector units. It is recommended to use solid-state protectors.
- e) Primary protection shall be provided for all cables exposed to lightning, crossing power lines and/or prone to having accidental contact to power lines.
- f) Secondary protection shall be considered to protect the equipment against sneak currents or continuous foreign current exceeding 0.35A.
- g) Fast response secondary protectors shall be installed in series between the primary protector and the switching equipment at the main building. This shall also be provided at the remote station between the primary protectors and the station equipment. Protectors shall be conformant to UL497A.
- h) An integrated assembly of both primary and secondary overvoltage and overcurrent protection is recommended. Protector modules shall be equipped with in-service test points so that non-intrusive testing can be done without accidentally disengaging a working circuit during maintenance. The communication link shall also be properly protected against any interference such as Electromagnetic Interferences (EMI) and coupling impedance.
- i) All necessary protection against lightning shall be installed including the proper.

EW-3.6.13 Testing Procedures and Criteria

The Supplier shall test the grounding and bonding system to evaluate the bonding connections between telecommunication busbars and AC grounding/electrode.

These tests shall be performed after the installation of cables and grounding system and before the installation of end-use equipment.



The recommended True RMS measurement of AC current in the bonding conductors is less than 1 A. For DC current, it is less than 500 mA. Depending on equipment needs, the acceptable AC and DC measurement may vary.

The presence of abnormally high AC current levels indicates that there is a dangerous condition within the testing area. Wearing of proper safety gears and taking precautions when splicing cables or grounding is important.

The two-point bonding measurement is also important to be performed using an earth grounding resistance tester configured for continuity test.

The test is performed by connecting the meter leads between the nearest grounding electrode and other metallic items. The recommended maximum value between these two points is 100 milliohms.

The Supplier shall refer to the equipment's manufacturer should there be any special set-up or safety precautions needed before and during testing.

EW-3.6.14 Maintenance and Restoration

The Supplier shall establish the guidelines for managing and maintaining the installed communication system and its infrastructure including the associated procedures in ensuring the continuous operation of the system within the given operating limitations as well as the restoration requirements during re-establishment of components following its failure, if there is any.

The Supplier shall, within the warranty period, regularly conduct the routine inspection and maintenance of all spaces, pathways, splice enclosures, equipment, cable layout, etc. to extend the network's performance capabilities and prolong its useful life.

The Supplier shall submit a detailed maintenance plan subject for approval of NPC. The maintenance plan together with all the proper documentations shall ensure the smooth network maintenance by providing better understanding of the system. It shall address the skill set requirements, codes, standards and safety, records of cables, circuits, updated pathway segments indicating history of operation and maintenance, PBs, equipment baseline including their specifications, storage and replenishment of repair materials, training requirements, restoration procedures, maintenance schedule of all OSP equipment including all periodic testing and calibration, management escalation procedures with contact information, among others.

EW-3.6.15 Routine Maintenance

The Supplier shall perform the routine maintenance regularly, of at least yearly within the warranty period, to examine the network for any abnormalities. It can be done physically or through the aid of sophisticated network monitoring and surveillance systems/devices capable to detect such abnormalities (e.g. changes in resistivity, continuity, indications of moisture and degradation, loss of sheath integrity). Such devices shall not affect the operation of the entire network.



Routine Maintenance checklist shall be prepared by the Supplier and shall be submitted to NPC. It includes ensuring the cabling integrity and verifying the good condition of poles, guys, and anchors verification of that no dangerous electrical conditions have been developed as well as the compliance of the network facilities with all the safety regulations, applicable codes and standards. Routine Maintenance focuses on but not limited to:

- a) Inspection of "T" zone which is basically the area wherein the cable is attached to a pole extending to up to 0.91m to both sides. This area normally includes the terminals, service wire attachments and splices
- b) Trimming of trees to prevent degradation of transmission capabilities caused by abrasions to cable sheaths.
- c) Pole inspections including checking for any deterioration, height requirements, presence of unwanted/unauthorized attachments. This is done to ensure employee and public safety.
- d) Maintenance of OSP identification methods for easy identification
- e) Right-of-Way inspections for impeding obstacles
- f) Defective cable pair recovery system

EW-3.6.16 Demand Maintenance

The Supplier shall be able to address demand maintenance during the warranty period and shall be able to provide assistance in such cases after this period. Demand maintenance may be needed in response to cases, but not limited to the following:

- a) Customer service demands
- b) Relocation of OSP due to road improvements
- c) Site improvements
- d) Property augmentation/addition that imposes conflict to the existing OSP
- e) Changes in clearance, separation and/or pole spacing
- f) Obligations under joint-use agreements such as re-arrangement and replacement of components like poles
- g) Indications of imminent danger to the network or any specially designed network from a network monitoring and surveillance systems
- h) Changes in road elevation affecting the requirements for PBs

Demand maintenance is not limited to damages that caused out-of-service condition and can also be needed in cases where damage to the network has been incurred by natural calamities like storm, earthquakes, etc., vehicular accidents, road washouts, floods, physical degradation and those hazards that disrupts public safety with the risk of losing the telecommunications network facility.

The Supplier shall also submit his comprehensive demand maintenance checklist to NPC.

EW-3.6.17 Restoration Procedures in Case of Emergency

The Supplier shall include in his maintenance plan a thorough and comprehensive procedures to be undertaken in cases of emergency shutdown or out-of-service of the network.



An emergency recovery plan shall address and provide information of at least the following:

- a) Identification and contact of key personnel who must respond quickly and possess the necessary skill set to repair the problem. It is important that these key personnel have predefined duties and responsibilities and are properly trained.
- b) Accessing and obtaining the right materials for repair. These materials shall be readily accessible and shall be sufficient in quantities.
- c) Basic troubleshooting procedures shall be properly documented and shall be clear and concise. Restoration team must be familiar with these details and that a step-by-step procedure is recommended to be documented.
- d) Restoration tools for emergency must always be easily accessible and ready to use. Such tools and equipment shall be maintained regularly and marked appropriately, thus the plan shall be able to provide this information. Use of worn-out tools/equipment as an alternative shall be avoided as well as the use of equipment for routine maintenance in place of emergency equipment, even for short time is not recommended.
- e) Critical circuits that needs prompt response during an emergency shall be marked/documented in the plan. These circuits shall be of first priority when restoring the network. The first goal of OSP restoration is to restore the network's operation in a staggered but prioritized manner. Returning the system back to normal operation then restoring the system closely as possible to its original or improved operational parameters comes next.
- f) Emergency test equipment shall be regularly calibrated and shall be readily available for use. Calibration procedure shall be provided in step-by-step and must be easy to understand and follow.
- g) Minimize service interruptions and ensure safety of personnel by providing temporary grounding and bonding connections. These points shall be clearly stated and marked in the plan.

Emergency restoration procedure/plan shall be able to guide the restoration team to identify and repair the problem, may it be temporary or permanently. However, temporary repairs shall not be left on a provisional status and must be repaired or corrected permanently. It shall also include the procedures and guidelines allowing the proper documentation of the restoration, reassignments and configurations done to the network.

The emergency restoration plan is subject for updating upon the completion of an after-action report detailing the problems encountered, its causes and the corrective action done whether its short or long term. An after-action report shall be submitted whenever a restoration is done and completed and shall contain preventive measures and recommendations to avoid the same problem from reoccurring. The plan is prepared to identify any OSP structure that requires revision and/or replacement.

The Supplier shall also nominate or provide their support center. This support center shall be able to respond quickly and in timely manner to any type of maintenance request. Support center staff members shall be capable to all aspects pertaining to restoration, maintenance and operation of the network facility. It is also important that the support center has complete end-to-end



and up-to-date necessary documentation for all kinds and types of materials and equipment, has access to next-level support and is capable of providing emergency restoration materials including test equipment.

EW-3.6.18 Documentation

The Supplier shall submit the Schematic Design/Diagram showing the initial proposed facility based on the gathered data from site survey. Construction documents and work prints shall also be submitted indicating the final design of the system as well as the specifications for installation and the record of changes made during installation. As-built drawings shall also be submitted. All documentations are subject to NPC's approval.

The Supplier shall also provide his comprehensive design and construction specifications checklists in accordance with OSPDRM. The checklists can be modified as deemed necessary by the Supplier/Designer in order to fully detail all the data required and used in the system.

The Supplier is also recommended to submit photographs and video recordings of the site or field survey conducted. All other information that needs to be recorded shall be properly documented and such documents shall be provided to NPC.

The Supplier shall also submit photographs and video record with stamped dates of the conducted site survey as well as the route and the affecting factors determined and encountered during pre-installation, installation and post-installation activities.

EW-3.7 PEMS and Communication Architectural Diagram

The PEMS and Communication architecture shall be as presented below. However, the Supplier may offer similar or equivalent system architecture subject to NPC's review and approval.



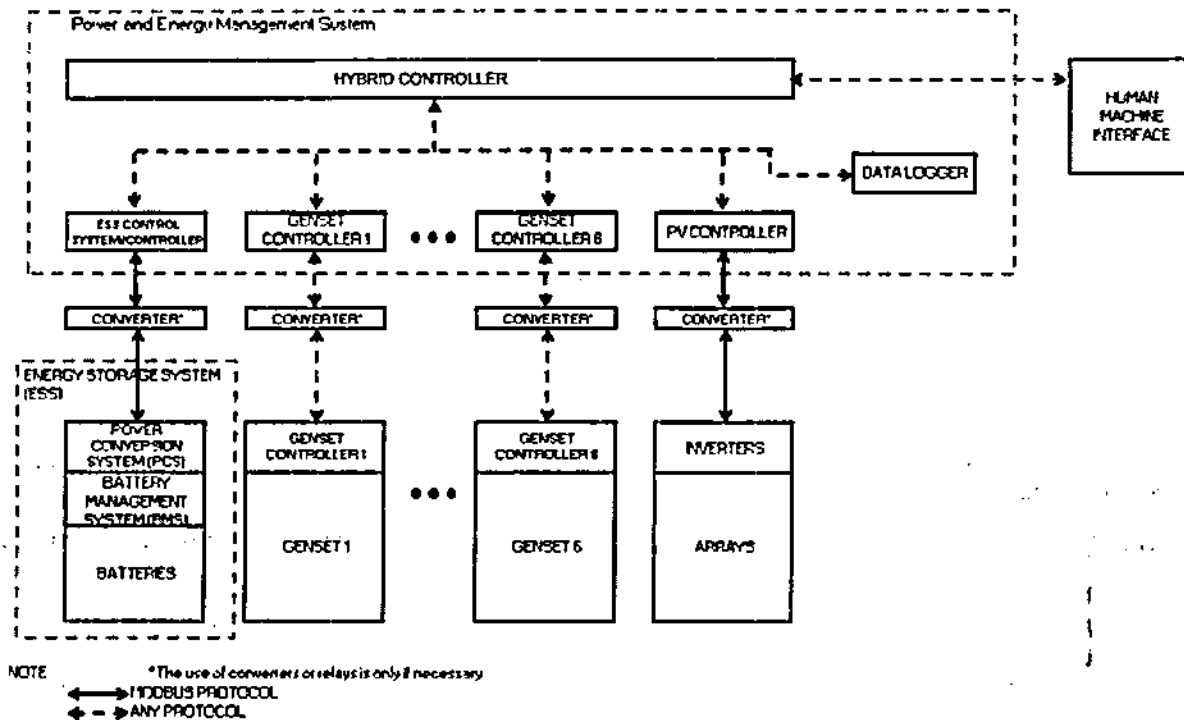


Figure 1: PEMS and Communication Diagram

EW-3.8 Warranty

The PEMS, including all its components, shall have a minimum warranty of five (5) years. This warranty shall be covered by a back-to-back warranty arrangement with the manufacturer. The supplier shall submit its warranty agreement with the manufacturer that stipulates the scope and responsibilities of each party. Both parties (bidder and manufacturer) shall be equally and severally liable for failure of either party to perform warranty obligations.

EW-3.9 Measurement of Payment

Measurement of payment for all electrical works shall be based on the bid price of each item as shown in the Schedule of Requirements – Electrical Works, Section VII of the Bid Document. The cost of each item shall cover all works required and described in the pertinent provisions of the specifications.

SECTION VI

**PART I-TECHNICAL
SPECIFICATIONS**

ELECTRICAL WORKS

EW 4.0 – LIGHTING SYSTEM

PART I – TECHNICAL SPECIFICATIONS**EW – ELECTRICAL WORKS****EW – 4.0 – LIGHTING SYSTEM****TABLE OF CONTENTS**

<u>CLAUSE NO.</u>	<u>TITLE</u>	<u>PAGE NO.</u>
EW-4.0	LIGHTING SYSTEM.....	1
EW-4.1	General	1
EW-4.2	Scope of Work	1
EW-4.3	Standard of Materials	1
EW-4.4	Lighting System	2
	EW-4.4.1 Technical Requirements and Characteristics	2
	EW-4.4.2 Dry Type Transformer	2
	EW-4.4.3 Lighting and Power Panel board	3
	EW-4.4.4 Lighting Fixtures, Luminaires and Accessories.....	3
	EW-4.4.5 Switches and Single Phase Outlets.....	4
	EW-4.4.6 Cables.....	4
	EW-4.4.7 Conduit	5
	EW-4.4.8 Junction/ Utility Boxes	6
EW-4.5	Measurement of Payment	6



PART I – TECHNICAL SPECIFICATIONS

EW– ELECTRICAL WORKS

EW-4.0 LIGHTING SYSTEM

EW-4.1 General

This specification covers the technical and associated requirements of complete lighting system and perimeter lighting system for the Design, Supply, Delivery, Installation, Testing and Commissioning of Palanan Solar PV-Diesel Hybrid System (with ESS).

EW-4.2 Scope of Work

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

1. Supply, Installation and Test of complete Lighting and Power System for the Guardpost;
2. Supply, Installation and Test of Complete Perimeter Lighting;
3. Supply, Installation and Test of 2kVA Dry Type Transformer; and
4. All other works necessary although not specifically mentioned and detailed but are required for the complete, safe and reliable operation of the Lighting System for Palanan Solar PV Plant.

EW-4.3 Standard of Materials

All materials to be used in the work shall be new, of high quality, free from all defects and of proven acceptability for the purpose of intended. Unless otherwise specified, materials shall conform to the latest applicable standard issued by the following authorities:

1. American National Standards Institute (ANSI)
2. Institute of Electrical and Electronic Engineers (IEEE)
3. Underwriter's Laboratory (UL)
4. National Electrical Manufacturer's Association (NEMA)
5. National Electrical Code (NEC)
6. Philippine Electrical Code (PEC)

Other recognized national standards maybe accepted if such will guarantee a quality superior to that guaranteed by the above standards. Use of other standards shall be subjected to the approval of National Power Corporation.



EW-4.4 Lighting System

The lighting system covered by this specification shall include all outlets (convenience and power), switches, associated conduits and cables, lighting fixtures (indoor, outdoor and emergency), fittings, distribution panel boards, dry type transformers, contactors, timers, etc.

The devices/materials furnished shall be in accordance with, but not limited to, the latest issues of the Applicable Codes and Standards, including all addenda, in effect at time of purchase order unless otherwise stated in this specification.

All materials and parts which are not specifically mentioned herein but are necessary for the proper installation and safe operation of the lighting system shall be identified by the Supplier and shall be furnished at no additional cost to NPC.

EW-4.4.1 Technical Requirements and Characteristics

Circuits shall be wired separately for lighting and outlets. Lighting fixtures shall be controlled and switched locally approximately as shown on the drawings.

Replacement of fixture bulbs or tubes shall be possible without disconnecting any part of the power supply and risk of touching live parts of the installation.

The lighting and power panel shall be tapped to the dry type transformer sourced from the AC combiner box.

EW-4.4.2 Dry Type Transformer

The dry type transformer covered by this specification shall be used for the lighting and power system of the guardpost and perimeter lights at Palanan Solar PV Plant. It shall be indoor type and shall be in accordance with the latest revision of IEEE Std. C57.12.01. The installation of this transformer shall be wall or floor-mounted and in accordance to the standard procedure as suggested by the manufacturer. In relation, the stability/integrity of the supporting structure shall not be compromised during and after the installation of this equipment. The transformer shall also meet the following minimum requirements:

ITEM	DESCRIPTION	REQUIREMENTS
1	Core	High Grade Silicone Steel
2	Insulation	Class H
3	Application	Solar PV Plant station service transformer
4	Type	Dry type transformer
5	Class	Indoor/Outdoor
6	Type of Cooling	AN
7	Temperature Rise (°C)	150
8	Insulation level:	
	a. Maximum operating voltage, kV	



	▪ H-winding	1.2
	▪ X-winding	0.6
	b. Nominal operating voltage, kV	
	▪ H-winding	0.48
	▪ X-winding	0.24
	c. Basic insulation level, kV	10
9	Winding Material	
	a. H-winding	100% copper
	b. X-winding	100% copper
10	Enclosure	NEMA 3R

EW-4.4.3 Lighting and Power Panel board

The lighting and power panel board shall be flush-mounted.

The main and branch circuit breakers shall be molded case type with instantaneous magnetic trip and thermal over current trip.

Nameplate shall be black plastic with engraved white letter.

EW-4.4.4 Lighting Fixtures, Luminaires and Accessories**Lighting Fixtures**

All lighting fixtures when installed shall be free of leaks, warps, dents and other irregularities.

The hangers and brackets of all kinds for safety and proper installation of lighting fixtures shall be furnished and installed by the Supplier at his own expense.

The housing of lighting fixture shall be fabricated of steel sheet, corrosion resistant, good ventilation and easy installation.

All lighting fixtures, samples and catalogues shall be submitted for NPC's review and approval prior to the order. No lighting fixtures shall be installed without approval of NPC.

Lighting fixtures shall be wired with approved fixture wire, 90°C insulation. Each fixture shall be wired to a single point with an adequate slack for proper connection. All lighting fixtures shall be protected from damage during installation. Any broken lighting fixtures, receptacles, stems and the like, shall be replaced with new parts, at no cost to NPC.



Lighting Luminaires**a) 1 x 9 Watts Compact LED Lamp**

Shall be cool white frosted finish, rated 240V AC, 60Hz operations. Lamp holders shall have E27 base.

When used in damp and wet locations, it shall have an explosion and corrosion proof body and sealed.

b) LED Flood Light

Light Emitting Diode (LED) Flood Light shall be IP65 rated, forged with high quality aluminum alloy with clear tempered glass and built-in cooling fins.

EW-4.4.5 Switches and Single Phase Outlets

Switches and single phase outlets shall comply with NEMA Standard. The ratings of switches and single phase outlets with one conductor earthed shall be as specific herein. All switches and single-phase outlets shall be flush mounted, impact resistant and splash proof type.

Switches

Switches for lighting fixtures shall be of the toggle quiet and flush mounted and fixed to the wall 1.37m above the finished floor level. The rating of the switches shall be 10A, 240VAC, single-phase and has a protection against rain water droplets penetration or other approved equivalent accessory.

Single Phase Outlets

All outlets shall be provided with separate earthing pins connected to the yellow/green part in the feeder cable. Outlets with rated voltage not exceeding 250 Volts shall be in accordance with PEC for 2-pole three-wire (indoor and outdoor). Outlets installed outside the guardpost or in an open environment location shall be rated as weatherproof convenience outlet.

EW-4.4.6 Cables

Cable shall be stranded annealed copper conductor suitable for continuous temperature of 90°C when used in wet or dry location and 90°C when exposed to oil or coolant. The minimum size of conductor to be used shall be 3.5mm².

Insulation shall be suitable for wet and dry location, fungi resistant and ultraviolet stable.

All cables shall be moisture and heat resistant, flame retardant polyvinyl chloride insulation, chemical and abrasion resistant nylon sheath. The cable specification shall meet ASTM specification, PNS 35, UL standard 83 and requirements of PEC.



The Supplier shall submit catalogues and/or brochures showing details of cable insulation and ampacity ratings of all types of cables to be supplied for approval of NPC.

Cable Installation

Cables pulled through conduits shall be supported in an approved manner to avoid damaged to the insulation. Grease or oily substances shall not be used to facilitate the passage of the conductor in conduits.

The pull shall be applied to cables only by means of approved grips. The end portion of the cable, which has been marked or deformed by the grip, shall be cut-off by the Supplier.

All cable runs shall be continuous and all termination shall be at the terminal boards, equipment, etc. No splices are allowed in conduit or cable tray.

Prior to installation, cables and conduits shall be thoroughly cleaned to prevent damage to cables during installation. After cables have been installed, cables shall be tested for continuity and insulation resistance and shall be tagged with respective cable number.

EW-4.4.7 Conduit

All embedded and concealed in ceiling conduits, boxes and fitting required for the power and control conductors including all necessary hardware and accessories such as screws, bolts, concrete inserts, clamps, locknuts, couplings shall be furnished by the Supplier. The required quantities of various items of conduits and associated materials shall be furnished in accordance with the installation requirements.

During installation, due precaution shall be taken to protect the conduit and threads from mechanical injury. The ends of the conduit shall be sealed in an approved manner. Conduit runs shall be sealed by the use of caps and discs or plugs. The seals shall be maintained, except during inspection and tests, until the conductor is pulled in. Conduit shall be check to be free from obstructions by pulling a wooden mandrel of appropriate size through the conduit.

Conduits running in floors and terminating at equipment mounted on concrete bases shall be brought up to the equipment within the concrete bases, wherever possible.

All joints between lengths of conduits and threaded connection to boxes, fittings and equipment enclosures shall be made watertight.

Conduits installed outdoors running underground shall be buried to a minimum of 0.5m.

Non-Metallic Conduits

Non-metallic conduit shall be made of un-plasticized polyvinyl chloride (uPVC) smooth walled inside and outside, coloured red-orange, schedule 40.



The uPVC conduits shall be non-corrosive and weatherproof, resistant to the attacks of acids and alkalis and must have a self-extinguishing property hence shall not support combustion. It shall resist corrosion, rust and scale.

Metallic Conduits

Metallic conduit shall be made of Electrical Metallic Tubing (EMT), galvanized on the outside for corrosion protection and shall have an approved corrosion-resistant organic coating on the inside. EMT shall be installed by the use of set-screw or compression-type couplings and connectors.

EW-4.4.8 Junction/ Utility Boxes

Junction/ Utility Boxes

All junction/utility boxes for concealed work shall be of hot dip galvanized steel or un-plasticized polyvinyl Chloride. All wall boxes on exposed work shall be of aluminum blasted cast iron.

Utility boxes shall be firmly anchored in place and where required provided with fixture supports. The Supplier shall provide special supports for recessed lighting fixtures, etc. Suitable expansion screws shall be used for securing boxes to solid masonry and approved type toggles for securing to hollow masonry units.

Pull Boxes

Pull boxes shall be installed at all necessary points, to prevent damage to the insulation or other damage that might result from pulling resistance or for other reasons related to improper installation. All pull boxes shall be made of galvanized sheet steel not less than 2mm or un-plasticized polyvinyl chloride. Where pull boxes are used in connection with exposed conduits, plain covers attached to the pull box with a suitable number of countersunk flathead machine screws may be used.

EW-4.5 Measurement of Payment

Measurement of payment for all electrical works shall be based on the bid price of each item as shown in the Schedule of Requirements – Electrical Works, Section VII of the Bid Document. The cost of each item shall cover all works required and described in the pertinent provisions of the specifications.



SECTION VI

PART I-TECHNICAL SPECIFICATIONS

ELECTRICAL WORKS

EW 5.0 – GROUNDING SYSTEM

PART I – TECHNICAL SPECIFICATION**EW – ELECTRICAL WORKS****EW – 5.0 – GROUNDING SYSTEM****TABLE OF CONTENTS**

<u>CLAUSE NO.</u>	<u>TITLE</u>	<u>PAGE NO.</u>
EW-5.0	GROUNDING SYSTEM	1
EW-5.1	General	1
EW-5.1.1	Technical Characteristics and Requirements	1
EW-5.1.2	Lightning Rod and Support.....	3
EW-5.1.3	Lightning Down Conductor	3
EW-5.1.4	Grounding Cables	3
EW-5.1.5	Ground Rods.....	3
EW-5.1.6	Exothermic Welding Materials	4
EW-5.1.7	Grounding Hardware.....	4
EW-5.1.8	Steel Structure Grounding.....	4
EW-5.1.9	Equipment Earthing.....	4
EW-5.1.10	Building Earthing.....	5
EW-5.1.11	Fence Earthing.....	5
EW-5.1.12	Pipe Earthing	5
EW-5.1.13	Cable Tray Earthing	5
EW-5.1.14	Ground Rods.....	5
EW-5.2	Measurement of Payment.....	6



PART I – TECHNICAL SPECIFICATIONS**EW – ELECTRICAL WORKS****EW-5.0 GROUNDING SYSTEM****EW-5.1 General**

This specification covers the technical and associated requirements for the entire grounding system of the solar plants and/or switchyards, required to protect persons and equipment, to reduce electromagnetic interference (EMI) and to allow safe service and maintenance of the installations. The grounding system includes all major and minor equipment such as PV modules, mounting structures, inverters, AC combiner boxes, DC boxes, transformer and protection panel, ground rods, motors, pumps, etc. and connections.

All materials and parts which are not specifically mentioned herein but are necessary for the safety of operating personnel and safe operation of the plant shall be furnished and determined by the Supplier at no additional cost to NPC.

EW-5.1.1 Technical Characteristics and Requirements

The ruling criteria in the design of the grounding grid shall be the safety of personnel and the proper operation of the electrical equipment during normal operation and during transient disturbances such as short circuits in the electric power system and during lightning discharges. The grounding system shall meet the following minimum requirements:

ITEM	DESCRIPTION	REQUIREMENTS
Grounding Design Criteria		
1	Fault duration, sec.	3
2	Total fault level (line to ground), kA	8
3	Grounding connection (exothermic, compression, etc.)	Exothermic
4	Grid conductor (specify size and type)	$\geq 100 \text{ mm}^2$ tin-annealed copper stranded conductor (bare)
5	Bonding Conductor (riser)	
	a. All major equipment such as inverter, transformer, ESS, etc.	$\geq 100 \text{ mm}^2$ tin-annealed copper stranded conductor with 1.2 kV PVC Insulation
	b. For motors/pumps rated 30kW and above, CT/PT, FDS, LA, etc.	$\geq 50 \text{ mm}^2$ tin-annealed copper stranded conductor with 1.2 kV PVC Insulation
	c. For motors/pumps rated below 10kW, perimeter lighting and fence earthing	$\geq 22 \text{ mm}^2$ tin-annealed copper stranded conductor with 1.2 kV PVC Insulation



6	Burial depth of grid conductor below finished grade, m	0.6
7	Ground mat design resistance	5 Ohms (max.)
8	Permissible temperature rise of grid copper conductor, °C	300
9	Ground Rod	
	a. Type	Copper rod
	b. Diameter, mm	> 19 mm
	c. Length/section, m	> 3 m
10	Resistivity of crushed rock, (wet) Ohmmeter	3000
11	Approximate area of plant/switchyard to be covered by the ground grid	Refer to Bid Drawings
12	Soil resistivity (for calculation), ohmmeter	By Supplier ¹
Lightning Protection		
1	Manufacturer	By Supplier
2	Place of Manufacture	By Supplier
Lightning Rod		
1	Material	Copper
2	Length, mm	2000
3	Minimum Diameter, mm	16
Down Conductor		
1	Type	Insulated Copper Conductor
2	Minimum Cross-Section Area	50 mm ²
3	Overall Diameter, mm	By Supplier

The Supplier shall carry out earth resistivity measurement for the plant site. Based on the result of this measurement and the system parameter, the appropriate design and the calculation will be determined whether impermissible touch and step voltages occur at any place inside plant area and at any place 10 m outside of the plant boundary line which may be endangered. These calculations will decide on the provisions for grounding to be made with the relevant part of the civil works related to foundations. If the calculations proved after the application of all engineering possibility that touch and step voltages are still higher than permitted and consequently the Supplier managed to design the earthing and grounding grid in such a way to obtain the lowest touch and step voltage value, all documents including limitation and justification shall be provided to NPC for approval.

If in case the actual measured resistance of the Supplier-designed and installed ground grid is higher than specified in this section, the Supplier shall install, at no extra cost to the NPC, additional grounding rods, mats, grounding

¹ Design of grounding system is responsibility of Supplier including measurement of actual soil resistivity.



electrodes, etc., until the field-measured resistance is equal to or less than the specified value.

The ground grid shall be composed of a system of copper conductors buried approximately 60 cm. beneath the surface of the earth, excluding crushed rock surfacing. Driven ground rods shall be installed at regular intervals and connected to the grounding conductor at grid nodes. A minimum of four (4) of the specified ground rods must be installed (one at each corner of the ground grid). The Supplier shall determine the spacing of ground grid conductors and the total number and location of ground rods and their lengths (single or two or more coupled sections).

EW-5.1.2 Lightning Rod and Support

The lightning rod shall be copper-covered steel of circular cross section, with a nominal diameter of 16 mm and a nominal length of 2 meters.

The air terminal (lightning rod) shall be located at the highest point of the facility to capture the lightning strike to a preferred point, so that the discharge current can be safely directed via the down conductor to the grounding system. The lightning rod support shall consist of a minimum of 3.0 meters of galvanized iron piping mast. The Supplier shall give technical details of the protection including mounting and installation details for approval.

EW-5.1.3 Lightning Down Conductor

The down conductor will provide a low impedance path from the air termination to the ground system so that the lightning current can be safely conducted to earth, without the development of excessively large voltages.

The main copper conductor shall be made of electrical grade copper, with a minimum cross sectional equivalent to 55 mm². The main conductor shall consist of copper strands helically bound by a copper tape conductor designed to evenly distribute the lightning currents concentrically along the conductor length.

In order to reduce the possibility of dangerous sparking (side-flashing), the down conductor route(s) should be as direct as possible with no sharp bends or stress points where the inductance, and hence impedance, is increased under impulse conditions. The down conductor should not be subject to bends of less than 0.5-meter radius and shall be secured to the structure by approved metallic fastening at least every 2.0 meters.

EW-5.1.4 Grounding Cables

Grounding cables shall be copper conductor of soft drawn or hard drawn concentric stranding bare copper conductor in accordance with the latest revision of ASTM B3 and manufactured in accordance with ASTM Specification B8 (class B).

EW-5.1.5 Ground Rods

The ground rod shall be copper-covered steel of circular cross section, with a nominal diameter of 19 mm and a nominal length of 3 meters.



Each ground rod shall have a conical swaged point at one end and shall have a continuous smooth copper covering of at least 0.254 mm thickness molten-welded or copper bonded (electro-deposit) to a steel core. The copper clad or pressed type will not be accepted.

EW-5.1.6 Exothermic Welding Materials

The Supplier shall supply exothermic welding materials for cable-to-cable, cable-to-ground rod and cable-to-steel structure grounding connections. These materials shall be Cadweld or approved equal. The Supplier should submit detailed information describing the proposed process.

EW-5.1.7 Grounding Hardware

Terminal Lugs

Terminal lugs shall be one hole, socket type, rounded edge lug, cast of high strength corrosion resistant copper alloy. Machine screws, nuts, and washers used with the lugs shall be bronze.

EW-5.1.8 Steel Structure Grounding

All generating plant metal parts such as structures, equipment, cable trays, fence, etc. shall be connected to the ground grid by suitable ground connections.

If there is any possibility for a conductor to fall down on a steel structure, this structure must be connected to the grid with a connection able to sustain the earth fault current.

EW-5.1.9 Equipment Earthing

Transformer Earthing

The transformer shall be earthed at two points diagonally opposite each other. These connections shall be made from two different points of the earthing grid.

Lightning Arrester

Lightning arresters shall be connected to the earthing grid with 50 mm² tin-annealed copper conductor.

Power Cables

The lead sheath or armor (shield) of the MV power cables, if to be provided, shall be earthed by connecting a flexible braid to the shield. This shall be done at both ends of each cable. Cable end boxes shall be earthed with copper cable connection on one of the mounting bolts.

Lighting Poles

Poles for lighting shall be connected to the earthing grid with 22 mm² tin-annealed copper conductor (one connection for each pole).



Other Metallic Structures

Other types of metal structures within the diesel / solar PV plant area, not mentioned thereto, shall be connected to the earthing grid.

Major equipment shall be equipped with at least two (2) terminals or suitable grounding pads of adequate size to accommodate at least two fixing screws for proper connection to the earthing system.

EW-5.1.10 Building Earthing

Generally, each electrical device inside the control building/room must be equipped with an earthing screw of sufficient diameter for connection to the earthing system. The same applies to all metallic parts such as panels, etc. which are effectively connected by earth conductors.

Control panels and desks, switchboards, etc. consisting of several individual sections or compartments shall each be connected to a common tinned copper earth bar unless all panels are solidly welded together, or other approved means are applied ensuring solid earthing connections. In such a case, provisions for earthing must be made at one end at least.

EW-5.1.11 Fence Earthing

Steel fences around the switchyard or station shall be connected to the earthing system at appropriate connection point along the fence and at all corners and gate posts.

EW-5.1.12 Pipe Earthing

All piping shall be earthed at all service points in an approved manner.

The conceptual design of the grounding system based on the specified conditions shall be referred to the bid drawing.

The supply shall include special tools, kits and expandable materials necessary to weld the grid joints and ground rod connections by exothermic process, including reasonable waste to be expected during installations. Standard grounding connectors shall be fixed to metal frames by means of bolted clamps.

EW-5.1.13 Cable Tray Earthing

Cable trays and ladders shall be connected to the earthing system at every ten (10) meters interval.

EW-5.1.14 Ground Rods

Ground rods shall be driven to a depth such that the top of each rod is at the same elevation as the ground grid and shall be bonded to the ground grid conductors by suitable exothermic connections.



EW-5.2 Measurement of Payment

Measurement of payment for all electrical works shall be based on the bid price of each item as shown in the Schedule of Requirements – Electrical Works, Section VII of the Bid Document. The cost of each item shall cover all works required and described in the pertinent provisions of the specifications.



SECTION VI

PART I-TECHNICAL SPECIFICATIONS

ELECTRICAL WORKS

EW 6.0 – SWITCHYARD EQUIPMENT AND APPURTENANCES

PART I – TECHNICAL SPECIFICATION**EW – ELECTRICAL WORKS****EW – 6.0 – SWITCHYARD EQUIPMENT AND APPURTENANCES****TABLE OF CONTENTS**

<u>CLAUSE NO.</u>	<u>TITLE</u>	<u>PAGE NO.</u>
EW-6.0	SWITCHYARD EQUIPMENT AND APPURTENANCES.....	1
EW-6.1	General	1
EW-6.2	Scope of Work.....	1
EW-6.3	Codes and Standards.....	2
EW-6.4	Power, Control and Instrumentation Cable	2
	EW-6.4.1 Technical Characteristics and Requirements	2
	EW-6.4.2 Insulation	3
	EW-6.4.3 Jacket	3
	EW-6.4.4 Assembly	3
	EW-6.4.5 Application	3
EW-6.5	Fuse Disconnect Switch with Lightning Arrester Combination	3
	EW-6.5.1 Technical Characteristics and Requirements	3
EW-6.6	Bus Conductor and Hardware	5
	EW-6.6.1 Technical Characteristics and Requirements	5
EW-6.7	Measurement of Payment.....	7



PART I – TECHNICAL SPECIFICATIONS

EW – ELECTRICAL WORKS

EW-6.0 SWITCHYARD EQUIPMENT AND APPURTENANCES

EW-6.1 General

This specification covers the furnishing of all labor, materials, equipment, tools and other incidentals for the erection/installation of switchyard take – off structures for Palanan Solar PV Plant and Palanan Diesel Power Plant.

The work shall be performed and completed in accordance with generally accepted modern practice in the erection and installation of steel poles.

All equipment and materials which the Supplier shall supply and install shall be new and unused. They shall be suitable for their intended purpose complying with all applicable regulations, quality and dimension standards.

EW-6.2 Scope of Work

In accordance with the specification contained in this section and as shown on the bid drawings, the works and services to be performed by the successful bidder shall essentially consist of but not limited to the following:

- a) Supply, delivery, erection/installation of Steel Pole take off structure including dressing and accessories as shown on the bid drawings (grounding materials, tension insulators, etc.);
- b) Supply, Installation/stringing and test of bus conductor, and structure ground wires complete with appurtenances and accessories;
- c) Supply, installation and test of medium voltage power cables and conduit complete with appurtenances and accessories;
- d) Supply, Installation and Test of 15kV Fuse Disconnect Switches with Lightning Arrester Combination;
- e) Supply, Installation and Test of Grounding System;
- f) Supply, Installation and Test of Lightning Protection System; and
- g) All other works and services including those not specifically detailed herein but are required for the complete, safe and reliable operation of the project.

The Supplier shall perform the entire quantity of work necessary to complete the erection of the take-off structures at the Contract Unit Price, be it more or less than the quantity herein estimated.



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 Supplier shall furnish high quality steel pole(s) including dressing and accessories meeting the requirements of the specification and industry standards.

EW-6.3 Codes and Standards

All equipment covered by this specification shall be designed, manufactured, assembled and tested in accordance with, but not limited to, the latest issues of applicable ASTM, AWS, AZI, ASCE, ISO or equivalent standards, including all addenda, in effect at time of purchase order unless otherwise stated in this specification.

EW-6.4 Power, Control and Instrumentation Cable

This specification covers the technical and associated requirements of power, control and instrumentation cables, and medium voltage power cable for use in switchyards.

All cables shall be designed to withstand the short-circuit condition and voltage drop of 3% (max.).

EW-6.4.1 Technical Characteristics and Requirements

The cables 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 used, due to switching operations, sudden load variations, faults, etc. The medium voltage XLPE power cable and the 600V power, control and instrumentation cable to be supplied shall be compliant to ICEA S-66-524 or IEC 60502-2 and UL 83, PNS 35, ICEA S-73-532 specification and requirements of PEC respectively.

The cables shall be selected to withstand without distress any short-circuit currents in the conductor and sheath related to the existing fault levels.

The cables and its accessories shall be manufactured to fulfill the requirements when operating with full load or at any load factor.

The power cables shall meet the following minimum requirements:

ITEM	DESCRIPTION	REQUIREMENTS
1	Conductor Shape	Circular Stranded Wire
2	Conductor Material	Annealed Copper
3	Insulation	
	a. Material	Cross-linked polyethylene (XLPE)
	b. Thickness, mm	≥ 4.5
4	Outer covering/Jacket	
	a. Material	PVC Sheath Jacketing
	b. Thickness, mm	Manufacturer's Data
	c. Termite Protection Required	Yes



5	Shielded	Yes
	a. Type of Shielding	Copper Tape Screen
6	Provided with Filler and Binder Tape	Yes

EW-6.4.2 Insulation

Insulation shall be of the type specified in the Technical Data Sheets.

EW-6.4.3 Jacket

A tough, ozone, low chlorine, heat, flame and moisture-resistant PVC or Nylon jacket capable of providing protection against sunlight, acids, alkalis and oils shall be furnished for all cables.

EW-6.4.4 Assembly

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.

EW-6.4.5 Application

All cables shall be suitable for installation in cable tray, conduit, trench, underground duct in wet and dry locations, and above ground raceway in damp and dry locations.

EW-6.5 Fuse Disconnect Switch with Lightning Arrester Combination

This specification covers the supply and delivery of fuse disconnect switch with lightning arrester combination for use in various diesel and solar power plants.

The materials furnished shall be in accordance with, but not limited to, the latest issues of the Applicable Codes and Standards, including all addenda, in effect at time of purchase order unless otherwise stated herein.

EW-6.5.1 Technical Characteristics and Requirements

The fuse disconnect switch to be supplied shall be suitable for high voltage transformer acting as an overload protector and a device for opening and closing the circuit. All the metal parts of the fuse disconnect switch shall be free from erosion and rust. The FDS shall meet the following minimum requirements:

ITEM	DESCRIPTION	REQUIREMENTS
1	Class (Indoor, Outdoor)	Outdoor
2	Rated voltage, kV	15
3	Nominal system voltage, kV	13.8
4	Frequency, Hz	60
5	BIL, kV	110
6	Ampere Frame	100



7	Interrupting Capacity, kA	10
8	Fuse Link	
	a. Type	Universal buttonhead design
	b. Current Rating, A	Refer to Single Line Diagram
9	Lightning Arrester	
	a. Type	Metal Oxide Varistor (MOV), gapless
	b. Class (indoor, outdoor)	Outdoor
	c. Rated frequency, Hz	60
	d. Nominal system voltage, kV	13.8
	e. Duty cycle voltage (rating), kVrms	12
	f. Maximum Continuous Operating Voltage (MCOV), for the arresters having the following duty cycle voltage, kV rms	8.4
	g. Nominal discharge current, kA	10
	h. Creepage distance, mm	465
	i. Supporting brackets, bolts, nuts, etc.	Yes

Fuse Cut-Out

Fuse cutouts shall be satisfactory use in a tropical climate with high relative humidity. The cutouts will be mounted by means of steel brackets on steel poles cross arms.

The cutouts are intended for use with buttonhead-type fuse links and must be able to accommodate fuse links meeting the interchangeability requirements of ANSI standard. The cutouts to be supplied shall include the following:

1. Fuse Support Assembly
2. Fuse Holder Assembly
3. Mounting Bracket
4. Lock Washers

Fuse Link

The fuse link to be supplied shall be universal buttonhead with tin fuse element suitable for 15 kV open type distribution cut-out to be used in the overcurrent protection of circuits. It is characterized by perfect time current characteristics, high mechanical strength and reliable arc extinguishing performance, etc. The fuse link shall meet the electrical and mechanical interchangeability requirement in accordance with ANSI standard.



Lightning Arrester

Gapless arresters shall have elements fabricated from non-linear resistance metal oxide materials to perform both the surge discharge and power frequency reseal functions.

Arresters of this type shall be protected in a hermetically sealed wet-process porcelain jacket, which shall have a high creepage distance and a high dielectric strength.

The primary terminals shall be suitable for the connection of the type and size of conductors which can be either copper or aluminum conductors without use of bimetal inserts.

The arrester shall be supplied with a cross-arm mounting bracket that conforms with the requirements of NEMA or with appropriate bracket as a cutout arrester combination on it.

All mounting bolts and conductor connection shall be provided with lock washer. Lock washers shall be fabricated from material that complies with the requirements as per ANSI standard.

All exposed steel or iron part of the arrester shall be hot-dipped galvanized in accordance with ASTM standard.

The Supplier shall submit for approval the brochures and/or catalogues with complete technical specification of the fuse cut out with lightning arrester combination including mounting brackets and accessories.

EW-6.6**Bus Conductor and Hardware**

This specification covers the technical and associated requirements for stranded aluminum bus conductors and line hardware for use in various electric generating plant switchyards.

All line hardware/materials shall meet the performance requirements application criteria and manufacturing tolerances passed ANSI CB5. 1-1979 - American National Standard for Galvanized Steel Bolts and nuts for overhead line construction.

EW-6.6.1**Technical Characteristics and Requirements**

Describe herein is the general specification of the bus conductor, line materials and equipment to be supplied for this project. The bus conductor, line materials and equipment shall meet the following minimum requirements:

ITEM	DESCRIPTION	REQUIREMENTS
Stranded Conductor Requirements		
1	Type designation	Aluminum Conductor Steel Reinforced (ACSR)
2	Code Name	QUAIL
3	Conductor size	2/0 AWG ACSR
4	Ampacity, A	270



5	Outer Layers	
	a. Material	Aluminum
	b. Stranding No.	6
	c. Calculated Cross-sectional Area, mm ²	67.33
	d. Coefficient of Elongation (°C)	Manufacturer's Data
6	Core	
	a. Material	Aluminum Clad Steel
	b. Stranding No.	1
	c. Calculated Cross-sectional Area, mm ²	11.22
	d. Coefficient of Elongation (°C)	Manufacturer's Data
7	Conductor Coefficient of Linear Expansion (°C)	Manufacturer's Data
Conductor Hardware		
1	Tension Clamp	
	a. Type	Bolted, U-Bolt
	b. Material of Body	Aluminum Alloy
2	Connectors	
	a. Type	wedge pressure clamp for stranded conductor connection
	b. Angle and T-connectors type	wedge pressure clamp for stranded conductor connection

Stranded Conductor

All wires of the stranded conductor shall be concentrically stranded. The wires in each layer shall be evenly and closely stranded around the underlying wire(s). The tension in individual wires in a layer shall be sufficient to hold each wire firmly in place with only enough strand separation to prevent crowding at the time of stranding and during installation. All steel and aluminum wires shall lie naturally in their position in the stranded conductor and, when the core and/or the aluminum wires are cut, the wire ends shall remain in position or be readily replaced by hand and then remain approximately in position.

The aluminum shall be of the higher purity commercially obtainable which shall not be less than 99.5%. The type of conductor to be supplied shall be stated in the Technical Data Sheets and shall be manufactured according to the applicable ASTM or equivalent IEC standards.

The completed conductor shall be smooth, free from nick, burrs, aluminum or steel particles, dirt and excessive die grease. The conductor shall be absolutely free of copper dust and copper particles.

Clamps

Aluminum strain clamps and suspension clamps for aluminum conductor, if required in the Technical Data Sheets, shall have its clamp bodies and keeper pieces, made of high strength and heat treated cast aluminum alloy. Cotter bolts, U-bolts, nuts, and lock washers shall be hot dip galvanized steel. Cotter



pins shall be made of stainless steel. Slip strength of the strain clamp shall be not less than 85% of the rated ultimate strength of the conductor.

Cross Arms

The cross arms to be supplied for this project shall be in accordance to ASCE manual 72 "Design of Steel Transmission Pole Structures". The materials shall meet ASTM A-570 specification (36 KSI min. steel strength) while the galvanizing shall be in accordance with ASTM A-123 specification.

Insulators

Insulators to be utilized in the project shall be in accordance to ANSI Class 55-3 for pin, Class 52-1 for suspension, Class 53-2 and Class 53-4 for spool standard as to material, ultimate tensile strength, leakage, distance, etc.

Line Hardware

Line hardware shall be made either of aluminum alloy, malleable iron or ductile iron with tensile strength in accordance with ANSI standard.

Bolts

All bolts such as carriage, double arming, oval, machine, etc. shall be hot dip galvanized as per ASTM A-153.

EW-6.7

Measurement of Payment

Measurement of payment for all electrical works shall be based on the bid price of each item as shown in the Schedule of Requirements – Electrical Works, Section VII of the Bid Document. The cost of each item shall cover all works required and described in the pertinent provisions of the specifications.



SECTION VI

**PART I-TECHNICAL
SPECIFICATIONS**

ELECTRICAL WORKS

EW 7.0 – 13.8KV TIE LINE

PART I-TECHNICAL SPECIFICATION**EW-ELECTRICAL WORKS****EW-7.0 – 13.8KV TIE LINE****TABLE OF CONTENTS**

<u>CLAUSE NO.</u>	<u>TITLE</u>	<u>PAGE NO.</u>
EW-7.0	13.8KV TIE LINE.....	1
EW-7.1	General	1
EW-7.2	Scope of Work.....	1
EW-7.3	Codes and Standards.....	2
EW-7.4	Line Materials	3
	EW-7.4.1 Scope.....	3
	EW-7.4.2 Line Materials Specifications.....	3
EW-7.5	Pole Erection and Line Material Installation.....	4
	EW-7.5.1 Scope.....	4
	EW-7.5.2 Structure Dressings/ Insulator Assemblies	6
	EW-7.5.3 Guy and Anchor Assemblies	6
	EW-7.5.4 Conductors (Including Compression Joints, Armor Rods, Repair Sleeves and Jumpers) Requirement.....	6
	EW-7.5.5 Communication Cables	8
	EW-7.5.6 Hauling of Tie Line Materials.....	9
EW-7.6	Factory Assembly and Tests.....	9
	EW-7.6.1 Field and Acceptance Test.....	9
	EW-7.6.2 Final Completion of Work.....	10
EW-7.7	Measurement of Payment.....	10



PART I - TECHNICAL SPECIFICATION**EW - ELECTRICAL WORKS****EW-7.0 13.8KV TIE LINE****EW-7.1 General**

This specification covers the furnishing of all labor, materials, equipment and other incidentals for the erection/installation of 13.8kV, 3-Phase Tie Line.

The proposed 70 meters (approximate) Palanan Solar PV Plant to Palanan Diesel Power Plant 13.8kV Tie Line Project is part of the Solar PV-Diesel Hybrid Projects that will enable to combine the output energy of the Solar PV Farm and Diesel Generating sets for Palanan, Isabela.

The tie line to be erected/installed shall utilize 2/0 AWG ACSR (Quail) designed for 13.8 kV, 3-phase system. The line shall be designed to use balanced twisted-pair cable for communication system which shall be compatible with the PCU/String Inverter at the solar PV plant and the communication interface with the diesel gensets at the DPP site.

The Supplier shall conduct check survey of the proposed tie line route and shall establish the required staking, line materials, and any other contingencies liable to affect his tender price, as no claim for extra payment in this connection will be entertained.

Any discrepancy between the bidding/tentative plan and the actual survey conducted by the Supplier shall be reported to NPC for evaluation and appropriate action.

The work shall be performed and completed in a workmanlike manner, in accordance with generally accepted modern practice in the erection and installation of steel poles (tie lines).

All equipment and materials which the Supplier shall supply and install shall be new and unused. They shall be suitable for their intended purpose complying with all applicable regulations, quality and dimension standards.

EW-7.2 Scope of Work

In accordance with the specifications contained in this section and as shown on the bid drawings, the works and services to be performed by the Supplier for the 13.8 kV tie line shall be essentially consist of, but are not limited to, the following:

- a) Clearing of right-of-way (6 meters wide) from the entire route;
- b) Final survey, assessment on the aerial route and staking of Steel Poles;



SECTION VI – TECHNICAL SPECIFICATIONS

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- c) Supply and delivery of Steel Pole, line hardware, Insulators, primary conductors, cross-arms, etc.; including dressing and accessories as shown on the bid drawings
- d) Dressing and erection of Steel Poles, guying and ground wires;
- e) Supply and Installation of guying assemblies;
- f) Supply and Installation/stringing of power conductors, communication cables, and structure ground wires complete with appurtenances and accessories;
- g) Furnishing and installation of Pole numbering;
- h) Conduct of continuity test on the entire line; and
- i) All other works necessary although not specifically mentioned and detailed but are required for the complete, safe and reliable operation of the Tie Line.

Bidders are required to make an ocular survey of the route of the tie line to enable them to see the actual field conditions in order to offer a realistic and equitable bid. NPC will extend reasonable assistance and cooperation in showing the route of the line.

The Supplier shall conduct check survey of the proposed line route and shall establish the required staking for all sites. Any discrepancy between the Plan and Profile and the actual survey conducted by the Supplier shall be reported to NPC.

The Supplier will be required to perform the entire quantity of work necessary to complete the erection of the line at the Contract Unit Price, be it more or less than the quantity herein estimated.

It is not NPC's intent to specify all technical requirements or to set forth those requirements adequately covered by applicable codes and standards. The Supplier shall furnish high quality steel pole(s), cables and its accessories meeting the requirements of the specification and industry standards.

EW-7.3**Codes and Standards**

All equipment covered by this specification shall be designed, manufactured, assembled and tested in accordance with, but not limited to, the latest issues of applicable ASTM, AWS, AZI, ASCE, ISO or equivalent standards, including all addenda, in effect at time of purchase order unless otherwise stated in this specification.



EW-7.4 Line Materials**EW-7.4.1 Scope**

This section covers the line material specification for 13.8kV tie line in accordance with the requirements specified hereunder and as shown on the drawings. The supplier shall meet the following minimum requirements:

ITEM	DESCRIPTION	REQUIREMENTS
1	Type	2/0 AWG ACSR
2	Code Name	QUAIL
3	Total Cross sectional area	100.29mm ² (approx)
4	Ampacity	270 A
5	Outer Layers	
	a. Material	Aluminum
	b. Calculated Cross-sectional Area, mm ²	67.33
	c. Stranding No. / diameter, mm	6/3.78
6	Core	
	a. Material	Aluminum Clad Steel
	b. Calculated Cross-sectional Area, mm ²	11.22
	c. Stranding No. / diameter, mm	1/3.78
7	Conductor overall diameter, mm	11.3 (approx.)
8	Ultimate Breaking Strength, kN	23.54
9	Rated DC Resistance at 20°, Ω/km	0.426
10	Weight of Conductor, kg/m	0.272 (approx.)
11	Test Requirements:	
	a. Stress – Strain Test and Report Required:	Yes
	b. Breaking Strength test and Report Required:	Yes
	c. Certified Stress-Strain Test Reports on a Cable identical to be specified conductor are acceptable:	Yes

EW-7.4.2 Line Materials Specifications

Describe herein is the general specification of the line materials and equipment to be supplied for this project;



a) Cross Arms

The cross arms to be supplied for this project shall be in accordance to ASCE manual 72 "Design of Steel Transmission Pole Structures". The materials shall meet ASTM A-570 specification (36 KSI min. steel strength) while the galvanizing shall be in accordance with ASTM A-123 specification.

b) Conductors

The conductors to be furnished shall be in accordance with, but not limited to, the latest issues of approved standards for ACSR conductors.

c) Insulators

Insulators such as pin, spool and suspension type to be utilized in the project shall be in accordance to ANSI standard as to material, ultimate tensile strength, leakage distance, etc.

d) Line Hardware

Line hardware shall be made either of aluminum alloy, malleable iron or ductile iron with tensile strength in accordance with ANSI standard.

e) Bolts

All bolts such as carriage, double arming, oval, machine, etc. shall be hot dip galvanized as per ASTM A-153.

EW-7.5 Pole Erection and Line Material Installation**EW-7.5.1 Scope**

The general outline of the pole structures, general dimensions, clearances and distances of conductors/wires must be in accordance with the NPC standard requirements. The steel poles shall meet the following minimum requirements:

ITEM	DESCRIPTION	REQUIREMENTS
1	Structural grade of steel used	ASTM A572 grade 345MPa (50ksi) (minimum)
2	Number of Pole Sections	One (1)
3	Pole Shape	Octagonal
4	Welding Method of Processing Steel Pole	Submerged-Arc Welding and Automatic Shielded Inert Gas Metal-Arched Welding (SIGMA)
5	Hot-Dipped Galvanized	According to Technical Specifications
6	Pole Marking	According to Technical Specifications



The Supplier shall use standard and accepted practice and method of erecting the poles depending on their location. Insofar as practicable, the poles shall be selected and matched so that the poles in each structure will be of equal cross-section. Except as otherwise provided in this paragraph or drawings, or otherwise directed by NPC, all poles shall be set in accordance with the following table:

Length of Poles		Depth of Pole Setting			
		In Earth		In Rock	
<u>Meter</u>	<u>Feet</u>	<u>Meter</u>	<u>Feet</u>	<u>Meter</u>	<u>Feet</u>
7.62	25	1.37	4.5	1.22	4.0
9.15	30	1.52	5.0	1.22	4.0
10.67	35	1.68	5.5	1.22	4.0
12.19	40	1.83	6.0	1.22	4.0

The Supplier shall excavate holes for pole setting to a depth indicated in table above. The diameter of the holes shall be 20cm larger than the pole diameter at ground level. Poles set in holes partly in earth and rock shall be set to a depth shown for earth. Poles at angle and dead end points and at the other points of unbalanced stress shall be set at six (6) inches deeper than shown above, and poles with extra-large diameters shall be used at these points whenever possible. Pole structures located in steeply sloping ground shall have their depth of setting measured on the downhill sides and shall be at least as deep as shown in the above tabulation. All poles shall be set to within three (3) inches of the specified setting. All holes shall be dug in the correct locations and shall be large enough to provide for the use of tamping bars all around the poles to the full depth of the holes.

All poles shall be set truly vertical and exact in alignment.

After the poles have been set and aligned properly, the holes shall be backfilled with materials consisting of 80% gravel whose sizes ranges from 7.6cm to 10cm diameter and 20% sand whose sizes range from 3mm to 8mm by volume. The gravel and sand material shall be filled around the holes and compacted thoroughly at 30cm (12 inches) layer by tamping tools before placing the next 30cm layer of gravel and sand, until the backfill material reaches the ground surface level. Materials from the excavated holes shall be placed and tamped around the poles to a height of 30cm (12 inches) above ground line and shall be spread sloping radially outward until it intersects with the ground surface. In cases where the poles are located/erected in the rice field areas, excavated materials shall be spread and leveled evenly over the site.

In section of the line where the soil bearing capacity is reduced or where special conditions is required, the Supplier shall furnish and place concrete foundation subject to the approval of NPC.

The Supplier shall number each structure for ground patrol. The reflectorized paint shall be weather resistant approved by NPC. The numbers shall be painted approximately 3.0 meters from the ground vertically on the flat surface of the poles.



EW-7.5.2 Structure Dressings/ Insulator Assemblies

The cross-arms and hardware shall be assembled and installed properly. All nuts and locknuts shall be adequately tightened.

Braces such as flat braces, x-braces, shall be attached where required. The poles and braces shall be bored as required and shall be attached by the Supplier in accordance with the NEMA standard. All nuts shall be tightened adequately.

The Supplier shall assemble and install the insulator assemblies as shown in the attached reference drawing.

The number of suspension insulators to be used for a single string of strain assembly shall be as indicated in the attached reference drawing.

EW-7.5.3 Guy and Anchor Assemblies

Guy and anchor assemblies shall be installed where required. However, NPC reserves the right to direct the Supplier to change the location of the guy and anchor assemblies as may be found desirable in the field. The guy assemblies shall be log type. Installing a guy assembly shall consist of excavating earth to a depth of at least 5'-0", installing anchor log in position, backfilling and compacting the backfill and installing the guy wire. The anchor rod shall protrude three (3) inches above the ground line when installed.

EW-7.5.4 Conductors (Including Compression Joints, Armor Rods, Repair Sleeves and Jumpers) Requirement

The Supplier shall install, join, string and sag the conductor in accordance with the attached reference drawings.

Tools and Special Equipment

The Supplier shall furnish all tools and special equipment necessary to install, join, string and sag the conductor in accordance with the best modern practices. NPC reserves the right to approve the tools and equipment to be used by the Supplier.

Compression Joints

All joints in the conductors shall be in accordance with the recommendations of the conductor manufacturer unless otherwise specified by NPC. All splices in conductors shall be made at least fifty (50) feet (15.24m.) away from the structure and no joints will be permitted in spans crossing over existing transmission lines or other public utility lines, unless approved by NPC. River crossing spans shall also be free from joints.

The Supplier shall furnish all necessary accessories, special tools, compressors, etc., required for making conductor splices.

The Supplier shall furnish filler paste for all compression joint consisting of seventy percent (70%) zinc chromate and thirty percent (30%) raw linseed oil



by weight. The paste shall be applied in the manner recommended by the manufacturer of the compression joints.

Armor Rods

The Supplier shall install Armor rods where required at points in accordance with manufacturer's recommendations and as shown on the attached reference drawing. Where it becomes necessary to shift the point of attachment after the armor rods are installed, such shift shall not exceed two and a half (2-1/2) feet (63.5mm.) either way from the center. If the required shift exceeds this limit, the Supplier shall reinstall the preformed armor rods.

Stringing

The stringing operation shall be conducted using method which will not injure the conductor. Particular care shall be made to ensure that the conductor is not twisted in any manner. NPC reserves the right to approve the stringing method used by the Supplier.

Sagging

General

All tie line conductors shall be sagged in accordance with the sag and tension chart for specific type of cable. These sag and tension are in accordance with the recommendation of the conductor manufacturer. The loading of the conductor shall be such that the design loadings of the structure shall not be exceeded during stringing.

Check

a) Tension

As required by NPC to avoid over-stressing the conductor while stringing, the conductor tension shall be measured by dynamometer to be furnished by the Supplier. The dynamometers used shall be frequently calibrated in order to ensure its accuracy.

b) Sags

All sags shall be measured by the line of sight method. While the sag in all conductors shall be in accordance with the stringing sags specified, maximum increase of five percent (5%) will be acceptable provided the five percent does not exceed six (6) inches (152mm.) and provided that all conductors in the same span assume the same sag and the necessary ground clearance is obtained. In any span where five percent (5%) of the specified sag is less than two (2) inches (51mm.), a maximum increase of two inches will be acceptable. A telescope shall be used for the line-of-sight sagging. The methods for checking sag and the points at which the checks are to be made shall be agreed upon between NPC and the Supplier. It is the intent of these specifications that NPC shall be assured, by means of sufficient and reasonable number of checks and the ground clearances as tabulated in the pertinent drawings are obtain at all



points, that the tensions are obtain and the general appearances of the line will be satisfactory.

c) **Sagging Information**

The Supplier shall submit to NPC, on approved form, the following information concerning the sagging of the conductor and shield wire:

1. Date
2. Type of conductor or shield wire sagged
3. Span sagged
4. Measured sag, in meters
5. Temperature in °C or °F
6. Relative elevations of point of supports.

Jumper Connection

At all dead-end structures or angle structures, where required, the jumper connections shall be formed in a neat and workmanlike manner.

Repair Sleeves

Compression type repair sleeves may be used to repair minor damage to the conductor. Provided that:

- a) At the location of the damage on the conductor to be repaired not more than one third (1/3) of the outer aluminum strands are damaged over a length of not more than four (4) inches.
- b) Not more than two (2) strands in the outer layer are broken, no strands in the inner layer of aluminum strands are broken, and the cross-sectional area of the damage strands is not reduced by more than twenty-five percent (25%).

EW-7.5.5 Communication Cables

The tie line shall be designed to include the communication cable and its necessary interfaces and auxiliaries. The communication cable must be clamped or banded to the poles with stainless steel straps. Drilling of holes to the steel pole for a bolt attachment is prohibited.

The communication cables shall be installed with appropriate clearance to the energized power cables for at least 43 inches from the lowest sag. The following clearance to the ground as per NESC shall be implemented:

Type of Location	Neutral or Comm.	Grounded Span Guy	TPX	7.2/12.5 kV	14.4/25 kV	19.9/35 kV
Railroads		23.5 ft	24.0 ft		26.5 ft	
Trucks Over 8 Feet		15.5 ft	16 ft		18.5 ft	
Water - No		14.0 ft	14.5		17.0	



Sailboats		ft	
Over fields, orchards, forest, etc.	15.5 ft	16.0 ft	18.5 ft
Pedestrians Only	9.5 ft	12.0 ft	14.5 ft
Oversized Vehicles - greater than 14 feet in height (x = known height of the oversized vehicle)	$X + 1.5$ ft	$X + 2$ ft	$X + 4.5$ ft
Vertical Clearance Over Buildings			
Accessible	10.5 ft	11.0 ft	13.5 ft
Non-accessible	3.0 ft	3.5 ft	12.5 ft

EW-7.5.6 Hauling of Tie Line Materials

Hauling of steel pole, power conductor, line hardware, insulators and other tie line materials shall be placed in a flat floored vehicle sufficient to carry its load with wooden loggings facing the floor and shall be kept intact while in transit.

EW-7.6 Factory Assembly and Tests**EW-7.6.1 Field and Acceptance Test**

Field tests and acceptance tests shall be performed by the Supplier to be witnessed by NPC on the various components of the tie line to determine whether requirements of the specification have been fulfilled. The Supplier shall provide instructions and acceptance criteria for field testing and commissioning for NPC's reference and application for the tie line system.

Four (4) certified copies of the reports of all routine tests mentioned herein based on specification standard shall be furnished to NPC immediately within a maximum of fifteen (15) days following the completion of the tests. For equipment and materials which had the required type test already, the type test certificates shall be submitted by the Supplier together with his proposal.

If, however, 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 Supplier shall proceed with the Factory Tests in accordance with the requirement of the specification and the manufacturer's test specification as approved by NPC.

If any of the tie line components (i.e. steel poles, insulators, conductors, hardware, etc.) fail to pass any test, NPC may, at his own judgment, direct the Supplier 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 the tie line component to meet the guarantees and other requirements of the specification shall be borne by the Supplier. The costs of witnessing the Factory Acceptance Tests by NPC or his representative(s) as a result of re-test to be conducted on the equipment shall also be borne by the Supplier.

EW-7.6.2 Final Completion of Work

After all the conductors are completely strung, Supplier and NPC shall conduct a joint final inspection from tapping point to receiving end of the line. The Supplier must satisfy NPC that all minimum requirements indicated on the General Design Data for 13.8kV, Single Circuit, Steel Pole Tie Line had been met, especially the minimum clearance to ground of the conductor. A continuity test of the line from the tapping point to the receiving end must also be conducted in order to ensure that the entire line is continuous. The decision made by NPC in any defect as found by him shall be final and all the requirements must be complied by the Supplier after receipt of official written communication before a Certificate of Final Completion of work is to be provided.

EW-7.7 Measurement of Payment

Measurement of payment for all electrical works shall be based on the bid price of each item as shown in the Schedule of Requirements – Electrical Works, Section VII of the Bid Document. The cost of each item shall cover all works required and described in the pertinent provisions of the specifications.

SECTION VI

PART I-TECHNICAL SPECIFICATIONS

MECHANICAL WORKS

PART I – TECHNICAL SPECIFICATION**MW – MECHANICAL WORKS****TABLE OF CONTENTS**

<u>CLAUSE NO.</u>	<u>TITLE</u>	<u>PAGE NO.</u>
MW-1.0	GENERAL.....	1
MW-2.0	SCOPE OF WORK.....	1
MW-3.0	MATERIALS AND EQUIPMENT.....	2
MW-3.1	General.....	2
MW-3.2	Code and Standards.....	3
MW-3.3	Equipment Foundation.....	3
MW-3.4	Piping System.....	4
	MW-3.4.1 Steel Pipe.....	4
	MW-3.4.2 PVC Pipe.....	5
	MW-3.4.3 Pipe Installation.....	5
MW-3.5	Corrosion Protection and Painting.....	5
	MW-3.5.1 Painting.....	5
	MW-3.5.2 Hot Dipped Galvanizing.....	6
MW-3.6	Tag Numbers/Standard Plant Identification Number (SPIN).....	6
MW-4.0	DOMESTIC WATER SUPPLY SYSTEM.....	6
MW-4.1	General.....	6
MW-4.2	Elevated Water Storage Tank.....	7
MW-4.3	Pump.....	7
	MW-4.3.1 Jetmatic Hand Pump.....	7
	MW-4.3.2 Portable Submersible Sump Pump.....	8
MW-4.4	Piping, Valves and Fittings.....	9
MW-4.5	Testing.....	9
	MW-4.5.1 Portable Submersible Sump Pump.....	9
	MW-4.5.2 Elevated Water Storage Tank.....	9
	MW-4.5.3 Domestic Water Supply Piping System.....	10
MW-4.6	Disinfecting of Water Storage Tank and Domestic Water Piping System.....	10
MW-5.0	FIRE FIGHTING SYSTEM.....	10
MW-5.1	General.....	10
MW-5.2	Portable Fire extinguisher.....	11
MW-5.3	Submittal.....	11
MW-6.0	GUARANTEE.....	11
MW-7.0	MEASUREMENT OF PAYMENT.....	12

PART I – TECHNICAL SPECIFICATION

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 for the **Design, Supply, Delivery, Installation, Testing and Commissioning of Palanan Solar PV-Diesel Hybrid System (With Energy Storage System)**.

The work shall be performed and completed with high quality workmanship in accordance with generally accepted modern practice in the design, supply, delivery, installation, testing and commissioning of mechanical equipment and associated works for the safe and reliable operation of project.

All equipment and materials including its associated structures and necessary accessories which the Supplier shall supply and install, and which thereafter will be incorporated in the plant shall be new and unused. They shall be suitable for their intended purpose and appropriately matched to other items complying 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 conduct actual inspection of the site and thoroughly investigate and familiarize himself with all the conditions at site; determine the required quantity of materials and equipment to be supplied/utilized during the project execution, determine possible sources of materials and equipment to be supplied, and verify the actual scope of works and relative costs. Any and/or all expenses arising through the lack of knowledge or understanding regarding the existing conditions of the site shall be the responsibility of the Supplier and no additional payment thereof shall be made by NPC.

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) Domestic Water Supply system consisting of one (1) unit of 1,000-liter elevated water storage tank, five (5) units of hose bibb 20 mm Ø, one (1) set of garden hose with nozzle and reel, one (1) unit of Portable Submersible Sump Pump, one (1) unit of Jetmatic Hand Pump; and associated steel supports, piping, valves, pipefittings, gaskets, flanges, bolts and nuts, and other accessories including excavation and backfilling of embedded pipes, disinfection and hydrotesting of the system and other incidentals as required to complete the piping system;

The Jetmatic Hand Pump shall be installed on the rainwater cistern tank that is directly connected to the gutter of solar panels arrays which collects rainwater;

The Portable Submersible Sump Pump shall be provided for the cleaning/removal of accumulated dirt/mud inside the rainwater cistern tank.

- b) Portable Type Fire Extinguisher, to be installed as shown on the drawings and/or as specified in MW-5.1;
- c) One (1) lot of painting materials to be applied to all equipment, pipes, steel structures, tanks, pipe's supports;
- d) Provide labels or Standard Plant Identification Number (SPIN) for all equipment, valves, piping, and instruments supplied; and
- e) All other works and services including those that are not specifically detailed herein but are required to fully complete the project;

MW-3.0 MATERIALS AND EQUIPMENT

MW-3.1 General

All materials, equipment, devices, and accessories to be supplied under this contract shall be new and unused, free from 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 and materials shall conform to the latest specifications and provisions of approved standards of engineering societies or other equivalent standards approved by NPC. The work shall be performed and completed in a high-quality workmanship, in accordance with generally modern accepted practice in the fabrication, assembly, installation and test of all equipment and materials



SECTION VI – TECHNICAL SPECIFICATIONS

supplied by the Supplier, notwithstanding any omission from these Specifications or drawings.

Defect and damages to the equipment resulting from faulty installation works shall be repaired and/or replaced by the Supplier at no cost to the NPC.

MW-3.2 Code and Standards

The supply, installation and test of equipment and materials shall conform to the latest specifications and provisions of the following engineering societies or other internationally accepted standards. Other standards which ensure equal or higher quality than the standards mentioned below will be accepted provided they meet the requirements of existing laws and regulations of the Government of the Republic of the Philippines.

ANSI	-	American National Standard Institute
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society of Testing Materials
AWS	-	American Welding Society
FM	-	Factory Mutual Engineering
HIS	-	Hydraulic Institute Standards
NEC	-	National Electric Code
NEMA	-	National Electrical Manufacturer's Association
OSHA	-	Occupational Safety Health Act of 1970
PEC	-	Philippine Electric Code
UL	-	Underwriter Laboratories
NFPA	-	National Fire Protection Association

In the event of any conflict among the above listed codes or this Specification, Appendices and Attachments, Bidder shall refer the conflict to NPC for written resolution. In addition to the above codes and standards, Bidder shall comply with all applicable State and local laws and regulations.

MW-3.3 Equipment Foundation

All equipment shall be installed in accordance with the manufacturer's recommendations and applicable codes and standards. Requirements for concrete foundations where the equipment are to be mounted shall be referred to the relevant Civil Works Specifications.

The Supplier shall be responsible for the correct positioning and leveling of the equipment and auxiliaries, and any checking made by the NPC during the course of the work shall not relieve the Supplier from his responsibility. During installation works, electro-mechanical equipment shall be carefully lifted or glided on the foundation by using only approved methods and equipment, and in a manner that will prevent damage to the equipment and foundation. The equipment shall be positioned on a location as shown on the drawings and shall be leveled and checked true to grade and alignment before final grouting. The Supplier shall strictly adhere to the installation procedures/manuals provided by Manufacturers of the equipment.



SECTION VI – TECHNICAL SPECIFICATIONS

Prior to equipment mounting and grouting, the surface area and blackouts of concrete foundation shall be cleaned of all dirt by any approved means.

Chipping of concrete surface to the required thickness shall be done by any approved methods without damaging the concrete structure as a whole.

The pouring of concrete to secure in place any equipment on its concrete foundation shall not be made until the NPC has verified the correct location of the foundation. Should incorrect positioning be ascertained after the concrete pouring, the Supplier shall make the correction at his own expense.

The concrete foundation surfaces shall be free of any loose materials, oil, water, or any other contaminants that would prevent the grout from bonding. The concrete shall be chipped to expose a minimum aggregate so as to remove all laitance and provide a rough surface for bonding. The exposed surface shall be blown with compressed air free of oil to remove dust.

All materials, equipment, devices, and accessories to be supplied under this contract 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 and equipment 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-3.4 Piping System**MW-3.4.1 Steel Pipe**

Domestic water piping installed within the area of the steel elevated water tank and pump shall be constructed from ASTM A53, Grade A, Schedule 40, seamless and hot dip galvanized.

All steel piping 65mm Ø and above shall be constructed with flanged joints or butt-welded joints and fittings. Pipes 50mm Ø and below shall be connected

with threaded joints. Steel pipes installed aboveground shall be properly supported to avoid pipe sagging.

MW-3.4.2 PVC Pipe

Domestic water supply and distribution piping shall generally be constructed from Unplasticized Polyvinyl Chloride (uPVC) pipe, Class 150, conforming to ASTM D-1784 or approved equivalent, except otherwise specified.

MW-3.4.3 Pipe Installation

All Unplasticized Polyvinyl Chloride (uPVC) water piping shall generally be embedded not less than 300mm from the ground surface to the bottom of pipe.

The Supplier shall install the piping system in a thorough manner and with good workmanship, in accordance with the drawings and specifications or as directed 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 acceptance 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 end 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.

Pipe sleeves shall be provided for pipe which penetrates platforms, floors, roofs, and partitions. Proper flashing shall be provided to ensure tightness and waterproofing, where required.

After installation, pipe insides shall be washed thoroughly using high pressure cleaning pump. Water for washing must be clean enough not to damage the equipment.

All existing facilities which are 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.

The Supplier shall strictly observe the safety requirements/regulations of NPC during the performance of the work.

Prior to the start of all piping works, the Supplier shall coordinate with NPC personnel at site to avoid interference with the existing installations or other structures. In case interference occurs, NPC will decide which work is to be relocated.

MW-3.5 Corrosion Protection and Painting

MW-3.5.1 Painting

The Contractor shall be responsible for the adoption of preparation procedures and protective coating systems that are suitable for the



environment experienced by the various equipment and piping systems and conforming manufacturer's recommendation and applicable standards.

Painting shall generally be applied to metallic surfaces unless otherwise specified.

Where a specific coating system is mentioned elsewhere in the specification, the Contractor shall accept responsibility for the suitability for such system. The Contractor has the option to nominate an alternative coating system that is of equal or better quality subject for the approval of NPC.

All other equipment and steel piping installed outdoors and indoors shall be prime coated with 80 microns DFT zinc rich epoxy paint and 80 microns DFT of chlorinated rubber for each intermediate and topcoat.

MW-3.5.2 Hot Dipped Galvanizing

The zinc protective coat shall be adherent, smooth, and free from discontinuity and imperfections such as bubble, porosity, cracks, or other irregularities of the protective layer. The thickness of applied layer shall correspond to a minimum rate of 550 gm/m².

MW-3.6 Tag Numbers/Standard Plant Identification Number (SPIN)

Tag Numbers or SPIN for all supplied equipment and materials shall be provided by the Contractor.

Tag Numbers/SPIN are designation codes which shall be used to achieve uniformity and standardization in identifying each component and equipment for installation, maintenance, documentation, and record purposes. The Tag Numbers/SPIN shall be clearly inscribed in a stainless steel or equivalent corrosion resistant metal in accordance with the NPC Standard Specifications.

Tag Numbers/SPIN are generally specified or indicated on the Bid drawings. In case of supplied equipment, portable type fire extinguishers, valves, instruments, or devices are not designated with tag numbers or SPIN, the Contractor shall assign a number subject to the approval of NPC.

MW-4.0 DOMESTIC WATER SUPPLY SYSTEM

MW-4.1 General

This section provides the essential information for the design, supply, installation, construction, test, and commissioning of Domestic Water Supply System to provide the water requirement of the plant including the required excavation and backfilling of pipe trenches.

The work shall include, but not limited to the following:

- a) Domestic Water Supply system consisting of one (1) unit of 1,000-liter elevated water storage tank, five (5) units of hose bibb 20 mm Ø



bronze body screwed ends Class 150, one (1) set of garden hose with nozzle and reel, one (1) set Jetmatic Hand Pump and associated steel supports, piping, valves, pipe fittings, gaskets, flanges, bolts and nuts and other accessories;

The garden hose shall be with nozzle 20mm Ø and reel, 30m long with connector for the 20mm Ø hose bibb, to be used for cleaning of solar panels;

The hand pump shall have a minimum discharge capacity of 0.455 m³/h (2 gpm) and capable of lifting water at a minimum depth of 7.6 m. The hand pump shall be reciprocating type and made of cast iron. The pump shall be installed on the cistern tank;

- b) One (1) set of Portable Submersible Sump Pump, 3.6 m³/h (15.9gpm) @ 6 m head, 230 VAC, 60 Hz, 1-ph, complete with flexible hose, controls and other accessories including spare parts for 1-year operation as described in the technical specifications;
- c) One (1) lot of piping works, valves, instrumentation and necessary accessories including the required excavation and backfilling works for embedded pipes, disinfection and hydrostatic testing of the system (under the presence of NPC) and other incidentals as required to complete the piping system.

MW-4.2 Elevated Water Storage Tank

The Supplier shall supply, deliver, install and test one (1) set of water storage tank. The water storage tank shall have a minimum capacity of 1000 liters and shall be of polyethylene type, vertical cylindrical, with ellipsoidal heads or approved design, to be erected/installed with steel supports as shown on the drawings.

The water storage tank shall be complete with manhole, inlet and outlet nozzles with valves, overflow pipe, strainer, drain nozzle with valve, level switch nozzle with valve, level switch nozzle with plug (for future use), pipe supports, access ladder and supporting steel structures.

Tank foundation and supporting steel structures shall be in accordance with requirements of relevant Civil Works specifications and drawings.

MW-4.3 Pump

MW-4.3.1 Jetmatic Hand Pump

The scope of work shall cover the supply, delivery, installation at the cistern tank and test of One (1) unit of hand pump complete with brass foot valve, stainless steel screen with 5mm Ø slots, associated valves, flanges, bolts, nuts and other accessories necessary for the safe and reliable operation of the domestic water supply system. The hand pump shall have a minimum discharge capacity of 0.455 m³/h (2 gpm) and capable of lifting water at a minimum depth of 7.6 m. The hand pump shall be reciprocating type and made of cast iron.



The pump shall be complete with necessary fittings and accessories to provide the safe and reliable operation of the pumping system.

The following documents shall be submitted by the Supplier for NPC's review and approval:

- a) Technical data, specifications, and catalogues;
- b) Outline/assembly and installation drawings showing all the dimensions; and
- c) Operation and maintenance manuals.

MW-4.3.2 Portable Submersible Sump Pump

The scope of work shall cover the supply, delivery, and test of One (1) unit of portable submersible sump pump complete with associated valves, flanges, bolts, nuts, and other accessories necessary for the safe and reliable operation of the domestic water supply system.

The pump shall be of motor-driven, submersible, single stage type and shall be suitable for mounting outdoor without protection. The driving shaft shall be directly coupled to the motor and the pump shall have the following characteristics:

- | | | |
|--------------|---|--|
| a. Quantity | : | One (1) unit complete with accessories |
| b. Capacity | : | 3.6 m ³ /h (min.) |
| c. Head | : | 6 meters (min.) |
| d. Materials | : | |
| Casing | : | Stainless steel |
| Impeller | : | Stainless Steel |
| Shaft | : | Stainless Steel |

The motor shall have an ingress protection of 68 and stainless-steel casing. The impeller shall be non-clog open type. The motor and pump shall be provided with lifting lugs, eyebolts, and pipe works.

The portable submersible sump pump shall be plug-in type, 230 V AC, single phase and 60 Hz rating.

The supplier shall include a flexible hose of the same size as the discharge pipe with a length of at least 10 meters. The supplier shall also supply all recommended spare parts of the manufacturer.

Flexible sump discharge hose shall be of polyethylene drain tubing. A hose clamp & universal male thread hose insert with barbed adapter for a tight seal shall be supplied.

MW-4.4 Piping, Valves and Fittings

Domestic water supply and distribution piping shall be constructed from Unplasticized Polyvinyl Chloride (uPVC) pipe, Schedule 40 or Class 150, conforming to ASTM D-1784 or approved equivalent.

Gate valves, shall be made of bronze or stainless steel, rising stem, union bonnet, inside screw, solid wedge or plug type disc, with screwed or flanged ends. Check valves shall be of swing type, cast bronze and with screwed ends.

Valves of all sizes shall have a rating of not less Class 150.

Garden hose connection valves or hose bibbs shall be of bronze material, 20mm size and outfitted with male thread hose connections.

Domestic water piping installed within the area of the elevated water tank shall be constructed from ASTM A53, Grade A, Schedule 40, seamless and hot dip galvanized.

MW-4.5 Testing

After installation of the equipment, the Supplier shall perform necessary tests at the site to determine its compliance with the requirements of the specifications. All costs for testing shall be borne by the Supplier.

MW-4.5.1 Portable Submersible Sump Pump

The pump and motor shall be subjected to factory tests to determine its conformance with the requirements of the specifications and approved test procedures which shall include but not limited to the following:

- a) Pressure hydrostatic proof of the casing to 1.5 times the maximum pressure for 30 minutes;
- b) Report of the characteristic curves such as Head vs. Flow and Efficiency vs. Flow, etc.; and
- c) Other tests as required by applicable codes and standards.

MW-4.5.2 Elevated Water Storage Tank

Upon completion of the tank, it shall be filled with water at a proper pressure to fill the tank to the maximum water level. The water shall remain in the tank for at least twenty-four (24) hours after which observations for leaks and other defects shall be made.

All defects shall be corrected by the Supplier to the satisfaction of NPC before final acceptance of the work is made. Any leakage that is disclosed in the test shall be repaired by the Supplier. All equipment and appurtenances necessary to carry out the tests and any repair, if required, shall be borne by the Supplier.

MW-4.5.3 Domestic Water Supply Piping System

The piping system shall be hydrostatically tested at a pressure of 1.5 times the operating pressure of the system.

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.

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.

MW-4.6 Disinfecting of Water Storage Tank and Domestic Water Piping System

The water storage tank and domestic water piping system shall be disinfected after testing and before being put into use. Before disinfections, the tank and piping should be drained, flushed, re-drained and refilled. In refilling, care must be taken to avoid entraining or entrapping air in the tank. 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.

MW-5.0 FIRE FIGHTING SYSTEM**MW-5.1 General**

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.

The Supplier shall place the fire extinguishers where they are readily accessible and available in the event of a fire with reference to the layout of the plant.



One fire extinguisher will be placed inside or near the ESS. Fire extinguishers shall be placed near inverters and junction boxes. One fire extinguisher is required for every installed inverter of the solar PV plant. However, if deemed necessary the number of fire extinguishers shall vary depending on the approved layout of the whole solar plant.

Fire extinguishers installed outdoors shall be installed with an appropriate cabinet with breakable glass complying with NFPA standards.

Final quantity may be adjusted per supplier's recommendation but in no case be less than the specified minimum requirements. The location shall conform with NFPA standards or any equivalent standard.

MW-5.2 Portable Fire extinguisher

The Supplier shall provide complete and ready for operation Portable Type Fire Extinguisher, filled with Clean Agent (HCFC or Halotron I Type), 7.1 kg. (15.5 lbs.), wall-hung type equipped with release valve, dial gauge indicator, appropriate length of hose with nozzle, locking pin, carrying handle and wall-mounting bracket. The fire extinguishers shall be of the same brand and model.

The fire extinguisher shall be Underwriter Laboratories/Factory Mutual approved and of rechargeable cylinder with five (5) years guarantee against leak.

The fire extinguisher shall be suitable for the protection against class ABC fires using Clean Agent (Hydro chlorofluorocarbon 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-5.3 Submittal

The Supplier shall submit the technical specifications/data and brochures/catalogs of the fire extinguishers for the approval of NPC prior to purchase.

MW-6.0 GUARANTEE

The Supplier shall guarantee that he will repair, and/or replace, at his own expense, the equipment and machineries, against defect, in design, workmanship and materials for a period of one (1) year after the Goods have been installed and commissioned. The Supplier guarantees that when the equipment and/or material are placed in operation and/or use, it will perform in the manner as set forth in the Contract.



MW-7.0 MEASUREMENT OF PAYMENT

Measurement of payment for all Mechanical Works shall be based on the bid price of each item in the Schedule of Requirements (Bid Price Schedule). The cost shall cover all works required and described in the pertinent provisions of the specifications.

SECTION VI

PART II-TECHNICAL DATA SHEETS

ELECTRICAL WORKS

**DRAWINGS AND DOCUMENTS TO BE SUBMITTED
DURING THE BID**

PART II – TECHNICAL DATA SHEETS**EW- ELECTRICAL WORKS****Drawings and Documents to be Submitted during the Bid****TABLE OF CONTENTS**

SECTION	DESCRIPTION	PAGE
Annex A	Letter of Authorization and Guarantee Statement	2
Annex B	Schematic Diagram	3
Annex C	ESS Manufacturer's Track Record Data Sheet	4
Annex D	Battery Module Manufacturer's Track Record Data Sheet	5
Annex E	PEMS Manufacturer's Track Record Data Sheet	6
F-1.0	Solar PV Plant	7
F-2.0	Solar PV Modules	7
F-3.0	String Inverter	7
F-4.0	Solar PV Plant (SPP) Transformer	8
F-5.0	Energy Storage System (ESS) Transformer	8
F-6.0	Energy Storage System	9
F-7.0	Battery Modules	9
F-8.0	Power and Energy Management System	10

PART II - TECHNICAL DATA SHEETS

EW – Electrical Works

Technical Requirements

1. The Bidder is required to provide all the information required under the column "Supplier's Data". Although not given by NPC, the Supplier's Data shall be based on the International Standard.
 - a
2. NPC's requirements are indicated below. The Supplier shall indicate their data corresponding to the said NPC requirements to facilitate evaluation of Supplier's compliance to the specifications.
3. All data and information specified in the requirements shall be in English language.

ANNEX A - LETTER OF AUTHORIZATION AND GUARANTEE STATEMENT

The following ***Drawings*** and ***Documents*** shall be submitted by the Supplier in **sequential order** as listed hereunder and shall be attached in the bid documents as **Annexes**. All data and information shall be in English language.

Letter of Authorization and Guarantee Statement for the Following Equipment:

- a. Solar PV (SPV) Module
- b. String Inverter
- c. Energy Storage System (ESS)
- d. Power and Energy Management System (PEMS)

either from the following:

- Original Equipment Manufacturer (OEM); or
- Licensee of the OEM accompanied by a Certification from OEM as a Licensee or the Licensee Agreement; or
- Authorized Distributor (accompanied by a Certificate of Authorized Distributorship from the OEM/Licensee of the OEM. If from the Licensee, a Certification from the OEM as a Licensee or the Licensee Agreement must also be submitted).

Note: Documents or brochures submitted must be in English language as stated in Section II-ITB Clause 11.0.

ANNEX B - SCHEMATIC DIAGRAM

The following ***Drawings*** and ***Documents*** shall be submitted by the Supplier in **sequential order** as listed hereunder as **Annexes** during the bid process. All data and information shall be in English language and shall be drawn using the metric system as unit of measurement.

Annex B	Schematic Diagram of the Proposed Solar PV-Diesel Hybrid Power Plant (with ESS) showing all equipment/components to be furnished including interfacing and communication system of the Solar PV with the Existing Power Plant
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Note: Failure to submit drawings and documents listed hereunder Annex B shall be ground for disqualification.

Figure 1. The effect of the number of trials on the number of correct responses. The number of correct responses was significantly higher for the 10 trials condition than for the 5 trials condition. Error bars represent the standard error of the mean.

[illegible]

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100

Designation

ANNEX E - PEMS Manufacturer's Track Record Data Sheet

[illegible]

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F-1.0 SOLAR PV PLANT

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
F-1.1	Total Capacity of Solar PV at AC Side	At least 150 kW	
F-1.2	Total Number of Inverters connected in parallel	By Supplier	

F-2.0 SOLAR PV MODULES

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
F-2.1	Manufacturer	By Supplier	
F-2.2	Model	By Supplier	
F-2.3	Place of Manufacture	By Supplier	
F-2.4	Cell Type	Crystalline Silicon	
F-2.5	Rated Power (Wp) at STC	By Supplier	
F-2.6	Efficiency	At least 19%	

F-3.0 STRING INVERTER

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
F-3.1	Manufacturer	By Supplier	
F-3.2	Model	By Supplier	
F-3.3	Place of Manufacture	By Supplier	
F-3.4	Rating	By Supplier	
F-3.5	Efficiency	≥95%	
F-3.6	Output Voltage (V _{AC})	480 V (nominal voltage adjustable by ±5% via system set points)	
F-3.7	Output Frequency (Hz)	60 Hz, ±0.5%	

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ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
F-3.8	Data Interface	Modbus	
F-3.9	Topology	Transformerless	

F-4.0 SOLAR PV PLANT (SPP) TRANSFORMER

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
F-4.1	Manufacturer / Brand	By Supplier	
F-4.2	Place of Manufacture	By Supplier	
F-4.3	Rated Capacity	225 KVA	
F-4.4	No. of unit/s	1 set	
F-4.5	Number of phase	Three (3)	
F-4.6	Frequency, Hz	60	

F-5.0 ENERGY STORAGE SYSTEM (ESS) TRANSFORMER

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
F-5.1	Manufacturer / Brand	By Supplier	
F-5.2	Place of Manufacture	By Supplier	
F-5.3	Rated Capacity	150 kVA	
F-5.4	No. of unit/s	1 set	
F-5.5	Number of phase	Three (3)	
F-5.6	Rated operating frequency, Hz	60	

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F-6.0 ENERGY STORAGE SYSTEM

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
F-6.1	Manufacturer	By Supplier	
F-6.2	Model	By Supplier	
F-6.3	Place of Manufacture	By Supplier	
F-6.4	Nominal Rating (kW)	120+20% overload	
F-6.5	Usable Energy	≥120 kWh	
F-6.6	Power Swing (kW)	120	
F-6.7	Reverse Power Swing (kW)	120	
F-6.8	Power Swing and Reverse Power Swing Response time (milliseconds)	≤200	
F-6.9	Power Factor	-1 to +1	
F-6.10	Operating Frequency (Hz)	60 Hz	
F-6.11	Technical and Functional Requirements for the Battery Management System, Power Conversion System, ESS Control System and Housing as stated in EW-2.4 ESS	Required	
F-6.12	Manufacturer's Track Record	> 5 years	
F-6.13	List of Reference Projects with contact details ¹	Required	

F-7.0 BATTERY MODULES

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
F-7.1	Model	By Supplier	

¹ Use Annex C

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Designation

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
F-7.2	Manufacturer	By Supplier	
F-7.3	Chemistry	NMC, LMO or Blended LMO / NMC	
F-7.4	Gross weight of one Battery Module	≤60 kg	
F-7.5	Nominal Capacity (Ah)	By Supplier	
F-7.6	Current Operational Install Base	At least 1MWh	
F-7.7	List of Reference Projects with contact details ²	Required	

F-8.0 POWER AND ENERGY MANAGEMENT SYSTEM

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
F-8.1	Technical and Functional Requirements as stated in EW-3.0 PEMS	Required	
F-8.2	List of Reference Projects with contact details ³	Required	
Hybrid Controller			
F-8.3	Manufacturer	By Supplier	
F-8.4	Model	By Supplier	
F-8.5	Place of Manufacture	By Supplier	
Genset Controller			
F-8.6	Manufacturer	By Supplier	
F-8.7	Model	By Supplier	
F-8.8	Place of Manufacture	By Supplier	

² Use Annex D³ Use Annex E

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Designation



ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
Solar/PV Controller⁴			
F-8.9	Manufacturer	By Supplier	
F-8.10	Model	By Supplier	
F-8.11	Place of Manufacture	By Supplier	
ESS Controller/ESS Control System⁵			
F-8.12	Manufacturer	By Supplier	
F-8.13	Model	By Supplier	
F-8.14	Place of Manufacture	By Supplier	

⁴ If the Solar/PV controller and the ESS Control System/ESS controller is built-in the String Inverter(s) and ESS respectively, the supplier shall indicate the brand and model of the said controllers.

⁵ If the Solar/PV controller and the ESS Control System/ESS controller is built-in the String Inverter(s) and ESS respectively, the supplier shall indicate the brand and model of the said controllers.

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SECTION VI

PART II-TECHNICAL DATA SHEETS

ELECTRICAL WORKS

**DOCUMENTS TO BE SUBMITTED DURING POST
QUALIFICATION**

PART II – TECHNICAL DATA SHEETS**EW- ELECTRICAL WORKS****Documents to be Submitted during Post-Qualification****TABLE OF CONTENTS**

SECTION	DESCRIPTION	PAGE
G-1.0	Solar PV Plant	1
G-2.0	Solar PV Modules	1
G-3.0	String Inverter	2
G-4.0	Solar PV Plant (SPP) Transformer	3
G-5.0	DC Box	5
G-6.0	AC Combiner Box	5
G-7.0	Energy Storage System	5
G-8.0	Battery Modules	6
G-9.0	Energy Storage System (ESS) Transformer	7
G-10.0	Power and Energy Management System	9
G-11.0	Power Cables	9
G-12.0	Fuse Disconnect Switch with Lightning Arrester Combination	10
G-13.0	13.8kV Tie Line Primary Conductor	10
G-14.0	13.8kV Tie Line Steel Pole	11
G-15.0	Bus Conductor and Hardware	11
G-16.0	Job Site Cameras	12
G-17.0	Spare Parts for Solar PV System and Auxiliaries	13
G-18.0	Standard/Special Tools for Solar PV System	14
G-19.0	List of Other Documents To Be Submitted in Addition To The Technical Data Sheets	14

PART II - TECHNICAL DATA SHEETS

EW – Electrical Works

Technical Requirements

1. The Bidder shall complete and submit this document during the post-qualification which shall serve as reference for the review and approval of brochure/drawings during implementation stage. The Bidder shall use additional sheets as necessary for any other additional information following the format shown herein or by reproducing the same.
2. The Bidder is required to provide all the information required under the Column "Supplier's Data". Although not given by NPC, the Supplier's Data shall be based on the International Standard.
3. NPC's requirements are indicated below. The Supplier shall indicate their data corresponding to the said NPC requirements to facilitate evaluation of Supplier's compliance to the specifications. The data required are technical features and characteristics of the Equipment to be provided by the bidder which shall at least be equal or superior to NPC's requirements.
4. The bidder shall provide copies of the manufacture's and equipment certifications as listed in this document
5. Non submission of the required documents shall be a ground for disqualification.

G-1.0 SOLAR PV PLANT

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-1.1	Total Number of Modules	By Supplier	
G-1.2	No. of Modules in Series (Array)	By Supplier	
G-1.3	Number of Parallel Combination	By Supplier	
G-1.4	Number of Inverters	By Supplier	

G-2.0 SOLAR PV MODULES

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-2.1	Manufacturer	By Supplier	
G-2.2	Model	By Supplier	
G-2.3	Cell Type	Crystalline Silicon	
G-2.4	Rated Power (Wp) at STC	By Supplier	
G-2.5	Module Efficiency	At least 19%	
G-2.6	Solar PV Module Service Life	By Supplier	
G-2.7	Rated Voltage (V) at STC	By Supplier	
G-2.8	Rated Current (A) at STC	By Supplier	
G-2.9	Open Circuit Voltage (Voc) at STC	By Supplier	
G-2.10	Short Circuit Current (Isc) at STC	By Supplier	
G-2.11	Power Tolerance	± 3%	
G-2.12	Dimension (L x W)	By Supplier	
G-2.13	Weight (kg)	By Supplier	
G-2.14	Junction Box IP Rating	IP65	

Name of Firm

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Designation



G-3.0 STRING INVERTER

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-3.1	Manufacturer	By Supplier	
G-3.2	Model	By Supplier	
G-3.3	Inverter Power Rating (KW)	By Supplier	
G-3.4	Efficiency at Rated Power	≥95%	
G-3.5	Input DC Power (KWp)	By Supplier	
G-3.6	No. of MPPT	At least One (1)	
G-3.7	Input Voltage Range per MPPT (V)	By Supplier	
G-3.8	Maximum Open Circuit Voltage per MPPT (V)	By Supplier	
G-3.9	Maximum Input Current per MPPT (A)	By Supplier	
G-3.10	Maximum Short Circuit Current per MPPT (A)	By Supplier	
G-3.11	Nominal Output Voltage (V)	480 V (adjustable by ±5% via system set points)	
G-3.12	Maximum Output Current (A)	By Supplier	
G-3.13	Number of Phase	Three (3)	
G-3.14	Nominal Output Frequency (Hz)	60 Hz, ±0.5%	
G-3.15	Power Factor at Rated Power Rating	By Supplier	
G-3.16	Total Harmonic Distortion	5%	
G-3.17	Operating Temperature Range (°C)	By Supplier	
G-3.18	Data Interface	Modbus	
G-3.19	Topology	Transformerless	
G-3.20	Ingress Protection Rating	IP65	
G-3.21	Over current Protection	Required	
G-3.22	Overvoltage Protection	Required	
G-3.23	Anti-Islanding Protection	Required	

Name of Firm

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Designation



ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-3.24	DC Reverse Polarity Protection	Required	
G-3.25	Ground Fault Monitoring	Required	
G-3.26	Grid Monitoring	Required	
G-3.27	PV Array Fault Monitoring	Required	
G-3.28	Residual Current Monitoring	Required	

G-4.0 SOLAR PV PLANT (SPP) TRANSFORMER

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-4.1	Manufacturer/Brand	By Supplier	
G-4.2	Model	By Supplier	
G-4.3	Rated Capacity (KVA)	225	
G-4.4	Number of Phase	Three (3)	
G-4.5	Type of Cooling	ONAN	
G-4.6	Insulation	Mineral Oil with its electrical and chemical characteristics is compliant with IEC and is Polychlorinated Biphenyls (PCB) free	
G-4.7	Type	Two-winding Transformer	
G-4.8	Audible Sound Level	Refer to Table specified under EW-1.10.3.8	
G-4.9	Vector Group	YNd11	
G-4.10	Temperature		
	• Ambient Temperature (°C)	40	
	• Temperature Rise (C°)	65	
G-4.11	Winding Connection		
	• H-Winding	Wye with Neutral Grounded	
	• X-Winding	Delta	

Name of Firm

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Designation



ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-4.12	Insulation Level		
	a. Nominal Voltage Level (KV)		
	• H-Winding	13.8	
	• X-Winding	0.48	
	b. Highest Voltage Level (KV)		
	• H-Winding	15	
	• X-Winding	1.2	
	c. Basic Insulation Level (KV)		
	• H-Winding	95	
	• X-Winding	30	
G-4.13	Winding Material	100% Copper	
G-4.14	Bushing Material	Porcelain	
G-4.15	No. of Bushing	Three (3)	
G-4.16	Impedance at Rated Capacity (%)	Manufacturer's Data	
G-4.17	Efficiency	By Supplier	
G-4.18	Tap Changer	No-Load	
G-4.19	Taps		
	• H-Winding	13.8 kV \pm 2 x 2.5%	
	• X-Winding	N/A	
G-4.20	Transformer Losses	By Supplier	
G-4.21	Tolerances		
	• No-Load & Load Loss	Not more than 10% of the manufacturer's specified value	
	• Total Loss	Not more than 6% of the manufacturer's specified value	
	• Impedance	\pm 10% of the manufacturer's specified value	

Name of Firm

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Designation



ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-4.22	Ground Terminal Connection	Suitable for 100 mm ² copper conductor	
G-4.23	Weight of Oil (Kg)	By Supplier	
G-4.24	Total Weight (Kg)	By Supplier	

G-5.0 DC BOX

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-5.1	DC Circuit Breakers		
	Continuous Current Rating	By Supplier	

G-6.0 AC COMBINER BOX

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-6.1	Circuit Breakers		
	Continuous Current Rating	By Supplier	

G-7.0 ENERGY STORAGE SYSTEM

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-7.1	Manufacturer	By Supplier	
G-7.2	Model	By Supplier	
G-7.3	Nominal Power Rating (KW)	At least 120	
G-7.4	Usable Energy (KWh)	At least 120	
G-7.5	Frequency (Hz)	60	
G-7.6	Battery Management System	By Supplier	
	Charge / Discharge		

Name of Firm

Name & Signature of Representative

Designation

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
	1. Nominal Charge / Discharge Current (A)	By Supplier	
	2. Maximum Charging Current (A)	By Supplier	
	3. Maximum Discharge Current (A)	By Supplier	
G-7.7	Number of Battery Modules	By Supplier	
G-7.8	Housing		
	Gross Weight, Installed with batteries (kg)	By Supplier	
	Maximum Housing Dimension, Length x Width x Height (m)	By Supplier	

G-8.0 BATTERY MODULES

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-8.1	Manufacturer	By Supplier	
G-8.2	Model	By Supplier	
G-8.3	Chemistry	Refer to EW-2.4.2(c)	
G-8.4	Nominal Capacity	By Supplier	
G-8.5	No. of Cells per Module	By Supplier	
G-8.6	Electrical Characteristics		
	• Nominal Terminal Voltage (V_{DC})	By Supplier	
	• Minimum Operating Voltage (V_{OC})	By Supplier	
	• Maximum Operating Voltage (V_{OC})	By Supplier	

Name of Firm

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Designation

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
	<ul style="list-style-type: none"> Maximum Normal State of Charge (MaxNSoC)¹ (%) 	By Supplier	
	<ul style="list-style-type: none"> Minimum Normal State of Charge (MinNSoC) (%) 	By Supplier	
	<ul style="list-style-type: none"> Nominal C-rate @ 25°C 	1 or higher	
	<ul style="list-style-type: none"> Self-discharge Rate per Month (% of its capacity) 	≤10%	
	<ul style="list-style-type: none"> Cycle Lifetime 	At least 4000	
G-8.7	Physical Characteristics		
	<ul style="list-style-type: none"> Dimension, Length x Width x Height (m) 	By Supplier	
	<ul style="list-style-type: none"> Maximum Gross Weight (Kg) 	60	
G-8.8	Overcharge Protection	Required	
G-8.9	Short Circuit Protection	Required	
G-8.10	Thermal Runaway Protection	Required	

G-9.0 ENERGY STORAGE SYSTEM (ESS) TRANSFORMER

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-9.1	Manufacturer/Brand	By Supplier	
G-9.2	Model	By Supplier	
G-9.3	Rated Capacity (KVA)	150	
G-9.4	Number of Phase	Three (3)	
G-9.5	Type of Cooling	ONAN	
G-9.6	Insulation	Mineral Oil with its electrical and chemical characteristics is compliant with IEC and	

¹ As defined under Section VI – Technical Specifications Clause EW-2.1

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Designation



ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
		is Polychlorinated Biphenyls (PCB) free	
G-9.7	Type	Two-winding Transformer	
G-9.8	Audible Sound Level	Refer to Table specified under EW-2.4.7.3.8	
G-9.9	Vector Group	YNd11	
G-9.10	Temperature		
	• Ambient Temperature (°C)	40	
	• Temperature Rise (C°)	65	
G-9.11	Winding Connection		
	• H-Winding	Wye with Neutral Grounded	
	• X-Winding	Delta	
G-9.12	Insulation Level		
	d. Nominal Voltage Level (KV)		
	• H-Winding	13.8	
	• X-Winding	By Supplier	
	e. Highest Voltage Level (KV)		
	• H-Winding	15	
	• X-Winding	By Supplier	
	f. Basic Insulation Level (KV)		
	• H-Winding	95	
	• X-Winding	By Supplier	
G-9.13	Winding Material	100% Copper	
G-9.14	Bushing Material	Porcelain	
G-9.15	No. of Bushing	Three (3)	
G-9.16	Impedance at Rated Capacity (%)	Manufacturer's Data	
G-9.17	Efficiency	By Supplier	
G-9.18	Tap Changer	No-Load	

Name of Firm

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Designation

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-9.19	Taps		
	• H-Winding	13.8 kV \pm 2 x 2.5%	
	• X-Winding	N/A	
G-9.20	Transformer Losses	By Supplier	
G-9.21	Tolerances		
	• No-Load & Load Loss	Not more than 10% of the manufacturer's specified value	
	• Total Loss	Not more than 6% of the manufacturer's specified value	
	• Impedance	\pm 10% of the manufacturer's specified value	
G-9.22	Ground Terminal Connection	Suitable for 100 mm ² copper conductor	
G-9.23	Weight of Oil (Kg)	By Supplier	
G-9.24	Total Weight (Kg)	By Supplier	

G-10.0 POWER AND ENERGY MANAGEMENT SYSTEM

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-10.1	Manufacturer	By Supplier	
G-10.2	Model	By Supplier	
G-10.3	Communication	By Supplier	

G-11.0 POWER CABLES²

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
15 kV Power Cable			
G-11.1	Manufacturer	By Supplier	

² Refer to EW-1.8 and EW-6.4 specifications

Name of Firm

Name & Signature of Representative

Designation



ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-11.2	Brand	By Supplier	
G-11.3	Max. continuous current carrying capacity of conductor at 90°C	Manufacturer's Data	
G-11.4	Conductor Cross-Section, mm ²	Refer to Single Line Diagram	
G-11.5	Conductor Material	Annealed Copper	
G-11.6	Insulation Material	Cross-linked polyethylene (XLPE)	
1.1kV DC Power Cable			
G-11.7	Manufacturer	By Supplier	
G-11.8	Brand	By Supplier	
G-11.9	Conductor Size	By Supplier	
G-11.10	Conductor Metal	Tin Annealed Copper Stranded Wire	
G-11.11	Type of Insulation	Refer to EW-1.8(b)	

G-12.0 FUSE DISCONNECT SWITCH WITH LIGHTNING ARRESTER COMBINATION³

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-12.1	Manufacturer	By Supplier	

G-13.0 13.8KV TIE LINE PRIMARY CONDUCTOR⁴

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-13.1	Manufacturer	By Supplier	
G-13.2	Type	2/0 AWG ACSR	

³ Refer to EW-6.0 specifications

⁴ Refer to EW-6.0 and EW-7.0 specifications

Name of Firm

Name & Signature of Representative

Designation

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-13.3	Ampacity	270 A	

G-14.0 13.8KV TIE LINE STEEL POLE⁵

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-14.1	Manufacturer	By Supplier	
G-14.2	Place of Manufacture	By Supplier	
G-14.3	Structural grade of steel used	ASTM A572 grade 345MPa (50ksi) (minimum)	
G-14.4	Pole Shape	Octagonal	

G-15.0 BUS CONDUCTOR AND HARDWARES⁶

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
Stranded Conductor Requirements			
G-15.1	Manufacturer	By Supplier	
G-15.2	Type designation	Aluminum Conductor Steel Reinforced (ACSR)	
G-15.3	Conductor size	2/0	
G-15.4	Ampacity, A	270	
Conductor Hardware			
G-15.5	Tension Clamp		
	a. Type	Bolted, U-Bolt	
	b. Material of Body	Aluminum Alloy	

⁵ Refer to EW-7.0 specifications⁶ Refer to EW-6.0 specifications

Name of Firm

Name & Signature of Representative

Designation

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-15.6	Connectors		
	a. Type	wedge pressure clamp for stranded conductor connection	
	b. Angle and T-connectors type	wedge pressure clamp for stranded conductor connection	

G-16.0 JOB SITE CAMERAS⁷

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-16.1	Manufacturer	By Supplier	
G-16.2	Type	Time-Lapse Camera	
G-16.3	Quantity	At least 2 sets	
G-16.4	Control Display	Thin-Film-Transistor (TFT) Liquid Crystal Display (LCD)	
G-16.5	Image Sensor Resolution	At least 1.3 Megapixel CMOS	
G-16.6	View Angle	At least 110 degrees viewing angle	
G-16.7	Still Image Resolution	1280 x 720	
G-16.8	Time Lapse Interval	15 minutes/ User-programmable	
G-16.9	Battery Type	Standard AA or AAA Size Alkaline Batteries	
G-16.10	Battery Life	At least 120 days of image recording	
G-16.11	Additional Battery (Spare)	To Be Provided	
G-16.12	Enclosure	IP64 compliant	
G-16.13	Storage Memory	SDHC	

⁷ Refer to EW-1.11

Name of Firm

Name & Signature of Representative

Designation

ITEM	DESCRIPTION	NPC REQUIREMENTS	SUPPLIER'S DATA
G-16.14	Storage Capacity	32GB	
G-16.15	Additional Storage per camera (Spare)	At least One (1)	

G-17.0 SPARE PARTS FOR SOLAR PV SYSTEM AND AUXILIARIES⁸
(Minimum Requirements as Specified in the Technical Specifications
and Manufacturer's Standard and Recommended Spare Parts)

ITEM	DESCRIPTION	QTY.	SHELF LIFE	INTERVAL OF REPLACEMENT
G-17.1	Memory Cards/ Data Storage	2 units		
G-17.2	Spare Wind Anemometers	3 pcs		
G-17.3	Spare Solar Pyranometer	1 pc		
G-17.4	Spare Thermocouple for solar module temperature	1 set		
G-17.5	Spare Thermocouple for ambient air	1 pc		
G-17.6	Battery Modules ⁹	1 pc		
	Other spare parts recommended by Manufacturer (Specify)	1 lot		
	1.			
	2.			
	3.			

⁸ Refer to GW-7.0

⁹ Not to be supplied

Notes: Minimum requirements but the Supplier may increase the specified quantity if found not sufficient during Warranty Period.

Name of Firm

Name & Signature of Representative

Designation

G-18.0 STANDARD / SPECIAL TOOLS FOR SOLAR PV SYSTEM¹⁰

ITEM	DESCRIPTION	QTY.
G-18.1	Tool Box	1 unit
G-18.2	Insulation Resistance Tester (with rated voltage at 250V / 500V / 1000V)	1 set
G-18.3	Earthing Resistor (0-1000 ohms)	1 set
G-18.4	Voltmeter (with a minimum rated voltage of 600VAC and 1.1kVDC)	1 set
G-18.5	Clamp Meter (with minimum rated current of 500A)	1 set
G-18.6	PVC hose, flexible and robust, 20mm diameter, at least 30m length with drum and reel assembly	1 unit
G-18.7	Extendable/telescopic panel cleaning pole with squeegee and sponge, at least 12ft length with hose attachment (20mm diameter hose)	1 unit

G-19.0 LIST OF OTHER DOCUMENTS TO BE SUBMITTED IN ADDITION TO THE TECHNICAL DATA SHEETS**Manufacturer's Certification Requirements**

1. **ISO 9001 Certificate of the Manufacturer** for the following equipment:
 - a. Solar PV (SPV) Modules
 - b. String Inverters
 - c. Energy Storage System
 - d. Battery Modules/Batteries
2. **ISO 14001 Certificate of the Manufacturer or equivalent** for the following equipment:
 - a. Solar PV (SPV) Modules
 - b. Battery Modules/ Batteries

Equipment Certification Requirements

1. Test Certificates/Certificates of Conformance of the **SPV modules** to be supplied that comply with the following standards:
 - a. **IEC 61215** – Crystalline Silicon Terrestrial Photovoltaic (PV) Modules- Design Qualification and Type Approval
 - b. **IEC 61730-1** – Photovoltaic (PV) module safety qualification – Part 1: Requirements for construction

¹⁰ Refer to GW-8.0

Name of Firm

Name & Signature of Representative

Designation



- c. IEC 61730- 2 – Photovoltaic (PV) module safety qualification- Part 2: Requirements for testing
 - d. IEC 61701 – Salt mist corrosion testing of photovoltaic (PV) modules
2. Test Certificates/ Certificates of Conformance of the **String Inverters** to be supplied that comply with the following standards:
- a. IEC 62109-1 – Safety of power converters for use in photovoltaic power systems- Part 1: General requirements
 - b. IEC 62109-2 – Safety of power converters for use in photovoltaic power systems- Part 2: Particular requirements for inverters
 - c. IEC 62116 – Utility-interconnected photovoltaic inverters – Test procedure of islanding prevention measures
3. Test Certificates/ Certificates of Conformance of the **Battery Modules** to be supplied that comply with the following standards:
- a. IEC 62619 – Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications; or
 - b. UL 1642 – UL Standard for Safety of Lithium Batteries

Other Requirement

1. Latest Copy of **Bloomberg New Energy Finance List of Tier 1 Manufactures** reckoned from the bid opening date.

Name of Firm

Name & Signature of Representative

Designation

SECTION VI

**PART II-TECHNICAL
DATA SHEETS**

ELECTRICAL WORKS

**DOCUMENTS TO BE SUBMITTED DURING
IMPLEMENTATION**

PART II – TECHNICAL DATA SHEETS**ANNEX H - ADDITIONAL DRAWINGS AND DOCUMENTS TO BE
SUBMITTED DURING IMPLEMENTATION**

ANNEX	DESCRIPTION
Annex H.1	<p>Prior to the purchase of materials, equipment and implementation of works, the supplier shall prepare and submit five (5) copies of, but not limited to, the following drawings/documents for review/approval of NPC:</p> <ul style="list-style-type: none"> a) Civil Drawings: <ul style="list-style-type: none"> 1. Site Development plan; 2. Topographic survey/layout; 3. Lot or Parcellary survey; 4. Longitudinal and Transverse Section drawings and details; 5. Perimeter lighting and Fence layout; 6. SPP support/structure design and details; 7. Foundation plans and details; <ul style="list-style-type: none"> i. Energy Storage System Housing; ii. SPP array; iii. ESS transformer; iv. SPP transformer; v. Perimeter lighting; b) Electrical Drawings: <ul style="list-style-type: none"> 1. System architecture; 2. Overall single line diagram; 3. SPP single line diagram; 4. ESS single diagram; 5. SPP Load schedule; 6. ESS Load schedule; 7. SPP cable layout; 8. ESS electrical layout and details (e.g. Lightning and Power Layout, Wiring and Cable Tray Details) 9. SPP and ESS Lightning Protection layout and details; 10. SPP and ESS switchyard layout and details; 11. SPP and ESS grounding layout and details; c) List of recommended Spare Parts and Special Tools; and d) Operation and Maintenance Manuals. <p>Other drawings that are not listed herewith but are deemed necessary for construction of the project shall be submitted to NPC for approval. Plans, schematics, equipment or items supplied or used without such approval shall be at the Supplier's risk of subsequent rejections.</p>

Name of Firm

Name & Signature of Representative

Designation

Annex H.2	<p>Manufacturer's General Data and Illustrated Catalogues and Brochures stating the following minimum requirements for the equipment offered:</p> <ol style="list-style-type: none"> 1. Solar PV Modules <ol style="list-style-type: none"> a. Manufacturer b. Model c. Cell Type d. Rated Power (W_P) at STC e. Efficiency f. Solar PV Module Service Life g. Rated Voltage (V) at STC h. Rated Current (A) at STC i. Open Circuit Voltage (V_{oc}) at STC j. Open Circuit Current (I_{sc}) at STC k. Power Tolerance l. Dimension (L X W) m. Weight (Kg) n. Junction Box IP Rating 2. String Inverter <ol style="list-style-type: none"> a. Manufacturer b. Model c. Rating d. Efficiency e. Input DC Power (W) f. No. of MPPT g. Maximum Input Voltage (V_{dc}) h. Minimum Input Voltage (V_{dc}) i. MPP Voltage Range (V_{dc}) j. Maximum Input per MPPT (Input A/ Input B) (A) k. Maximum Short Circuit per MPPT (A) l. Maximum Output Current (A) m. Power Factor at rated power (pf) n. Total Harmonic Distortion o. Connection Phase p. Output Voltage (V_{ac}) q. Output Frequency (Hz) r. Data Interface s. Protection Rating t. Operating Temperature Range u. Topology 3. DC Box <ol style="list-style-type: none"> a. Protection Rating b. Surge Protection c. DC Circuit Breakers <ul style="list-style-type: none"> • Continuous Current Rating • Type
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Name of Firm

Name & Signature of Representative

Designation



	<ol style="list-style-type: none"> 4. AC Combiner Box <ol style="list-style-type: none"> a. Protection Rating b. Surge Protection c. Circuit Breakers d. Metering System 5. Dry Type Transformer <ol style="list-style-type: none"> a. Manufacturer b. Model c. Place of Manufacture d. Rated Capacity (kVA) e. Nominal Voltage (H-winding, kV) f. Nominal Voltage (X-winding, kV) g. Number of Phase h. Core i. Insulation j. Type k. Class l. Type of Cooling m. Temperature Rise (°C) n. Insulation Level <ul style="list-style-type: none"> • Maximum operating voltage, kV • Nominal operating voltage, kV • Winding Material o. Enclosure p. Dimension (L X W), mm q. Total Weight, kg 6. Solar PV Plant (SPP) Transformer <ol style="list-style-type: none"> a. Manufacturer/Brand b. Model c. Rated Capacity, kVA d. Number of Phase e. Type of Cooling f. Insulation g. Type h. Audible Sound Level i. Vector Group j. Temperature <ul style="list-style-type: none"> • Ambient Temperature • Temperature Rise k. Winding Connection l. Insulation Level <ul style="list-style-type: none"> • Nominal Voltage Level • Highest Voltage Level • Basic Insulation Level m. Winding Material n. Bushing Material o. % Impedance p. Efficiency
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Name of Firm

Name & Signature of Representative

Designation

	<ul style="list-style-type: none"> q. Tap Changer r. Taps s. Transformer Losses t. Tolerances u. Ground Terminal Connection v. Weight of Oil w. Total Weight
	<p>7. Energy Storage System (ESS) Transformer</p> <ul style="list-style-type: none"> a. Manufacturer/Brand b. Model c. Rated Capacity, kVA d. Number of Phase e. Type of Cooling f. Insulation g. Type h. Audible Sound Level i. Vector Group j. Temperature <ul style="list-style-type: none"> • Ambient Temperature • Temperature Rise k. Winding Connections l. Insulation Level <ul style="list-style-type: none"> • Nominal Voltage Level • Highest Voltage Level • Basic Insulation Level m. Winding Material n. Bushing Material o. % Impedance p. Efficiency q. Tap Changer r. Taps s. Transformer Losses t. Tolerances u. Ground Terminal Connection v. Weight of Oil w. Total Weight
	<p>8. Energy Storage System</p> <ul style="list-style-type: none"> a. Manufacturer b. Model c. Nominal Rating, kW d. Usable Energy, kWh e. Operating Frequency (Hz)
	<p>9. Battery Modules</p> <ul style="list-style-type: none"> a. Manufacturer b. Model c. Chemistry d. Nominal Capacity (Ah)

Name of Firm

Name & Signature of Representative

Designation

	<p>e. Electrical Characteristics</p> <ul style="list-style-type: none"> • Nominal Terminal Voltage • Minimum Operating Voltage • Maximum Operating Voltage • Maximum Normal State of Charge • Minimum Normal State of Charge • Nominal C-rate @ 25°C • Self-Discharge Rate • Cycle lifetime <p>f. Physical Characteristics</p> <ul style="list-style-type: none"> • Length • Width • Height • Gross Weight • Number of cells <p>g. Safety Protection</p> <p>10. Power and Energy Management System</p> <ol style="list-style-type: none"> Manufacturer Model Communication <p>11. Power Cables</p> <p>15 kV XLPE Cable</p> <ol style="list-style-type: none"> Manufacturer Place of Manufacturer Maximum operating Temperature, °C Max. continuous current carrying capacity of conductor at 90°C Type of cable Conductor Cross-Section, mm² Conductor Diameter, mm Maximum Outside Diameter, mm Conductor Shape Conductor Material Insulation (Material & Thickness) Outer covering/Jacket (Material, Thickness & Termite Protection Required) Shield (Type) Filler & Binder Tape <p>600 V THHN/THWN-2 Cable</p> <ol style="list-style-type: none"> Manufacturer Place of Manufacturer Maximum operating Temperature, °C Max. continuous current carrying capacity of conductor at 90°C Conductor Cross-Section, mm² Conductor Diameter, mm Maximum Outside Diameter, mm Conductor Material Insulation (Material & Thickness)
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Name of Firm

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Designation



	<p>12. 1.1kV DC Cable</p> <ol style="list-style-type: none"> Manufacturer Place of Manufacturer Conductor Size Conductor Metal Conductor Shape Conductor Material Type of wire Type of Insulation Maximum Operating Temperature <p>13. Control and Instrumentation Cables</p> <p>General</p> <ol style="list-style-type: none"> Manufacturer Place of Manufacturer Conductor Size <p>RS-485</p> <ol style="list-style-type: none"> Type of Conductor Shielding Type of Insulation Type of Jacket Impedance <p>Ethernet Cable</p> <ol style="list-style-type: none"> Type of Conductor Shielding Type of Insulation Type of Jacket <p>Balanced Twisted-pair</p> <ol style="list-style-type: none"> Number of twisted-pairs Type of Insulation Capacitance Operating voltage Operating temperature range Type of Shielding Type of Jacket <p>14. Communication Equipment</p> <p>General</p> <ol style="list-style-type: none"> Manufacturer Place of Manufacturer Power Supply Requirement Operating Temperature Output Power, Peak Envelope Power (PEP) Modulation Modulation Error Ratio (MER) Operating Frequency
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Name of Firm

Name & Signature of Representative

Designation

	<ul style="list-style-type: none"> i. Output Frequency j. Operating/Nominal Bandwidth k. Return Loss l. Signal-to-Noise Ratio (SNR) m. Input/output Impedance n. Gain o. Losses p. Bit Rate <p>Digital Transmitter</p> <ul style="list-style-type: none"> a. Signal Suppression b. Harmonic Distortion <p>Digital Receiver</p> <ul style="list-style-type: none"> a. Sensitivity b. Selectivity c. Image IF rejection <p>15. Grounding System</p> <p>General</p> <ul style="list-style-type: none"> a. Grid Conductor (Size & Type) b. Bonding Conductor (riser) <ul style="list-style-type: none"> • All major equipment such as inverter, transformer, ESS, etc. • For motors/pumps rated 30kW and above, CT/PT, FDS & LA • For motors/pumps, perimeter lighting and fence earthing c. Ground Rod (Type, Diameter & Section/Length) <p>16. Lightning Protection</p> <ul style="list-style-type: none"> a. Manufacturer b. Place of Manufacturer <p>17. Lightning Rod</p> <ul style="list-style-type: none"> a. Material b. Length, mm c. Minimum Diameter, mm <p>18. Down Conductor</p> <ul style="list-style-type: none"> a. Type b. Minimum Cross-section Area c. Overall Diameter, mm d. Insulation Material e. Sheath Material f. Weight (kg/m) <p>19. Accessories</p> <ul style="list-style-type: none"> a. Support Pipe, Downlead Clamp, Terminal Lug, Guy Wire, PVC conduit, etc. <p>20. Fuse Disconnect Switch with Lightning Arrester Combination</p> <ul style="list-style-type: none"> a. Manufacturer
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Name of Firm

Name & Signature of Representative

Designation



	<ul style="list-style-type: none"> b. Place of Manufacturer c. Class (indoor & outdoor) d. Rated Voltage, kV e. Nominal System Voltage, kV f. Frequency, Hz g. BIL, kV h. Ampere Frame i. Interrupting Capacity, kA j. Fuse Link (Type & Current Rating) k. Lightning Arrester <ul style="list-style-type: none"> • Type • Class • Rated frequency, Hz • Nominal system voltage • Duty Cycle Voltage (rating), kVrms • Maximum Continuous Operating Voltage (MCOV) • Nominal discharge current, kA • Creepage Distance, mm • Supporting brackets, bolts, nuts, etc.
	<p>21. 13.8kV Tie Line Primary Conductor</p> <ul style="list-style-type: none"> a. Manufacturer b. Place of Manufacturer c. Type d. Code Name e. Total cross-sectional area f. Ampacity g. Outer Layers <ul style="list-style-type: none"> • Material • Calculated cross sectional area, mm² • Stranding No./diameter, mm h. Core <ul style="list-style-type: none"> • Material • Calculated cross sectional area, mm² • Stranding No./diameter, mm i. Conductor overall diameter, mm j. Ultimate Breaking Strength, kN k. Rated DC Resistance l. Weight of Conductor, kg/m
	<p>22. 13.8kV Tie Line Steel Pole</p> <ul style="list-style-type: none"> a. Manufacturer b. Place of Manufacturer c. Structural grade of steel used d. Number of Pole Sections e. Pole Shape f. Welding Method of Processing Steel Pole g. Hot-Dipped Galvanized h. Pole Marking

Name of Firm

Name & Signature of Representative

Designation

	<p>23. Bus Conductor and Hardwares</p> <p>Stranded Conductor Requirements</p> <ol style="list-style-type: none"> Manufacturer Place of Manufacturer Type of designation Code Name Conductor Size Ampacity, A Outer Layers <ul style="list-style-type: none"> Material Stranding No. Calculated cross sectional area, mm² Coefficient of Elongation Core <ul style="list-style-type: none"> Material Stranding No. Calculated cross sectional area, mm² Coefficient of Elongation Conductor Coefficient of Linear Expansion <p>Conductor Hardware</p> <ol style="list-style-type: none"> Tension clamp <ul style="list-style-type: none"> Type Material Connectors <ul style="list-style-type: none"> Type Angle and T-connectors type <p>24. Job Site Cameras</p> <ol style="list-style-type: none"> Manufacturer Type Control Display Image Sensor Resolution View Angle Still Image Resolution Time Lapse Interval Battery Type & Life Enclosure IP Rating Storage Memory Storage Capacity
Annex H.3	<p>Site Acceptance Test Procedure for the following:</p> <ol style="list-style-type: none"> SPV panels String Inverters Energy Storage System (as an integrated system) including: <ul style="list-style-type: none"> Battery Management System (BMS) Power Conversion System (PCS) ESS Control System (ECS)

Name of Firm

Name & Signature of Representative

Designation

	<ul style="list-style-type: none"> • Battery Modules d) Battery Modules/ Batteries e) Power and Energy Management System (PEMS) including: <ul style="list-style-type: none"> • Solar/PV Controller(s) • Genset Controllers • ESS Control System/ESS Controller(s)
Annex H.4	Warranty Statement for the following (as stated in GW-19): <ul style="list-style-type: none"> a) SPV panels at least 10-year warranty b) String Inverters at least 5-year warranty c) Energy Storage System at least 5-year warranty d) Power and Energy Management System at least 5-year warranty e) Battery Modules/ Batteries at least 5-year warranty
Annex H.5	Computation of Performance Ratio and Annual Yield using the latest version of PVsyst Software reckoned from the bid opening date.
Annex H.6	Commissioning Test Procedures (Refer to Section GW-13.3.3 Commissioning Test) Performance Test Procedures (Refer to Section GW-13.4 Performance Test)
Annex H.7	ISO 9001 Certificate of the Manufacturer for the following equipment: <ul style="list-style-type: none"> a) Solar PV (SPV) Modules b) String Inverters c) Energy Storage System d) Battery Modules/Batteries
Annex H.8	ISO 14001 Certificate of the Manufacturer or equivalent for the following equipment: <ul style="list-style-type: none"> a) Solar PV (SPV) Modules b) Battery Modules/ Batteries
Annex H.9	Manufacturer's Certificate on the Average Service Life of the SPV Modules to be supplied
Annex H.10	Test Certificates/ Certificates of Conformance of the SPV modules to be supplied that comply with the following standards: <ul style="list-style-type: none"> a) IEC 61215 – Crystalline Silicon Terrestrial Photovoltaic (PV) Modules- Design Qualification and Type Approval b) IEC 61730-1– Photovoltaic (PV) module safety qualification – Part 1: Requirements for construction c) IEC 61730- 2– Photovoltaic (PV) module safety qualification- Part 2: Requirements for testing d) IEC 61701 – Salt mist corrosion testing of photovoltaic (PV) modules
Annex H.11	Test Certificates/ Certificates of Conformance of the String Inverters to be supplied that comply with the following standards: <ul style="list-style-type: none"> a) IEC 62109-1- Safety of power converters for use in photovoltaic power systems- Part 1: General requirements b) IEC 62109-2- Safety of power converters for use in photovoltaic power systems- Part 2: Particular requirements for inverters c) IEC 62116 – Utility-interconnected photovoltaic inverters- Test procedure of islanding prevention measures
Annex H.12	Test Certificates/ Certificates of Conformance of the Battery Modules to be supplied that comply with the following standards:

Name of Firm

Name & Signature of Representative

Designation



	a) IEC 62619 – Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications; or b) UL 1642 – UL Standard for Safety of Lithium Batteries
Annex H.13	Latest Copy of Bloomberg New Energy Finance List of Tier 1 Manufacturers reckoned from the bid opening date.

Name of Firm

Name & Signature of Representative

Designation

SECTION VII

SCHEDULE OF REQUIREMENTS

**SECTION VII - SCHEDULE OF REQUIREMENTS
(BID PRICE SCHEDULE)
BPS.1 - SUMMARY**

DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS)

ITEM NO.	PARTICULARS	Qty.	Unit	TOTAL AMOUNT IN FIGURES		TOTAL PESO EQUIVALENT
				Foreign Currency	Phil. Peso	Phil. Peso
A.	Architectural Works	1	Lot			
B.	Civil Works	1	Lot			
C.	Electrical Works	1	Lot			
D.	Mechanical Works	1	Lot			
E.	Other Works/Supply/Services	1	Lot			
TOTAL AMOUNT						

NOTES: Final delivery site of all equipment/materials shall be at the Culasi, Palanan, Isabela

Name of Bidder

Name and Signature of Authorized Representative

Designation

SECTION VII-SCHEDULE OF REQUIREMENTS

SECTION VII - SCHEDULE OF REQUIREMENTS

BPS.2 - Breakdown of Prices

CULASI, PALANAN, ISABELA

Item No.	Description of Work or Materials	QTY.- UNIT	C O D E	UNIT PRICE FOR GOODS AND RELATED SERVICES TO BE SUPPLIED FROM ABROAD				UNIT PRICE FOR GOODS AND RELATED SERVICES TO BE SUPPLIED FROM WITHIN THE PHILIPPINES			TOTAL PRICE	
				Unit Price of Goods or Services Foreign Currency (Y ^{***})	Import Duties & other Levies Imposed by Phil. Govt. (Phil. Peso)	Value Added Tax and other Taxes Imposed by Phil. Govt. (Phil. Peso)	Local Transport from Port to Delivery Site *** (Phil. Peso)	Unit Price of Goods or Services (Phil. Peso)	Value Added Tax and other Taxes Imposed by Phil. Govt. (Phil. Peso)	Local Transport from Plant to Delivery Site *** (Phil. Peso)	Foreign Currency (E x C)	Local Currency Portion (Phil. Peso) ((F+G+H) x C) or ((I+J+K) x C)
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)
A	ARCHITECTURAL WORKS											
A.1	Guard Post	1 Lot										
	a. Wall System & Finishes:											
	1. 150mm thk. CHB wall including mortars and reinforcing bars.											
	2. Plastering (Plain cement plaster wall finish including preparation).											
	3. Floor Finishes (Plain cement plaster floor finish).											
	b. Roofing & Blankets:											
	1. Roofing Sheets (2mm thick metallic plastic long span corrugated, roofing sheet including stainless steel fasteners, sealant and 2mm thick metallic plastic end flashing)											
	2. Gutter (2mm thick metallic plastic gutter including fasteners, sealants, hardware and accessories)											
	3. Fascia Board (1/2" x 1/2" x 12" Fiber cement board including steel frame, hardware and accessories)											
	4. Downspout (4" ø uPVC pipe series 1000 downspout including joint fittings, solvents and brackets)											
	5. Ceiling: 6mm thk marine plywood on standard metal furring spaced @ 0.40 O.C.B.W. and metal hangers spaced 0.80 O.C.B.W											
	6. Roof Drain: Removable stainless wire basket strainer											
	c. Painting											
	1. All Concrete Surfaces											
	2. All Wood Surfaces											
A.2	Gutter: 2.0mm thick Metallic Plastic Gutter including fasteners, sealants, hardware and accessories.	1 Lot										
SUB-TOTAL A												
(Amount in Words)												

Notes: Final delivery site of all equipment/materials shall be at the plant site stated above.

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Name of Bidder

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SECTION VII-SCHEDULE OF REQUIREMENTS

SECTION VII - SCHEDULE OF REQUIREMENTS

BPS.2 - Breakdown of Prices

CULASI, PALANAN, ISABELA

Item No.	Description of Work or Materials	QTY.- UNIT	C O D E	UNIT PRICE FOR GOODS AND RELATED SERVICES TO BE SUPPLIED FROM ABROAD				UNIT PRICE FOR GOODS AND RELATED SERVICES TO BE SUPPLIED FROM WITHIN THE PHILIPPINES			TOTAL PRICE	
				Unit Price of Goods or Services Foreign Currency () ^{**}	Import Duties & other Levies Imposed by Phil. Govt. (Phil. Peso)	Value Added Tax and other Taxes Imposed by Phil. Govt. (Phil. Peso)	Local Transport from Port to Delivery Site *** (Phil. Peso)	Unit Price of Goods or Services (Phil. Peso)	Value Added Tax and other Taxes Imposed by Phil. Govt. (Phil. Peso)	Local Transport from Plant to Delivery Site *** (Phil. Peso)	Forex Currency (E x C)	Local Currency Portion (Phil. Peso) ((F+G+H) x C) or ((I+J+K) x C)
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)
B.	CIVIL WORKS											
B.1	Site Development:											
a.	Clearing & Grubbing:	1 Lot										
b.	Gravel Surfacing:	134 cu.m										
c.	Zocalo Wall:	208 il.m.										
d.	Perimeter Barbed Wire Fence (including pedestrian & vehicular gates, barbed wire, concrete post, CHB wall and footing):	378 il.m.										
B.2	Drainage System & Appurtenant Structures:											
a.	Open RC canal:	378 il.m.										
b.	90 mm dia. uPVC:	6 il.m.										
c.	100 mm dia. uPVC:	6 il.m.										
B.3	Other Structures and Facilities:											
a.	Supply of Labor and Construction Materials for Guard Post located in Solar Power Plant (including excavation, backfill, stripping, bedding, rebar, concrete, structural steel and other accessories) as described in Technical Specifications and as shown on the Bid Drawings:	1 Lot										
b.	ESS Control Room Foundation: Structural excavation, backfill, sand and gravel bedding, concrete (20.7MPa), rebar, structural steel (A36) including base plate and anchor bolts:	1 Lot										
c.	Mounting Structure: A 36 hot dipped galvanized steel mounting structure with concrete foundation (including excavation, backfill, stripping, bedding, rebar & stainless steel bolts) as described in Technical Specifications and as shown on the Bid Drawings:	1 Lot										
d.	Supply of Labor and Construction Materials for concrete foundation and structural steel (A36) supports and accessories for the Elevated Water Tank Storage including shop painting:	1 Lot										
e.	Supply of Labor and Construction Materials for Cistern including excavation, bedding, concrete, rebar, stainless steel rung, gravel surfacing & 100mm dia. uPVC pipe:	1 Lot										
f.	Supply of Labor and Construction Materials for concrete foundation, structural steel (A36) supports, pipe anchor blocks and accessories for the Gutter Support:	1 Lot										
B.4	Switchyard Appurtenances:											
a.	Seclusion Fence (including gate, concrete post, cyclone wire, footing, zocalo wall and uPVC pipe):	40 il.m.										
b.	Gravel Surfacing (150mm thick):	13 cu.m										
c.	50mm dia. uPVC Pipe Weep Holes:	20 il.m.										
d.	Transformer Concrete Pad	2 pcs										
SUB-TOTAL B												
(Amount in Words)												

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				Unit Price of Goods or Services Foreign Currency ()**	Import Duties & other Levies Imposed by Phil. Govt. (Phil. Peso)	Value Added Tax and other Taxes Imposed by Phil. Govt. (Phil. Peso)	Local Transport from Port to Delivery Site *** (Phil. Peso)	Unit Price of Goods or Services (Phil. Peso)	Value Added Tax and other Taxes Imposed by Phil. Govt. (Phil. Peso)	Local Transport from Plant to Delivery Site *** (Phil. Peso)	Forex Currency (E x C)	Local Currency Portion (Phil. Peso) ((F+G+H) x C) or ((I+J+K) x C)
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)
C.	ELECTICAL WORKS											
C.1	Solar Panel, Crystalline Silicon Modules	1 Lot										
C.2	String Inverters	1 Lot										
C.3	Protection Devices, AC Combine Box with Digital Metering System, DC Box and all other appurtenances as described in the Technical Specifications, Technical Data Sheet and as shown on the Bid Drawings including installation works, testing and commissioning of all major equipment at the Solar PV Plant.	1 Lot										
C.4	Energy Storage System (ESS)											
a.	Energy Storage System (ESS), ESS Housing, Battery Management System, Battery Modules, Power Conversion, ESS Dry Type Transformer and Digital Power Metering System complete with the required accessories, power and communication cables as described in the Technical Specifications, Technical Data Sheet and as shown on the Bid Drawings including installation works, testing and commissioning.	1 Lot										
b.	150 kVA ESS Transformer, 13.8kV HV Side, 3-phase, 60 Hz complete with the required accessories, protection relays and other appurtenances as described in the Technical Specifications, Technical Data Sheet and as shown on the Bid Drawings including installation works, testing and commissioning.	1 Set										
C.5	Power and Energy Management System (PEMS)											
a.	Hybrid Controller complete with required power and communication cables, accessories and protection shall be provided as described in the Technical Specifications including installation works, testing and commissioning.	1 Set										
b.	Genset Controller complete with required power and communication cables, accessories and protection shall be provided as described in the Technical Specifications including installation works, testing and commissioning.	6 Sets										
c.	Solar/PV Controller complete with required power and communication cables, accessories and protection shall be provided as described in the Technical Specifications including installation works, testing and commissioning.	1 Set										
d.	ESS Control System (ECS)/ESS Controller with required power and communication cables, accessories and protection shall be provided as described in the Technical Specifications including installation works, testing and commissioning.	1 Set										
e.	Human Machine Interface(HMI) complete with required power and communication cables, accessories and protection shall be provided as described in the Technical Specifications including installation works, testing and commissioning.	2 Sets										

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Designation



SECTION VII-SCHEDULE OF REQUIREMENTS

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BPS.2 - Breakdown of Prices

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				Unit Price of Goods or Services Foreign Currency (J ^{***})	Import Duties & other Levies Imposed by Phil. Govt. (Phil. Peso)	Value Added Tax and other Taxes Imposed by Phil. Govt. (Phil. Peso)	Local Transport from Port to Delivery Site ^{***} (Phil. Peso)	Unit Price of Goods or Services (Phil. Peso)	Value Added Tax and other Taxes Imposed by Phil. Govt. (Phil. Peso)	Local Transport from Plant to Delivery Site ^{***} (Phil. Peso)	Forex Currency (E x C)	Local Currency Portion (Phil. Peso) ((F+G+H) x C) or ((I+J+K) x C)
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)
	f. Communication Link between SPP and DPP necessary for data transfer from/to each and every integral component such as controller, transmitter, receiver (transceiver), modem, switch, hub, router, etc., complete with the required power and communication cables, balanced twisted pairs and support strand, conduit, basic equipment and tools and other accessories as described in Technical Specifications, Technical Data Sheet and as shown on the Bid Drawings including installation works, clearing of right of way, cable pulling, conduct of continuity test, testing and commissioning.	1 Lot										
C.6	225 kVA SPP Transformer, 480V/13.8kV, 3-phase, 60 Hz complete with the required accessories, protection relays and other appurtenances as described in the Technical Specifications, Technical Data Sheet and as shown on the Bid Drawings including installation works, testing and commissioning.	1 Set										
C.7	2 kVA Dry Type Transformer, 480V/240V, 1-phase, 60 Hz complete with the required accessories, protection relays and other appurtenances as described in the Technical Specifications, Technical Data Sheet and as shown on the Bid Drawings including installation works, testing and commissioning.	1 Set										
C.8	Power, Control & Instrumentation Cables complete with the required accessories for cabling works to interface the supplied equipment to the 13.8kV bus as described in the Technical Specifications, Technical Data Sheet and as shown on the Bid Drawings including installation works (for Solar and Diesel Power Plant).	1 Lot										
	a. 30 mm ² , 15kV, XLPE Power Cable Copper Conductor											
	b. 4.0 mm ² , DC Cable (PV Wire), UV Resistant, up to 1.1kVdc											
	c. 125 mm ² , 600V, Heat Resistance Thermoplastic (THHN), copper conductor											
	d. 30 mm ² , 600V, Heat Resistance Thermoplastic (THHN), copper conductor											
	e. 8.0 mm ² , 600V, Heat Resistance Thermoplastic (THHN), copper conductor											
	f. 5.5 mm ² , 600V, Heat Resistance Thermoplastic (THHN), copper conductor											
	g. 3.5 mm ² , 600V, Heat Resistance Thermoplastic (THHN), copper conductor											
C.9	Grounding System complete with the required grounding grid conductor, equipment bonding riser, exothermic welding materials, test pit, ground rods and other accessories as described in the Technical Specifications and Technical Data Sheets as shown on the Bid Drawings including installation works (for Solar and Diesel Power Plant).	1 Lot										
C.10	Lighting and power system of the solar plant site and SPP guard post complete with the required metering, panelboard, lighting fixtures, switches, outlets, cables, conduits, boxes and other fittings as described in the Technical Specifications and as shown on the Bid Drawings including installation works.	1 Lot										
C.11	Conduits complete with the required accessories for cabling works as described in the Technical Specifications and Technical Data Sheets as shown on the Bid Drawings including installation works (for Solar and Diesel Power Plant).	1 Lot										

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				Unit Price of Goods or Services Foreign Currency () ^{***}	Import Duties & other Levies Imposed by Phil. Govt. (Phil. Peso)	Value Added Tax and other Taxes Imposed by Phil. Govt. (Phil. Peso)	Local Transport from Port to Delivery Site *** (Phil. Peso)	Unit Price of Goods or Services (Phil. Peso)	Value Added Tax and other Taxes Imposed by Phil. Govt. (Phil. Peso)	Local Transport from Plant to Delivery Site *** (Phil. Peso)	Forex Currency (E x C)	Local Currency Portion (Phil. Peso) ((F+G+H) x C) or ((I+J+K) x C)
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C.12	World Meteorological Organization (WMO) compliant automated weather monitoring and logging system with data logger, at least two (2) pyranometers – one shall be installed horizontally and the other is the same as the orientation of the panels, one (1) ambient air thermocouple, one (1) anemometer, and one (1) thermocouple per string (to measure module temperatures) shall be provided for the Solar Farm including necessary spares.	1 Lot										
C.13	15kV Fuse Disconnected Switch with Lightning Arrestor Combination complete with the required fuse link, brackets and accessories as described in the Technical specifications and Technical Data Sheets as shown on the Bid Drawings including installation works, testing and commissioning (for Solar and Diesel Power Plant).	1 Lot										
C.14	Bus conductor, line materials/hardware, lightning protection as shown in Bid Drawing including installation works (for Solar PV and Diesel Power Plant)	1 Lot										
C.15	Take-off Structures: 25 ft. and 35 ft. Steel Pole (including steel cross arms, braces and bolts) as described in the Technical Specifications and as shown on the Bid Drawings	1 Lot										
C.16	13.8kV Tie Line complete with the required, primary conductor, steel pole and dressings, guying assemblies and other accessories as described in Technical Specifications, Technical Data Sheet, Staking Sheet and as shown on the Bid Drawings including installation works, clearing of right of way, pole numbering, stringing of power conductor, conduct of continuity test, testing and commissioning.	1 Lot										
C.17	Spare Parts for Solar PV System including their auxiliaries as described in the Technical Specifications (TS-GW-7.0), Technical Data Sheet (TDS-EW-PQ-G-17.0) and as recommended by the Manufacturer.	1 Lot										
C.18	Standard / Special Tools for Solar PV System and Power and Energy Management System including their auxiliaries as described in the Technical Specifications (TS-GW-8.0) and Technical Data Sheet (TDS-EW-PQ-G-18.0)	1 Lot										
SUB-TOTAL C				(Amount in Words)								

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(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)
D.	MECHANICAL WORKS											
D.1	Elevated Water Storage Tank, 1,000 liters capacity, polyethylene type, complete with nozzles, manhole, inlet and outlet nozzles, supports, overflow and drain nozzles with pipes, valves, pipe structural steel supports with anchor bolts on foundation and access ladder and other accessories as required in the technical specifications including installation works.	1 Set										
D.2	Hand pump jetmatic, 2 gpm min. flow, reciprocating type, cast iron body complete with foot valves, fittings, supports, concrete pad and other accessories as described in the technical specifications including installation works.	1 Set										
D.3	Domestic water pipe, garden hose, hose bibbs, fittings, supports, valves and other accessories for interconnection of the supplied equipment including required excavation and backfilling works; test and disfection as described in the technical specifications and shown on the bid drawings including installation works:											
a.	Check Valve, swing type, cast bronze, flanged or screwed ends, 32 mm Ø, 125 lb, Class 150.	1 Set										
b.	Gate valve, cast bronze, flanged or screwed ends, 25 mm Ø, 125 lb, Class 150.	3 Sets										
c.	Hose Bibb, 20 mm Ø, bronze body, screwed ends, Class 150.	5 Sets										
d.	Garden Hose with nozzle and reel, 20mm Ø, 30m long with connector for the 20mm hose bibb.	1 Set										
e.	Water Pipe, 32mm, ASTM A53 Grade A, schedule 40, seamless and hot dip galvanized, associated piping fittings, pipe supports and other associated accessories as described in the technical specifications.	11 m										
f.	Water Pipe, 32 mm O.D. (25 mm N.D.), uPVC pipe, sch 40, and its associated fittings, pipe supports and other accessories.	80 m										
g.	Water Pipe, 25 mm O.D. (20 mm N.D.), uPVC pipe, sch 40, and its associated fittings, pipe supports and other accessories.	94 m										

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D.4	Portable Submersible Sump Pump, 3.6 m ³ /hr capacity @ 6 meters head, 230 V AC, 60 Hz, 1 ph, complete with controls, flexible hose and necessary accessories as described in the technical specifications and shown on the bid drawings.	1	Set									
D.5	Portable Fire Extinguishers, UL/FM approved, HCFC or Halotron I, 7.1 kg (15.5 lbs), multi shots, wall hung type with bracket, mounting accessories and cabinet for outdoor installed fire extinguishers (one (1) unit for ESS and one (1) unit for each installed string inverter) as required in the technical specifications including installation	1	Lot									
D.6	Disinfection of elevated water tank and domestic water piping system including hydrostatic testing	1	Lot									
D.7	Tapping and/or Labels for Equipment, Valves, Piping, Instruments and its fixing accessories as described in the bid documents or shown on the drawings.	1	Lot									
D.8	Painting for water piping, its associated valves, fittings, supports and other accessories including touch-up for factory painted equipment and accessories as described in the technical specifications or shown on the drawings.	1	Lot									
D.9	Conduct testing and commissioning and other services as described in the technical specifications.	1	Lot									
SUB-TOTAL D		(Amount in Words)										
E.	OTHER WORKS/SUPPLY/SERVICES											
E.1	At least 4 Sets of Job Site Cameras, complete with all the necessary accessories and peripherals, spare / tools, installation and testing for the proper operation and maintenance in accordance with the Specifications and Technical Data Sheets for the provision of the following:	1	Lot									
	a. Construction Cameras, complete with the required accessories and peripherals; and,											
	b. SDHC Memory Cards, complete with the required storage capacity and spares; and,											
	c. Alkaline Batteries, complete with the required quantities and spares.											
E.2	Training at Plant Site for at least eight (8) NPC Personnel as described in the Technical Specifications.	1	Lot									
E.3	One (1)-yr regular (quarterly) diagnostic and monitoring of all supplied equipment/system and one (1)-yr Operation and Maintenance (O&M) supervision to ensure compliance to warranty requirements	1	Lot									
SUB-TOTAL E		(Amount in Words)										
GRAND TOTAL		(Amount in Words)										

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SECTION VIII

BIDDING FORMS

SECTION VIII – BIDDING FORMS

TABLE OF CONTENTS

NPCSF-GOODS-01	- Checklist of Technical and Financial Envelope Requirements for Bidders
NPCSF-GOODS-02	- List of all Ongoing Government & Private Contracts Including Contracts Awarded but not yet Started
NPCSF-GOODS-03	- Statement of the bidder's Single Largest Completed Contract (SLCC) similar to the contract to be bid
NPCSF-GOODS-04	- Computation of Net Financial Contracting Capacity (NFCC)
NPCSF-GOODS-05	- Joint Venture Agreement
NPCSF-GOODS-06a	- Form of Bid Security : Bank Guarantee
NPCSF-GOODS-06b	- Form of Bid Security : Surety Bond
NPCSF-GOODS-06c	- Bid Securing Declaration Form
NPCSF-GOODS-07	- Omnibus Sworn Statement (Revised)
NPCSF-GOODS-08	- Bid Letter
Sample Form	- Bank Guarantee Form for Advance Payment
Sample Form	- Certification from DTI as Domestic Bidder

Standard Form No: NPCSF-GOODS-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)****➤ Any of the following:**

- PhilGEPS Certificate of Registration and Membership under Platinum Category in accordance with Section 8.5.2 of the IRR;

OR:

- The following updated and valid Class "A" eligibility documents enumerated under "Annex A" of the Platinum Membership:

- Registration Certificate from the Securities and Exchange Commission (SEC) for corporations, Department of Trade and Industry (DTI) for sole proprietorship, or Cooperative Development Authority (CDA) for cooperatives;

- Mayor's/Business permit issued by the city or municipality where the principal place of business of the prospective bidder is located, or the equivalent document for Exclusive Economic Zones or Areas.

In cases of recently expired Mayor's/Business permits, it shall be accepted together with the official receipt as proof that the bidder has applied for renewal within the period prescribed by the concerned local government unit, provided that the renewed permit shall be submitted as a post qualification requirement in accordance with Section 34.2 of the Revised IRR of RA 9184.

- The prospective bidder's audited financial statements, showing, among others, the prospective bidder's total and current assets and liabilities, stamped "received" by the BIR or its duly accredited and authorized institutions, for the preceding calendar year which should not be earlier than two (2) years from the date of bid submission.

- Tax clearance per Executive Order 398, Series of 2005, as finally reviewed and approved by the BIR or as stated under GPPB NPM-039-2014, for Non-Resident Foreign Corporation (NRFC) and Non-Resident Alien Not Engaged in Trade or Business (NRANETB), a Delinquency Verification Certificate may be submitted as a form of Tax Clearance;

OR:

- A combination thereof

➤ 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-GOODS-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-GOODS-03) complete with the following supporting documents:

1. Contract/Purchase Order**2. Certificate of Acceptance; or Certificate of Completion; or Official Receipt (O.R); or Sales Invoice**

(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.)

Standard Form No: NPCSF-GOODS-01

- Duly signed computation of its Net Financial Contracting Capacity (NFCC) at least equal to the ABC (NPCSF-GOODS-04) or a Committed Line of Credit (CLC) at least equal to ten percent (10%) of the ABC, issued by a Universal or Commercial Bank; If the Bidder opted to submit a Committed Line of Credit (CLC), the bidder must submit a granted credit line valid/effective at the date of bidding.

b. (CLASS B)

- For Joint Venture (if applicable), any of the following:

- Valid Joint Venture Agreement (NPCSF-GOODS-05)

OR

- Notarized statements from all the potential joint venture partners stating that they will enter into and abide by the provisions of the JVA, if awarded the contract

- Certification from the relevant government office of their country stating that Filipinos are allowed to participate in their government procurement activities for the same item/product (For foreign bidders claiming eligibility by reason of their country's extension of reciprocal rights to Filipinos)

2. Technical Documents

- Bid Security, any one of the following:

- Bid Securing Declaration (NPCSF-GOODS-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-GOODS-06a) - 2% of ABC;

OR

- Surety Bond callable upon demand issued by a reputable surety or insurance company (NPCSF-GOODS-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-GOODS-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)

- Drawings and documents to be submitted with the Bid as specified in Clause GW-12.2 of Section VI - Technical Specifications (GW-General Works);

- Complete eligibility documents of the proposed subcontractor, if any

Standard Form No: NPCSF-GOODS-01

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-GOODS-08)
- Duly signed and completely filled-out Schedule of Requirement (Section VII) indicating the unit and total prices per item and the total amount in the prescribed Price Schedule form.
- For Domestic Bidder claiming for domestic preference:
 - Letter address to the BAC claiming for preference
 - Certification from DTI as Domestic Bidder in accordance with the prescribed forms provided

CONDITIONS:

1. Each Bidder shall submit one copy of the first and second components of its Bid. 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. In the case of foreign bidders, the eligibility requirements under Class "A" Documents (except for Tax Clearance) may be substituted by the appropriate equivalent documents, if any, issued by the country of the foreign bidder concerned. The eligibility requirements or statements, the bids, and all other documents to be submitted to the BAC must be in English. If the eligibility requirements or statements, the bids, and all other documents submitted to the BAC are in foreign language other than English, it must be accompanied by a translation of the documents in English. The documents shall be translated by the relevant foreign government agency, the foreign government agency authorized to translate documents, or a registered translator in the foreign bidder's country; and 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.

These documents shall be accompanied by a Sworn Statement in a form prescribed by the GPPE stating that the documents submitted are complete and authentic copies of the original, and all statements and information provided therein are true and correct. Upon receipt of the said documents, the PhilGEPS shall process the same in accordance with the guidelines on the Government of the Philippines – Official Merchants Registry (GoP-OMR).
3. 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.(j) of the revised IRR of R.A. 9184.

Standard Form Number: NPCSF-GOODS-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. _____	P _____
2. _____	P _____

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 as 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]*

Standard Form No: NPCSF-GOODS-06c

REPUBLIC OF THE PHILIPPINES)
CITY OF _____) S.S.**BID-SECURING DECLARATION****DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF
PALANAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS), (LuzP21Z1221Se)**To: **National Power Corporation**
BIR Road cor. Quezon Ave.
Diliman, Quezon CityI/We¹, 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-GOODS-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;

Standard Form No: NPCSF-GOODS-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]

SECTION IX

BID DRAWINGS

SECTION IX

BID DRAWINGS

AW – ARCHITECTURAL WORKS

CW – CIVIL WORKS

EW – ELECTRICAL WORKS

MW – MECHANICAL WORKS

SECTION IX

BID DRAWINGS

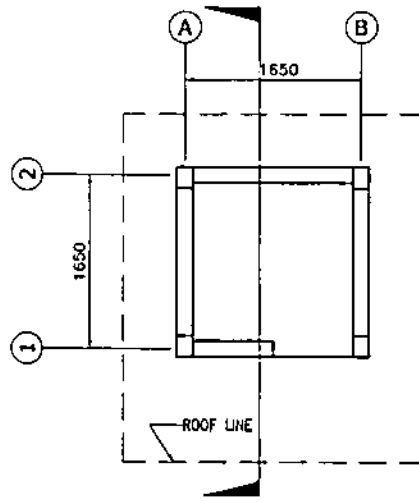
ARCHITECTURAL WORKS



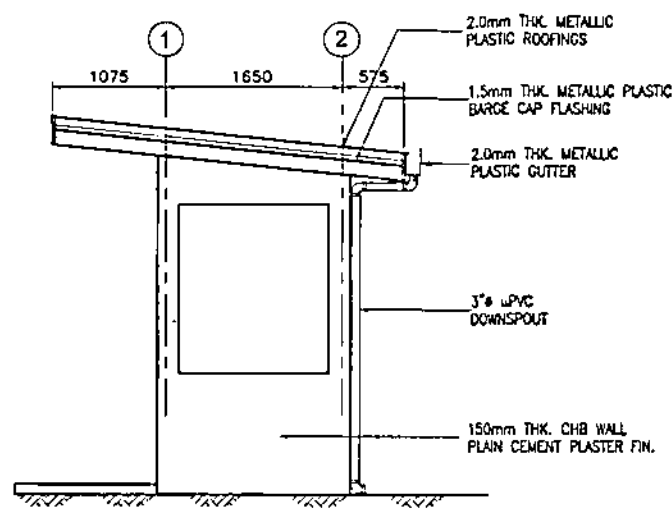
**TABLE OF CONTENTS
BID DRAWINGS****AW – ARCHITECTURAL WORKS**

<u>DRAWING NO.</u>	<u>TITLE</u>
PaISPV-BDA-17.001	GUARD POST (Solar Power Plant)

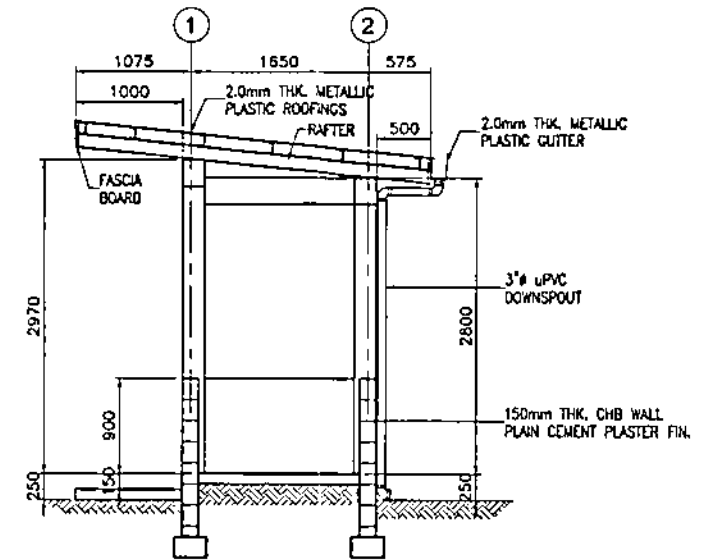




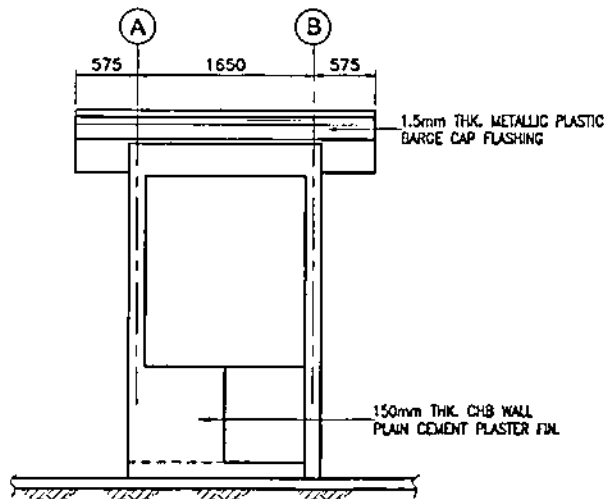
PLAN
PalSPV-BDA-17.001 SCALE 1:50



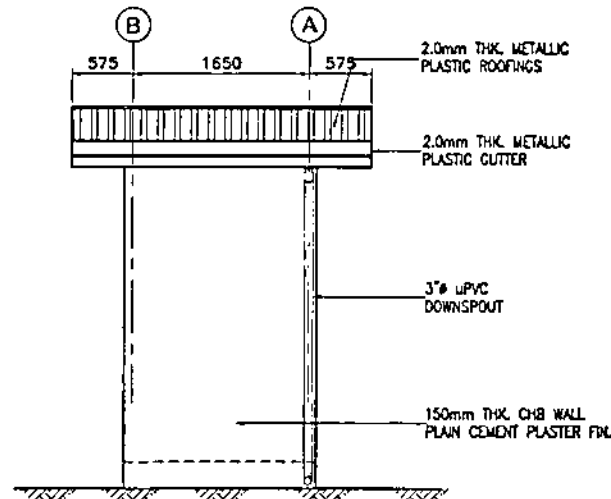
RIGHT & LEFT SIDE ELEVATION
PalSPV-BDA-17.001 SCALE 1:50



SECTION THRU 'A'
PalSPV-BDA-17.001 SCALE 1:50



FRONT ELEVATION
PalSPV-BDA-17.001 SCALE 1:50



REAR ELEVATION
PalSPV-BDA-17.001 SCALE 1:50

OWNER:		NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT: DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV ORG. WIND SYSTEM (WITH ESS)			
LOCATION: CULAB, PALANAN, ISABELA			
TITLE: GUARDPOST (SOLAR POWER PLANT)			
DESIGNED	BY	CHKD	DATE
DRAWN	BY	CHKD	DATE
REVIEWED	PRINCIPAL ENGINEER / ARCHT.		RECOMMENDED
CIVIL/ARCHT			APPROVED
ELEC			
MECH			
DWG NO PalSPV-BDA-17.001		SPECS NO LuzP21Z1221S@	
SCALE: AS SHOWN		BID DRAWING	
REV. DATE		NATURE OF REVISION	
BY	CHKD	RECD	APPD

SECTION IX

BID DRAWINGS

CIVIL WORKS

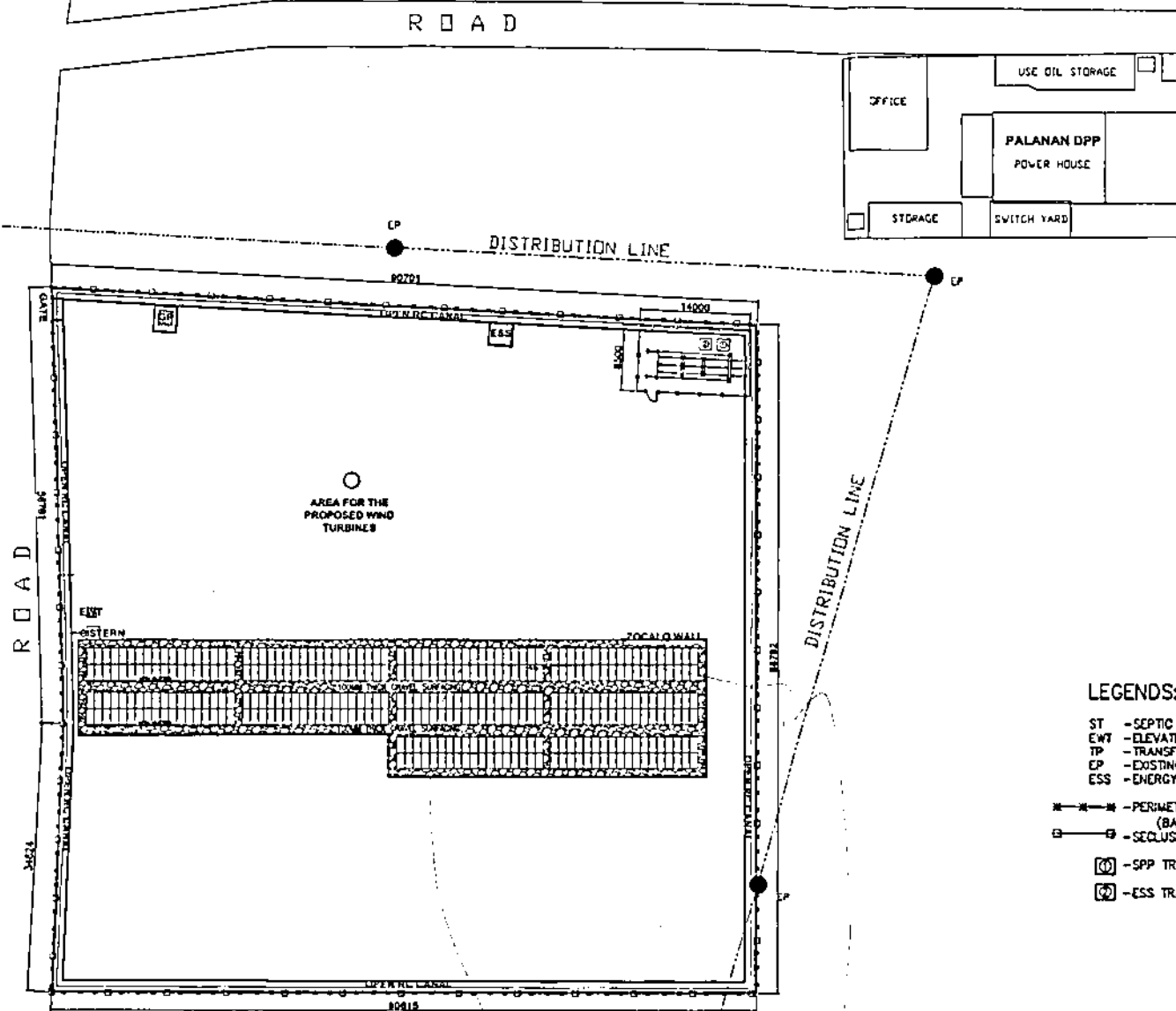
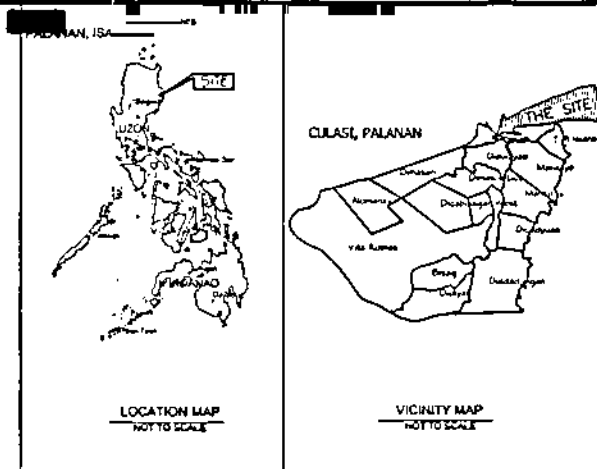


**TABLE OF CONTENTS
BID DRAWINGS****CW – CIVIL WORKS**

<u>DRAWING NO.</u>	<u>TITLE</u>
PalSPV-BDC-17.001	SITE DEVELOPMENT PLAN (Palanan Solar Power Plant)
PalSPV-BDC-17.002	DRAINAGE PLAN (Palanan Solar Power Plant)
PalSPV-BDC-17.003	TYPICAL MOUNTING STRUCTURE (Foundation Plan, Section & Details)
PalSPV-BDC-17.004	TYPICAL MOUNTING STRUCTURE (Frame & Details)
PalSPV-BDC-17.005	TYPICAL MOUNTING STRUCTURE (Frame & Details)
PalSPV-BDC-17.006	TYPICAL MOUNTING STRUCTURE (Frame Layout)
PalSPV-BDC-17.007	TYPICAL MOUNTING STRUCTURE (Front & Rear Elevation)
PalSPV-BDC-17.008	TYPICAL MOUNTING STRUCTURE (Rear Elevation with Inverter and combiner Box)
PalSPV-BDC-17.009	TYPICAL MOUNTING STRUCTURE WITH GUTTER & DETAILS OF GUTTER SUPPORT (Front Elevation & Isometric View)
PalSPV-BDC-17.010	TYPICAL CISTERN, GUTTER ELEVATION & OPEN RC CANAL (Section & Details)
PalSPV-BDC-17.011	CISTERN (Section & Details)
PalSPV-BDC-17.012	ELEVATED WATER STORAGE TANK (Plan, Section, Elevation & Details)



PaISPV-BDC-17.013	ENTRANCE GATE & PERIMETER FENCE (Elevation, Section & Details)
PaISPV-BDC-17.014	SECLUSION FENCE & PEDESTRIAN GATE (Plan, Sections & Details)
PaISPV-BDC-17.015	DIRECT BURIED STEEL POLE (Section & Details)
PaISPV-BDC-17.016	TRANSFORMER PAD (Plan, Sections & Details)
PaISPV-BDC-17.017	ESS STORAGE SYSTEM (ESS Foundation Detail)
PaISPV-BDC-17.018	GUARDPOST (Solar Power Plant)



LEGENDS:

- ST - SEPTIC TANK
- EWT - ELEVATED WATER TANK
- TP - TRANSFORMER PAD
- EP - EXISTING ELECTRICAL POLE
- ESS - ENERGY STORAGE SYSTEM
- PERIMETER FENCE (BARBED WIRE)
- SECURSION FENCE
- SPP TRANSFORMER
- ESS TRANSFORMER

NOTES:

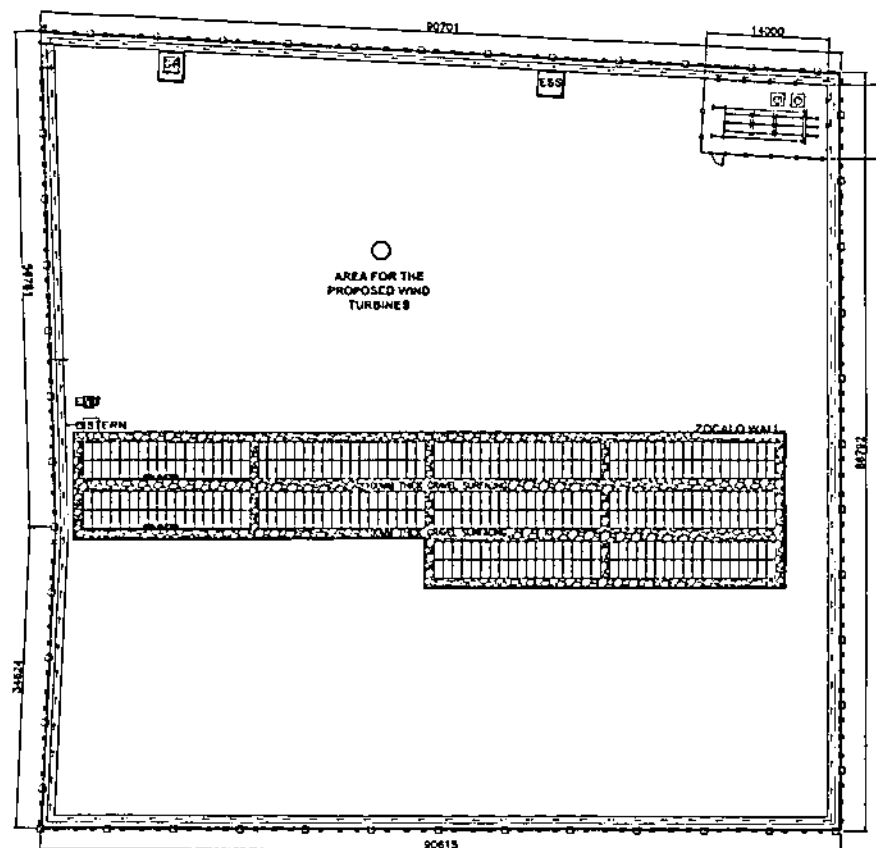
- ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE INDICATED.
- ELEVATIONS ARE IN METER UNLESS OTHERWISE SPECIFIED.
- THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS PRIOR TO CONSTRUCTION. THE NPC SHALL BE NOTIFIED OF ANY DISCREPANCIES OR INCONSISTENCIES.

OWNER		NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT: DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV DIESEL HYBRID SYSTEM (WITH ESS)			
LOCATION: CULASI, PALANAN, PALAW			
TITLE: SITE DEVELOPMENT PLAN (PALANAN SOLAR POWER PLANT)			
DESIGNED	BY	CHKD	DATE
DRAWN	BY	CHKD	DATE
REVIEWED	PRINCIPAL ENGR. / ARCHT.		
CIVIL/ARCHT			
ELEC			
MECH			
SUBMITTED		H. L. MENDOZA MUNICIPAL ENGINEER & C.E.O.	
RECOMMENDED		P. A. C. ESPIRITU MANAGER	
APPROVED		H. L. MENDOZA MANAGER, C.E.O.	
DWG NO P-ISP-V-BDC-17.001		SPEC NO LUZP21Z1221S	
SCALE: AS SHOWN		BID DRAWING	
REV.	DATE	NATURE OF REVISION	BY
CHKD	RECD	APPD	


P-ISP-V-BDC-17.001 SCALE 1:600




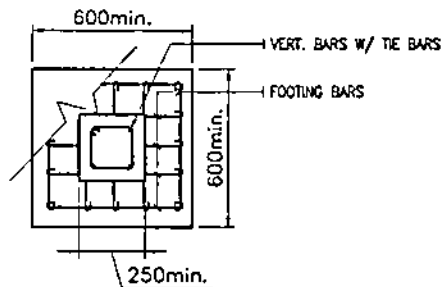
ST -SEPTIC TANK
EWT -ELEVATED WATER TANK
CS -CISTERN
GP -GUARDPOST
GP -TRANSFORMER PAD



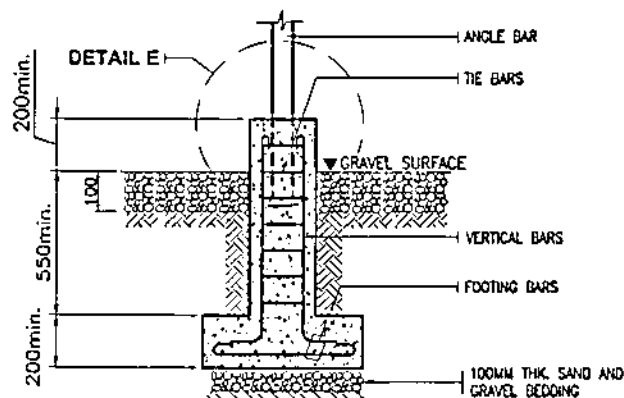
1. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE INDICATED.
2. ALL DRAINAGE APPURTENANT STRUCTURES SHALL BE CONSTRUCTED AT LOCATIONS INDICATED AT THE OTHER CONVENIENT LOCATIONS DESIGNATED BY THE NPC.
3. USE 17.30Mpa CONCRETE FOR ALL DRAINAGE APPURTENANT STRUCTURES UNLESS OTHERWISE INDICATED.
4. POLYVINYL CHLORIDE (PVC) PIPE SHALL BE UNPLASTICIZED CONFORMING TO ISO4433 OR EQUIVALENT.
5. MINIMUM SLOPE USED FOR DRAINAGE PIPE SYSTEM SHALL BE $S=0.25\%$.
6. ELEVATION AT TAPPING POINT SHALL BE VERIFIED TO SITE PRIOR TO CONSTRUCTION OF DRAINAGE.


DRAINAGE PLAN
 PalSPV-BQC-17.002 SCALE 1:500

OWNER		NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
			
PROJECT: DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV DIESEL HYBRID SYSTEM (WITH LES)			
LOCATION: CULAR, PALANAN BARBLA			
TITLE:		DRAINAGE PLAN (PALANAN SOLAR POWER PLANT)	
DESIGNED	BY	CHKD	DATE
DRAWN	<i>[Signature]</i>		
REVIEWED	PRINCIPAL ENG'R / ARCHT.		
CYCLER/ARCHT			
E.E.C.			
APPROVED			
DWG. NO. PalSPV-BDC-17.002		SPEC. NO. LuzP21Z1221S0	
SCALE: AS SHOWN		BID DRAWING	
NO.		REV. 0	



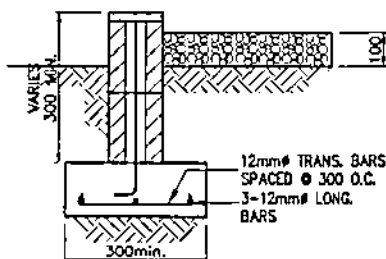
PLAN



SECTION B-B

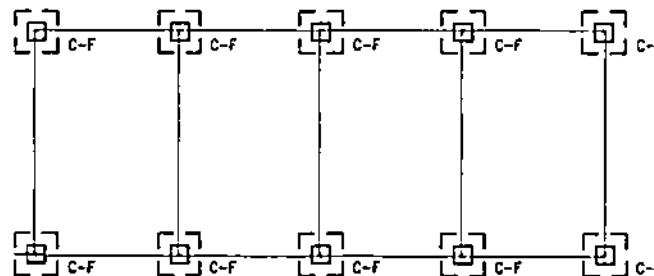
DETAILS OF C-F

PaISPV-BDC-17.003 SCALE NTS



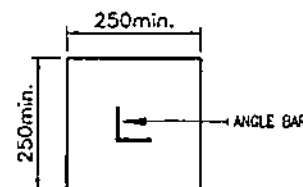
ZOCALO WALL

PaISPV-BDC-17.003 SCALE NTS

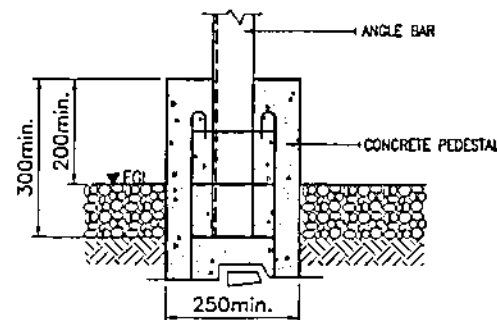


FOUNDATION PLAN

PaISPV-BDC-17.003 SCALE NTS



PLAN



SECTION

DETAIL E

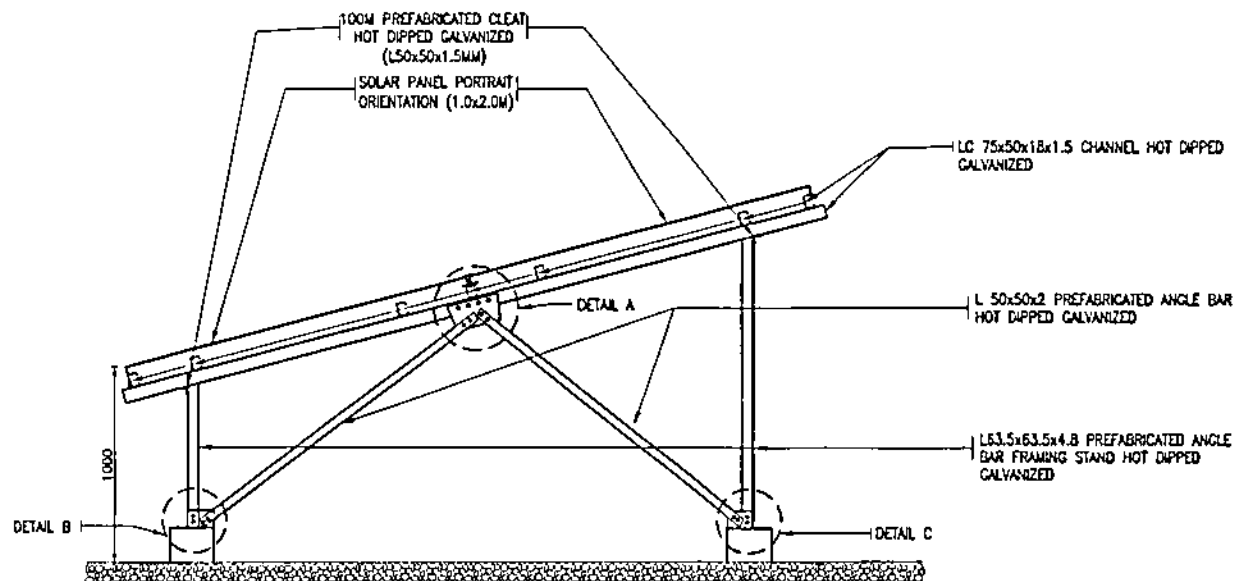
PaISPV-BDC-17.003 SCALE NTS

NOTES:

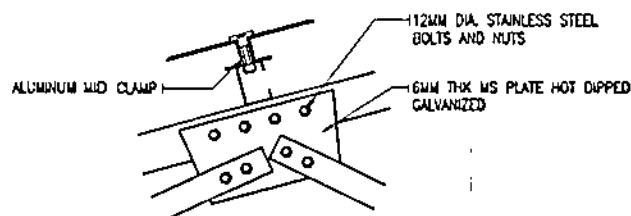
1. MINIMUM COMPRESSIVE STRENGTH OF CONCRETE SHALL BE 20.7MPa AT 28 DAY PERIOD.
2. REINFORCING STEEL BARS SHALL CONFORM TO LATEST REQUIREMENTS OF PHS FOR DEFORMED STEEL BARS GRADE 275.
3. ALLOWABLE BEARING CAPACITY OF SOIL SHALL NOT BE LESS THAN 15,000 KG/M².
4. ALL ASPECTS OF CONSTRUCTION AND DETAILING OF REINFORCEMENTS SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF ACI CODE.
5. DEGREE OF COMPACTION OF BACKFILL SHALL BE 90% OF RELATIVE DENSITY.
6. THE DESIGN OF THE FOUNDATION SHALL BE PREPARED BY THE SUPPLIER SUBJECT TO NPC'S REVIEW AND APPROVAL. FINAL DIMENSION SHALL BE IN CONSIDERATION OF THE MINIMUM REQUIREMENTS.
7. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.

OWNER:		NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT: DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV ORBES HYBRID SYSTEM (WITH ESR)			
LOCATION: CULAB, PALANAN, ISABELA			
TITLE: TYPICAL MOUNTING STRUCTURE (FOUNDATION PLAN, SECTION & DETAILS)			
DESIGNED	BY	CHKD	DATE
DRAWN	BY	CHKD	DATE
REVIEWED	PRINCIPAL ENGINEER / ARCHT.		RECOMMENDED
CALCULATED			APPROVED
ELEC.			
MECH.			
DWG NO PaISPV-BDC-17.003		SPECS NO Lu2P21Z1221S@	
SCALE: AS SHOWN		BID DRAWING	

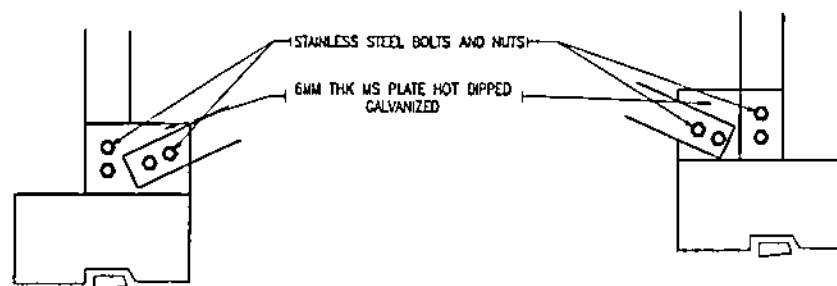
REV.	DATE	NATURE OF REVISION	BY	CHKD	RECD	APPD



FRAME
PaISPV-BQC-17.004 SCALE NTS



DETAIL A
PaISPV-BQC-17.004 SCALE NTS




DETAIL B
PaISPV-BQC-17.004 SCALE NTS

DETAIL C
PaISPV-BQC-17.004 SCALE NTS

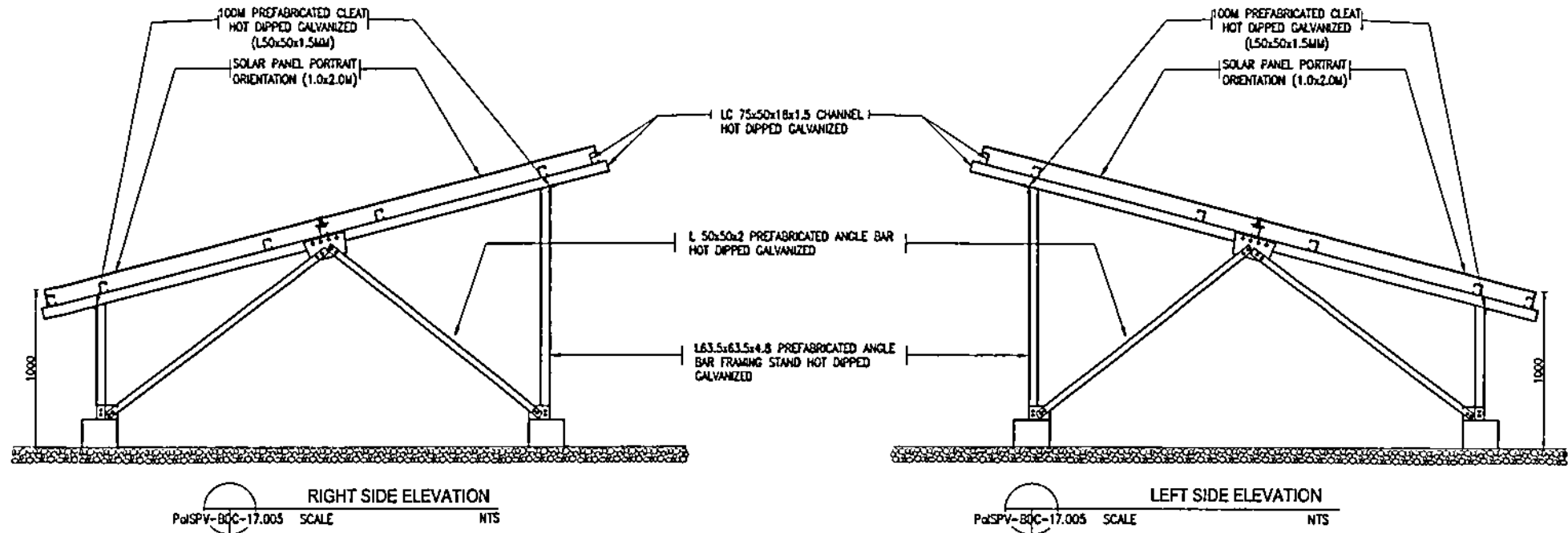
NOTES:


1. USE STRUCTURAL GRADE STEEL SHAPES, BARS AND PLATES CONFORMING TO ASTM A36.
2. ALL STRUCTURAL STEEL SHALL BE FABRICATED AND ERECTED IN ACCORDANCE WITH THE AISC SPECIFICATIONS AND CODE OF STANDARD PRACTICE.
3. ALL ANGULAR BARS ARE HOT DIP GALVANIZED IN ACCORDANCE WITH THE LATEST EDITION OF THE ASTM A123.
4. THESE DRAWINGS ARE FOR BIDDING PURPOSES ONLY. THE SUPPLIER SHALL SUBMIT THE APPROPRIATE DESIGN FOR THE MOUNTING STRUCTURE SUBJECT TO NPC'S REVIEW AND APPROVAL.
5. THE INCLINATION ANGLE OF THE SOLAR PANELS MUST BE 10°.

OWNER		 NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT: DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALAMAY SOLAR PV DIESEL HYBRID SYSTEM (PHN 138)			
LOCATION: CULASI, PALAMAY, ISABELA			
TITLE: TYPICAL MOUNTING STRUCTURE (FRAME & DETAILS)			
DESIGNED	BY	CHKD	DATE
DRAWN	BY	CHKD	DATE
REVIEWED	PRINCIPAL ENGR / ARCHT.		RECOMMENDED
CIVIL/ARCHT			
ELEC			APPROVED
MECH			
DWG. NO PaISPV-BQC-17.004		SPEC. NO LuzP2121215e	
SCALE: AS SHOWN		BID DRAWING	
REV.	DATE	NATURE OF REVISION	BY

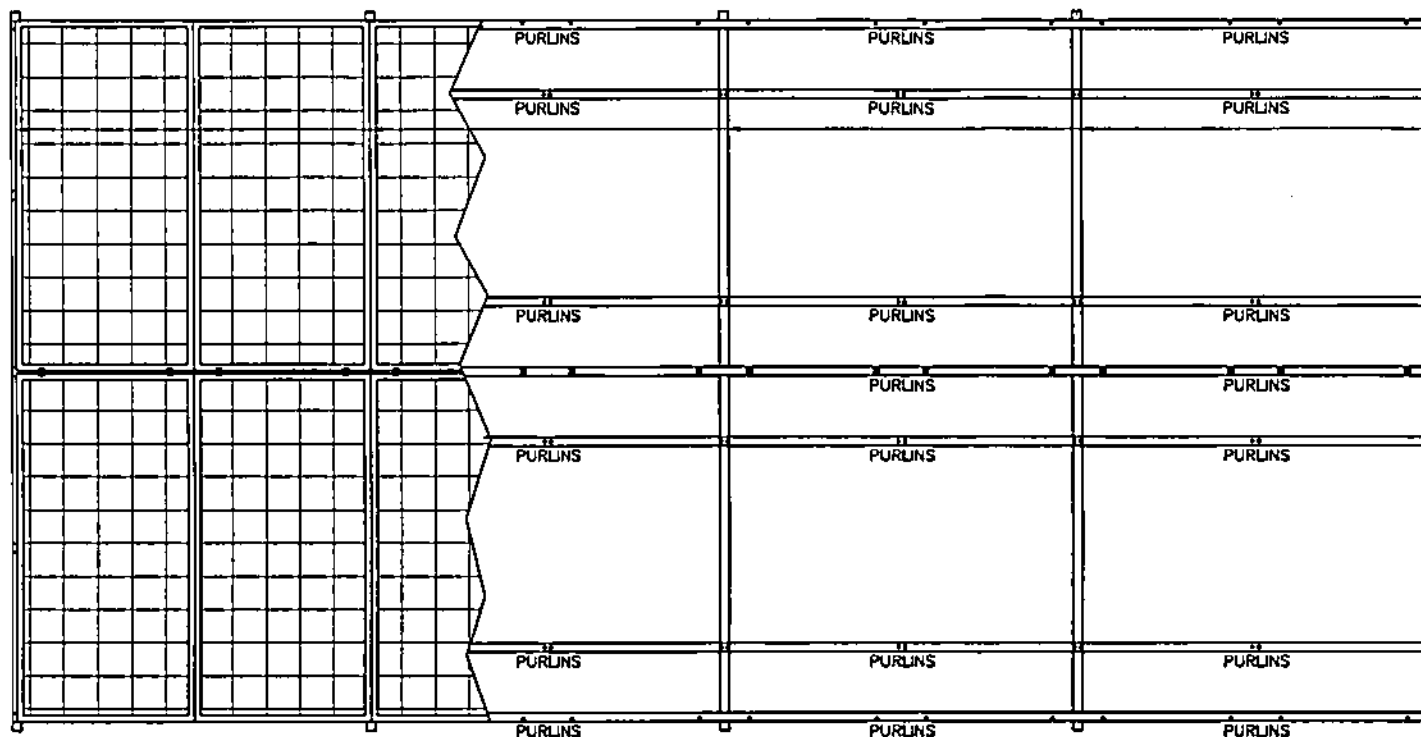
NOTES:

1. USE STRUCTURAL GRADE STEEL SHAPES, BARS AND PLATES CONFORMING TO ASTM A36.
2. ALL STRUCTURAL STEEL SHALL BE FABRICATED AND ERECTED IN ACCORDANCE WITH THE AISC SPECIFICATIONS AND CODE OF STANDARD PRACTICE.
3. ALL ANGULAR BARS ARE HOT DIP GALVANIZED IN ACCORDANCE WITH THE LATEST EDITION OF THE ASTM A123.
4. THESE DRAWINGS ARE FOR BIDDING PURPOSES ONLY. THE SUPPLIER SHALL SUBMIT THE APPROPRIATE DESIGN FOR THE MOUNTING STRUCTURE SUBJECT TO NPC'S REVIEW AND APPROVAL.
5. THE INCLINATION ANGLE OF THE SOLAR PANELS MUST BE 10°.



OWNER:		 NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT: DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALAMAN SOLAR PV (GRID, HYBRID SYSTEM WITH ESS)			
LOCATION: CULAB, PALAMAN, ISABELA			
TITLE: TYPICAL MOUNTING STRUCTURE (FRAME & DETAILS)			
DESIGNED	BY	CHKD	DATE
DRAWN	BY	CHKD	DATE
REVIEWED	PRINCIPAL ENGR./ARCHT.		RECOMMENDED
CIVIL/ARCHT			
ELEC			
MECH			
SUBMITTED:		H. L. MENDOZA PRINCIPAL ENGINEER, C&D	
APPROVED:		J. A. C. ESPIRITU MANAGER, C&D	
DWG. NO. PaISPV-BDC-17.005		SPEC. NO. L122P21Z1221Se	
SCALE: AS SHOWN		BID DRAWING REV. 0	

REV.	DATE	NATURE OF REVISION	BY	CHKD	RECD	APPD.




FRAMES

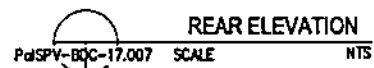
STAINLESS STEEL BOLTS AND NUTS

NOTES:



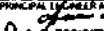
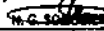
1. USE STRUCTURAL GRADE STEEL SHAPES, BARS AND PLATES CONFORMING TO ASTM A36.
2. ALL STRUCTURAL STEEL SHALL BE FABRICATED AND ERECTED IN ACCORDANCE WITH THE AISC SPECIFICATIONS AND CODE OF STANDARD PRACTICE.
3. ALL ANGULAR BARS ARE HOT DIP GALVANIZED IN ACCORDANCE WITH THE LATEST EDITION OF THE ASTM A123.
4. THESE DRAWINGS ARE FOR BIDDING PURPOSES ONLY. THE SUPPLIER SHALL SUBMIT THE APPROPRIATE DESIGN FOR THE MOUNTING STRUCTURE SUBJECT TO NPC'S REVIEW AND APPROVAL.

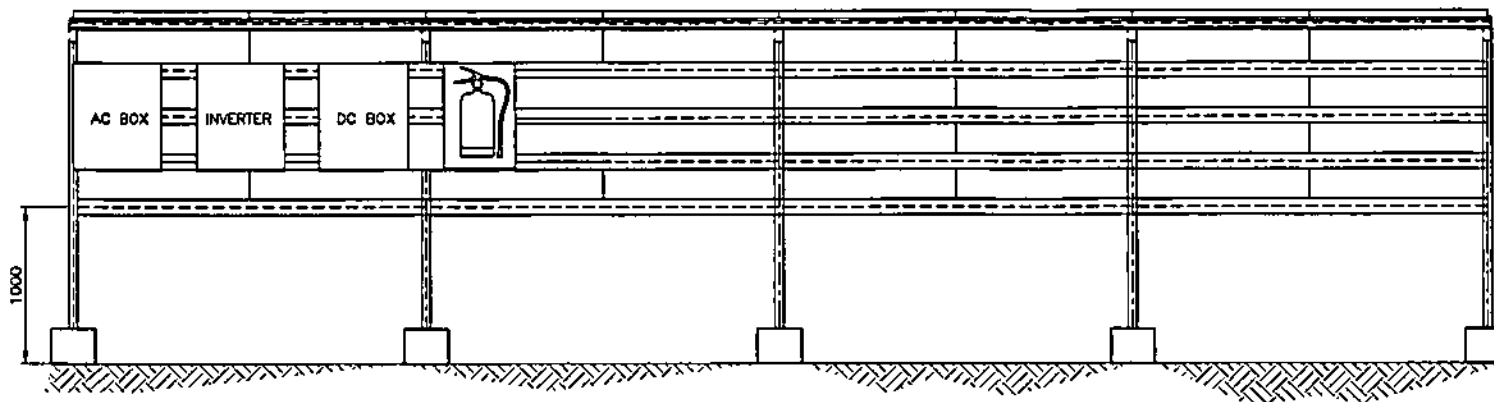
FRAME LAY-OUT
PaSPV-BDC-17.006 SCALE NTS

OWNER:				NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT: DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALAMAN SOLAR PHOTOVOLTAIC HYBRID SYSTEM (WITH ESS)					
LOCATION: CULAB, PALAMAN, MARABELA					
TITLE: TYPICAL MOUNTING STRUCTURE (FRAME LAYOUT)					
DESIGNED	BY	CHKD	DATE	SUBMITTED	
DRAWN					
REVIEWED	PRINCIPAL ENGR. / ARCHT.			RECOMMENDED	
CIVIL/ARCHT					
ELEC.				APPROVED	
MECH					
DWG NO PaISPV-BDC-17.006				SPEC NO LU2P21Z1221S	
REV.		DATE	NATURE OF REVISION	BY	CHKD
SCALE: AS SHOWN		BID DRAWING		REV. 0	

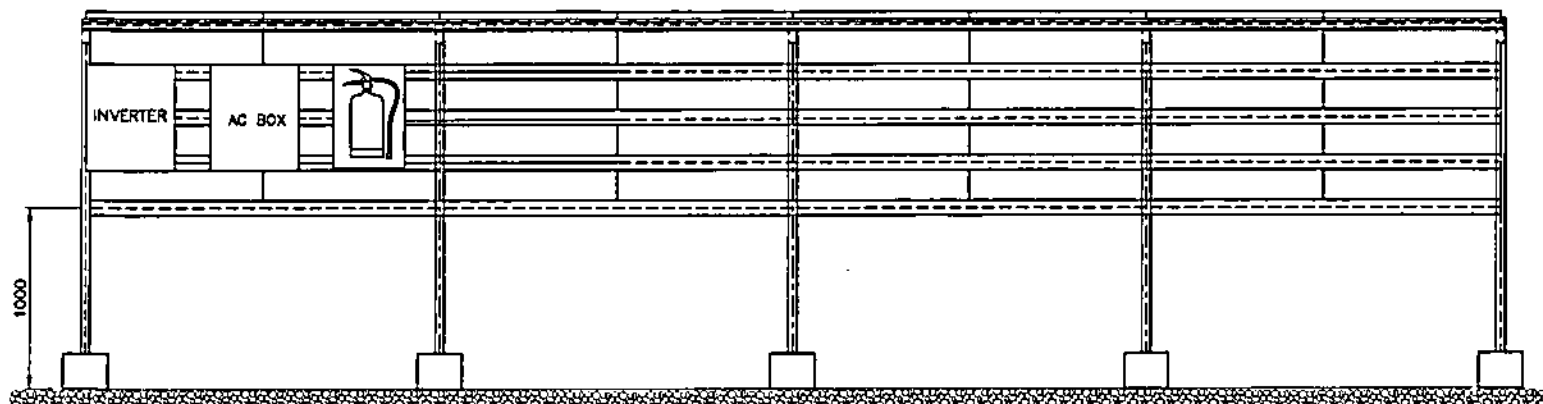


1. USE STRUCTURAL GRADE STEEL SHAPES, BARS AND PLATES CONFORMING TO ASTM A36.
2. ALL STRUCTURAL STEEL SHAPES BE FABRICATED AND ERECTED IN ACCORDANCE WITH THE AISC SPECIFICATIONS AND CODE OF STANDARD PRACTICE.
3. ALL ANGULAR BARS ARE NOT DIP GALVANIZED IN ACCORDANCE WITH THE LATEST EDITION OF THE ASTM A123.
4. THESE DRAWINGS ARE FOR BIDDING PURPOSES ONLY. THE SUPPLIER SHALL SUBMIT THE APPROPRIATE DESIGN FOR THE MOUNTING STRUCTURE SUBJECT TO NPC'S REVIEW AND APPROVAL.

OWNER		 AGHAM POWER CORPORATION AGHAM ROAD, OILMAN, QUEZON CITY	
PROJECT: DESIGN, SUPPLY, DELIVER, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV (DESAL HYDRO SYSTEM) (WITH ES&E)			
LOCATION: CULASE, PALANAN, ISABELA			
TITLE TYPICAL MOUNTING STRUCTURE (FRONT & REAR ELEVATION)			
	BY	CHKD	DATE
DESIGNED	AG		
DRAWN	TH		
REVIEWED	PRINCIPAL ENGINEER / ARCHT.		
CIVIL/ARCHT			
ELEC.			
MECH.			
SUBMITTED		 M. L. MENDOZA PRINCIPAL ENGINEER & CHIEF 7/1/14	
RECOMMENDED		 P. A. C. ESPIRITU MANAGING DIRECTOR	
APPROVED		 M. G. SOLIMAN MANAGER, E&C	
DWG NO PaISPV-BDC-17.007		SPEC NO LUZP21Z1221S	




REAR ELEVATION WITH FIRE EXTINGUISHER, DC BOX, INVERTER & AC BOX
PaISPV-BDC-17.008 SCALE NTS



REAR ELEVATION WITH FIRE EXTINGUISHER, INVERTER & AC BOX
PaISPV-BDC-17.008 SCALE NTS

NOTES:

1. USE STRUCTURAL GRADE STEEL SHAPES, BARS AND PLATES CONFORMING TO ASTM A36.
2. ALL STRUCTURAL STEEL SHALL BE FABRICATED AND ERECTED IN ACCORDANCE WITH THE AISC SPECIFICATIONS AND CODE OF STANDARD PRACTICE.
3. ALL ANGULAR BARS ARE HOT DIP GALVANIZED IN ACCORDANCE WITH THE LATEST EDITION OF THE ASTM A123.
4. THESE DRAWINGS ARE FOR BIDDING PURPOSES ONLY. THE SUPPLIER SHALL SUBMIT THE APPROPRIATE DESIGN FOR THE MOUNTING STRUCTURE SUBJECT TO NPC'S REVIEW AND APPROVAL.
5. LOCATION OF DC BOX, AC BOX, INVERTER AND FIRE EXTINGUISHER SHALL BE REFERRED TO ELECTRICAL DRAWINGS.

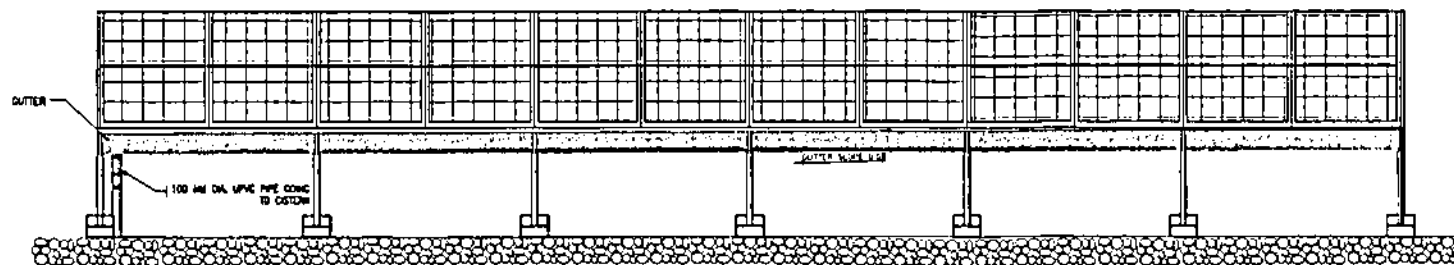
OWNER				NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT: DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH E&E)					
LOCATION: CUBALE, PALANAN, ISABELA					
TITLE: TYPICAL MOUNTING STRUCTURE (REAR ELEVATION WITH INVERTER AND COMBINER BOX)					
DESIGNED	BY	CHKD	DATE	SUBMITTED	
DRAWN					
REVIEWED	PRINCIPAL ENGR. / ARCHT.			RECOMMENDED	
CIVIL/ARCHT					
ELEC				APPROVED	
MECH					
DWG NO PaISPV-BDC-17.008				SPECS NO LUZP21212215e	
SCALE: AS SHOWN				BID DRAWING	
REV. 0					

REV.	DATE	NATURE OF REVISION	BY	CHKD	RECD	APPR.

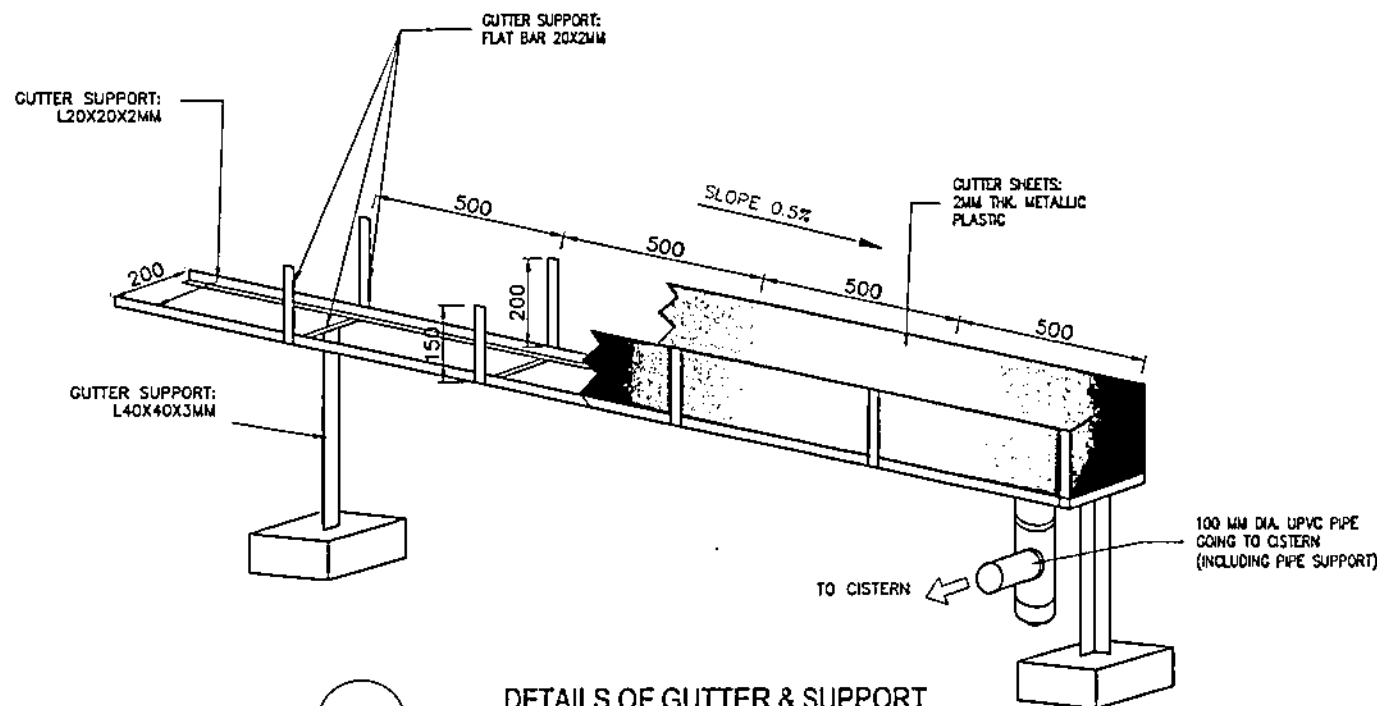
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE INDICATED.
2. THESE DRAWINGS ARE FOR BIDDING PURPOSES ONLY. THE SUPPLIER SHALL SUBMIT THE APPROPRIATE DESIGN FOR THE MOUNTING STRUCTURE SUBJECT TO NPC'S REVIEW AND APPROVAL.


GUTTER SLOPE = 0.5%



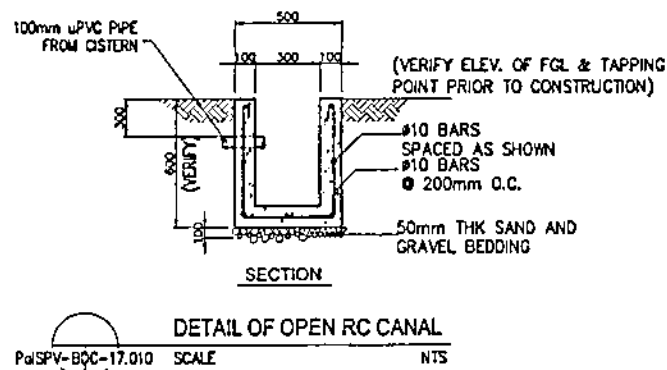
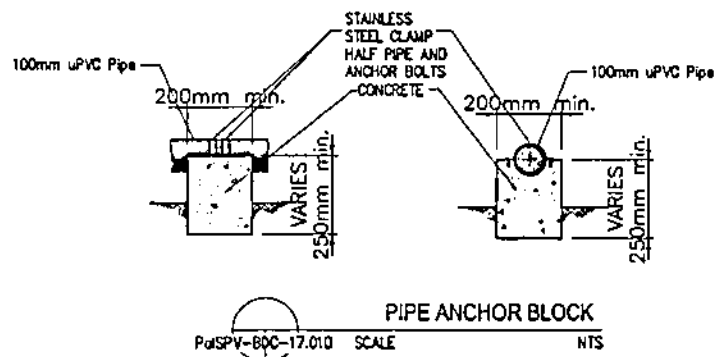
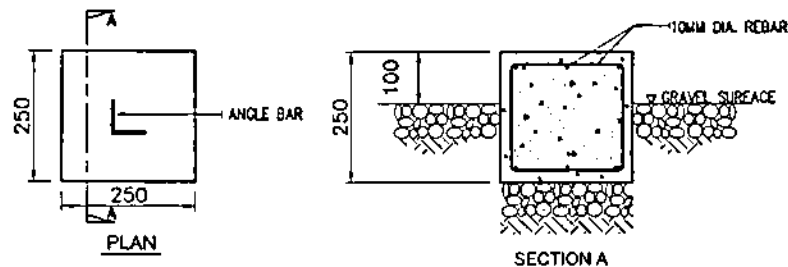
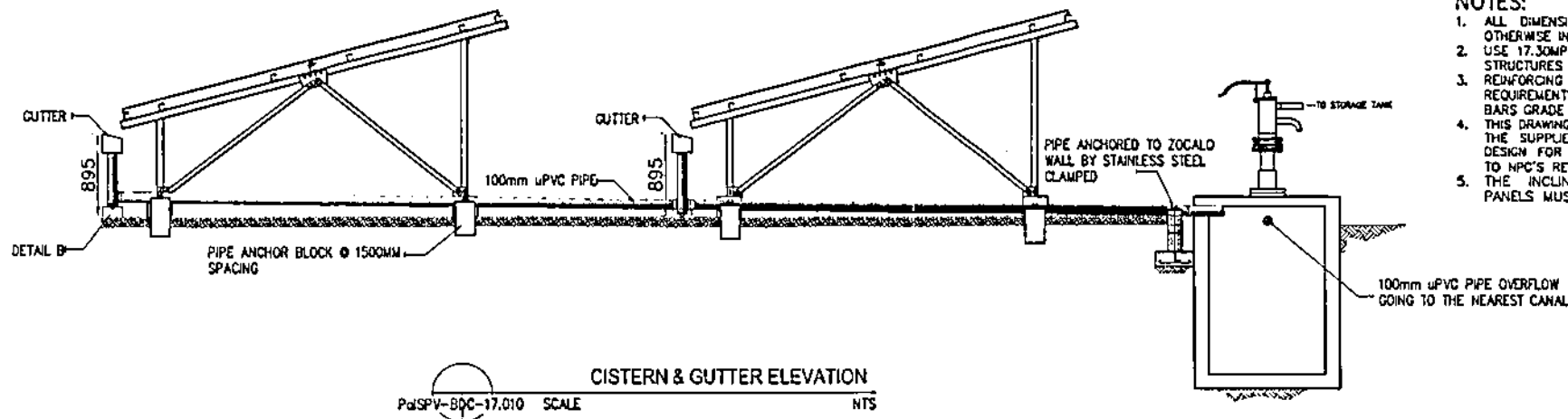
PalSPV-BDC-17.009 SCALE NTS
FRONT VIEW ELEVATION WITH GUTTER



PalSPV-BDC-17.009 SCALE NTS
DETAILS OF GUTTER & SUPPORT

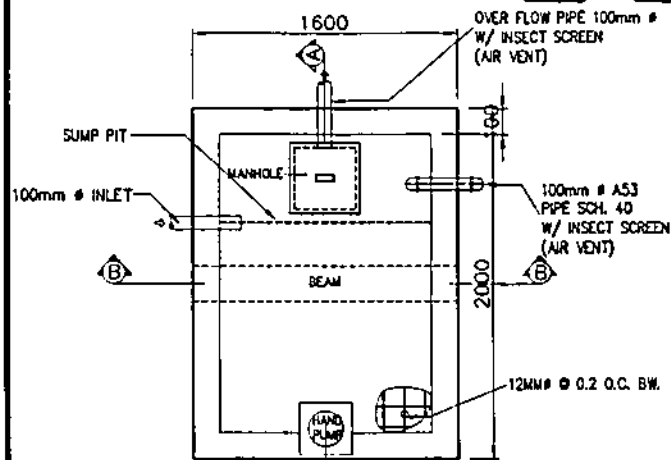
OWNER		 NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT: DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV DIESEL HYBRID SYSTEM (WITH ESS)			
LOCATION: CULASI, PALANAN, ISABELA			
TITLE: TYPICAL MOUNTING STRUCTURE WITH GUTTER & DETAILS OF GUTTER SUPPORT (FRONT ELEVATION & ISOMETRIC VIEW)			
DESIGNED	BY	CHKD	DATE
DRAWN			
REVIEWED	PRINCIPAL ENGINEER/ARCHT.		RECOMMENDED
CIVIL/ARCHT			
ELEC.			APPROVED
MECH			
DWG NO PalSPV-BDC-17.009		SPEC NO LuzP21Z1221S9	
SCALE: AS SHOWN		BID DRAWING	

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.

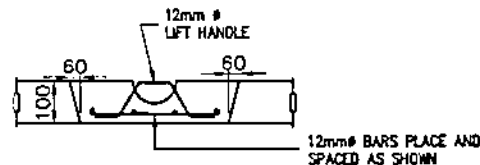


- NOTES:**
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE INDICATED IN THE DRAWING.
 2. USE 17.30MPa CONCRETE FOR ALL APPURTENANT STRUCTURES UNLESS OTHERWISE INDICATED.
 3. REINFORCING STEEL BARS SHALL CONFORM TO THE REQUIREMENTS OF THE PNS FOR DEFORMED STEEL BARS GRADE 275.
 4. THIS DRAWINGS ARE FOR BIDDING PURPOSES ONLY. THE SUPPLIER SHALL SUBMIT THE APPROPRIATE DESIGN FOR THE CISTERN AND GUTTER SUBJECT TO NPC'S REVIEW AND APPROVAL.
 5. THE INCLINATION ANGLE OF THE SOLAR PANELS MUST BE 10°.

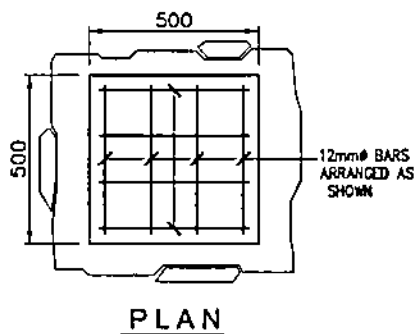
OWNER		NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT: URBAN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALAMAY SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS)			
LOCATION: CULASI, PALAMAY, MARBELA			
TITLE: TYPICAL CISTERN, GUTTER ELEVATION & OPEN RC CANAL (SECTION & DETAILS)			
DESIGNED	BY: <i>HL</i>	CHECK	DATE
DRAWN	BY: <i>HL</i>	SUBMITTED	H. L. MENDOZA PRINCIPAL ENGINEER/LEAD 9/14
REVIEWED	PRINCIPAL ENGR / ARCHT.	RECOMMENDED	D. A. C. ESPIRITU PRINCIPAL ENGINEER/LEAD 9/14
CIVIL/ARCHT		APPROVED	N. O. SORIANO MANAGER / LEO
ELEC			
MECH			
DWG NO PdSPV-BDC-17.010		SPEC NO LUZP21Z12215e	
REV. DATE		NATURE OF REVISION	
BY	CHECK	RECD	APPRO
SCALE: AS SHOWN		BID DRAWING	
		REV. 8	



PLAN
SCALE 1:30



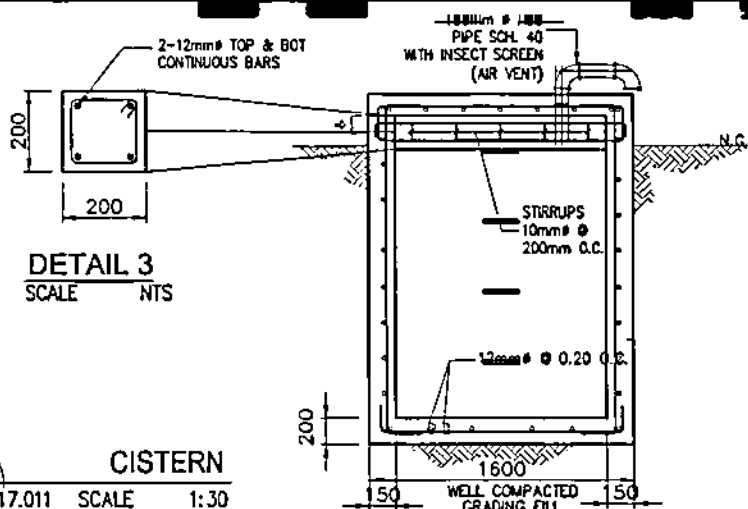
SECTION



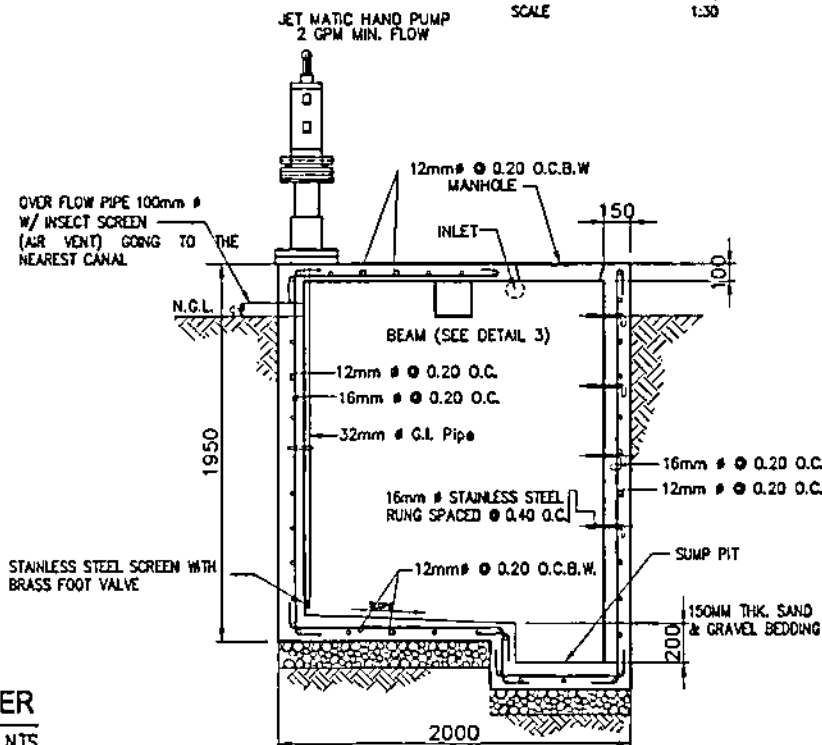
PLAN

DET. OF MANHOLE COVER
PdISPV-BDC-17.011 SCALE NTS

CISTERN
PdISPV-BDC-17.011 SCALE 1:30



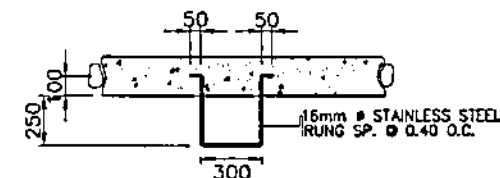
SECTION B - B
SCALE 1:30



SECTION A - A
SCALE 1:30

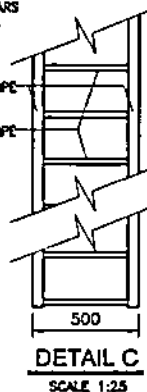
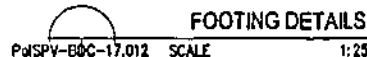
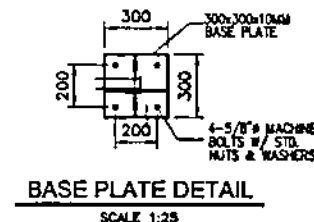
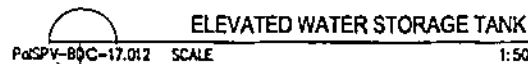
NOTES:

1. FLOORING, WALL AND ROOFING SHALL BE REINFORCED CONCRETE, FLOOR AND ROOF THICKNESS SHALL BE 150MM AND WALLS SHALL BE 200MM.
2. ALL DIMENSIONS, ELEVATIONS AND SPACING OF REBARS ARE IN METERS UNLESS OTHERWISE SPECIFIED.
3. MINIMUM COMPRESSIVE STRENGTH OF CONCRETE SHALL BE $f_c = 20.70 \text{ MPa}$ AT 28 DAYS PERIOD.
4. REINFORCING BARS SHALL CONFORM TO THE LATEST REQUIREMENTS OF PNS FOR US8 GRADE 275.
5. ALLOWABLE BEARING CAPACITY OF SOIL SHALL NOT BE LESS THAN 144 KPa.
6. ALL ASPECTS OF CONSTRUCTION AND DETAILING OF REINFORCEMENTS SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE ACI CODE.
7. INTEGRAL WATER PROOFING ADMIXTURES SHALL BE ADDED DURING CONCRETE BATCHING IN PROPORTIONS AS PER MANUFACTURERS RECOMMENDATION TO PREVENT WATER SEEPAGE.




DETAIL OF LADDER RUNG
SCALE 1:30

OWNER		NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT: DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH LBS)			
LOCATION: CULAN, PALANAN, ISABELA			
TITLE: CISTERN (SECTION & DETAILS)			
DESIGNED	BY	CHKD	DATE
DRAWN	BY	CHKD	DATE
REVIEWED	PRINCIPAL ENGR. / ARCHT.		RECOMMENDED
CIVIL/ARCHT			APPROVED
ELEC			
MECH			
Dwg. No PdISPV-BDC-17.011		Spec. No LuzP2121221Se	
SCALE: AS SHOWN		BID DRAWING	
REV.	DATE	NATURE OF REVISION	BY



1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE INDICATED.
2. MINIMUM COMPRESSIVE STRENGTH OF CONCRETE SHALL BE $f'_c = 20.70$ MPA A @ 28 DAYS PERIOD.
3. REINFORCING BARS MUST CONFORM TO THE LATEST PMS FOR DSB GRADE 275.
4. DETAILS OF REINFORCING BARS (SPICES, BENDS, HOOKS, ETC.) SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF ACI CODE.
5. ALL STRUCTURAL STEEL SHALL CONFORM TO ASTM A36 AND SHALL HAVE A MINIMUM YIELD STRESS, $F_y = 248.20$ MPA.
6. ALL STRUCTURAL STEEL SHALL BE FABRICATED AND ERCTED IN ACCORDANCE WITH THE LATEST AISC SPECIFICATIONS AND CODE OF STANDARD PRACTICE.
7. BOLTS SHALL CONFORM TO ASTM A-307 UNLESS OTHERWISE INDICATED.
8. WELDS ON ALL GUSSET PLATES AND CONNECTIONS SHALL BE FILLET WELD ALL AROUND.
9. WELDING SHALL CONFORM TO E70 SERIES OF THE SPECIFICATIONS FOR MILD STEEL ARC WELDING ELECTRODES ASTM A233.
10. ALL GUSSET PLATES SHALL BE 10 MM THICK.
11. ALL ASPECTS OF CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE PROVISION OF NPG SPECIFICATIONS AND ACI CODE.

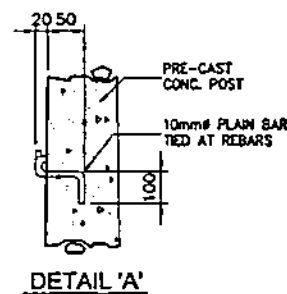
OWNER	 NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY
PROJECT:	15.8KV SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALAMAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH 12KW)
LOCATION:	CULASE, PALAMAN, ISABELA
TITLE:	ELEVATED WATER STORAGE TANK (PLAN, SECTION, ELEVATION & DETAILS)

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPR.
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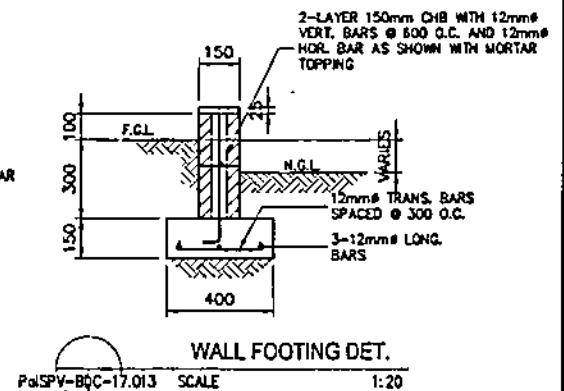
SCALE: AS SHOWN

BID DRAWING

REV. 11/10

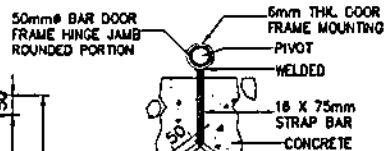


DETAIL 'A'

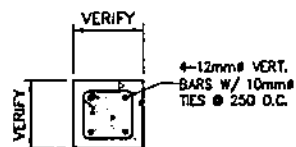


WALL FOOTING DET.

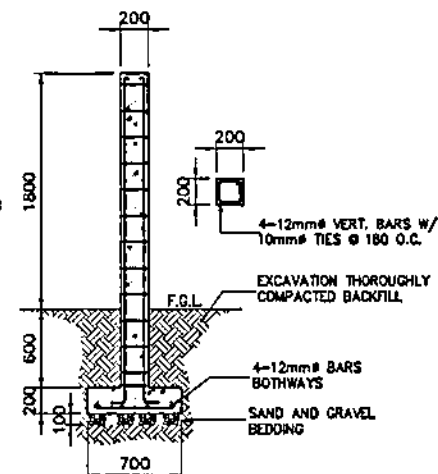
PolSPV-BQC-17.013 SCALE 1:20



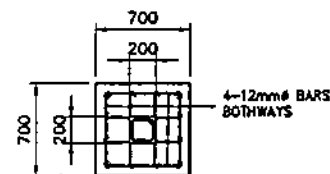
GATE HINGE



SECTION A-A



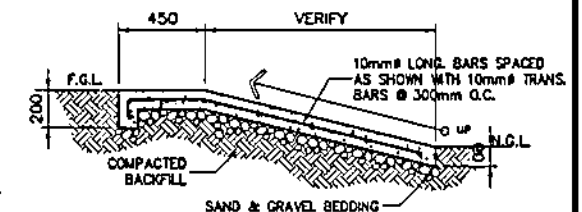
SECTION



PLAN

DET. OF GATE POST

PalSPV-80C-17.013 SCALE 1:40







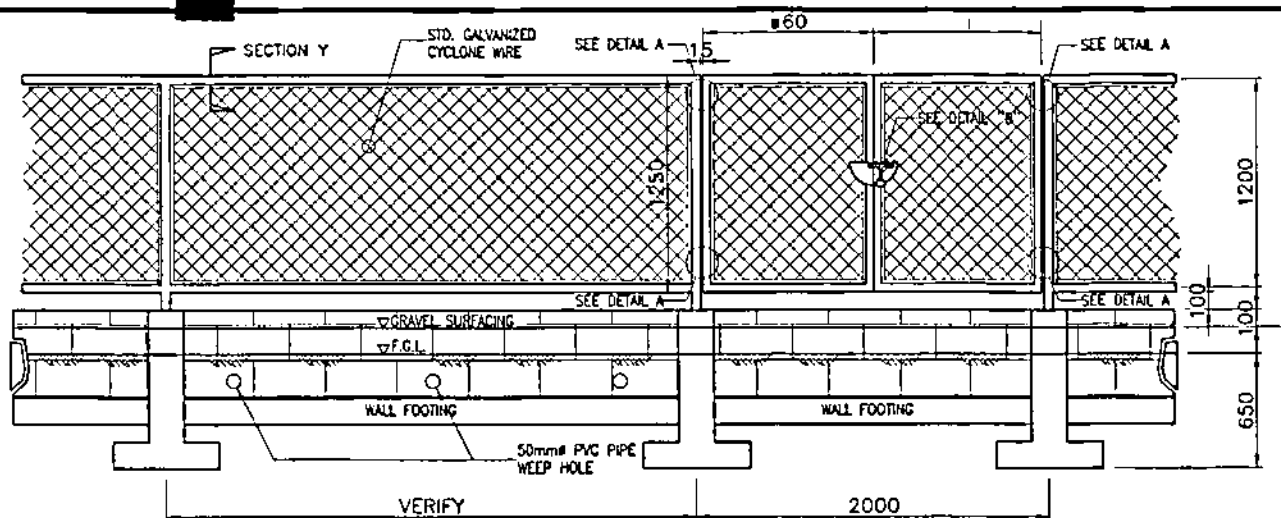
CONCRETE RAMP DET.

PolSPV-BQC-17.013 SCALE NTS

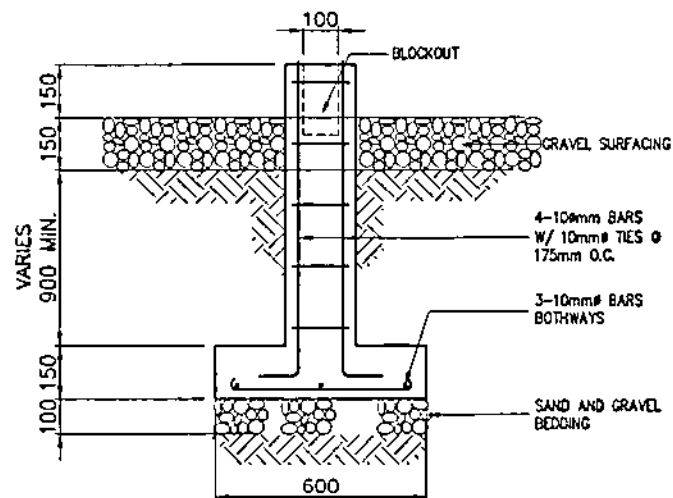
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE INDICATED IN THE DRAWING.

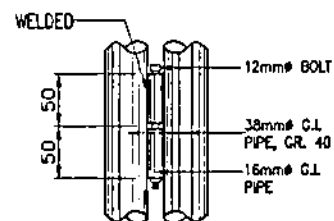
OWNER:		 NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT: DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALAMAM SOLAR PV-DIESEL HYBRID SYSTEM (WITH ISM)			
LOCATION: CULASI, PALAMAM, RABALA			
TITLE: ENTRANCE GATE & PERIMETER FENCE (ELEVATION, SECTION & DETAILS)			
DESIGNED	BY	CHECKED	DATE
DRAWN			
REVIEWED	PRINCIPAL ENGR. / NIGHT		
CIVIL/MARCH			
ELEC			
MECH			
SUBMITTED:		 M. L. MENDOZA PRINCIPAL ENGINEER IN CHARGE	
RECOMMENDED:		 A. C. ESPRITU 9/1/24 MANAGER	
APPROVED:		 M. G. S. MENDOZA MANAGER COO	
DWG NO PaISPV-BDC-17.013		SPEC NO LWSP21Z1221S	
SCALE: AS SHOWN		BID DRAWING	
REV 0			



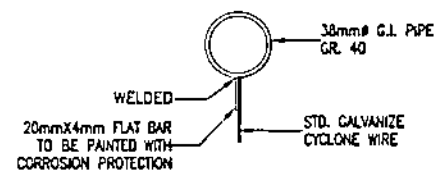
SECLUSION FENCE ELEVATION
PaISPV-BDC-17.014 SCALE 1:30



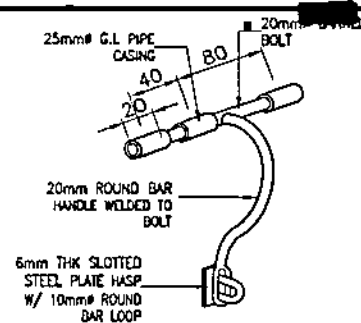
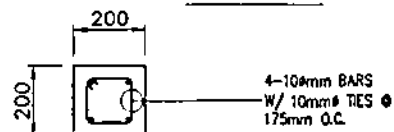
PEDESTAL FOOTING
PaISPV-BDC-17.014 SCALE 1:15



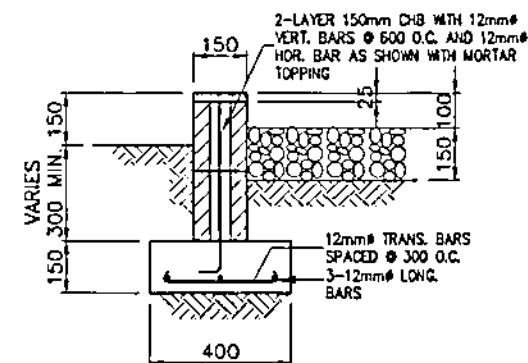
DETAIL 'A'



SECTION Y




DETAIL 'B'



WALL FOOTING
PaISPV-BDC-17.014 SCALE 1:15

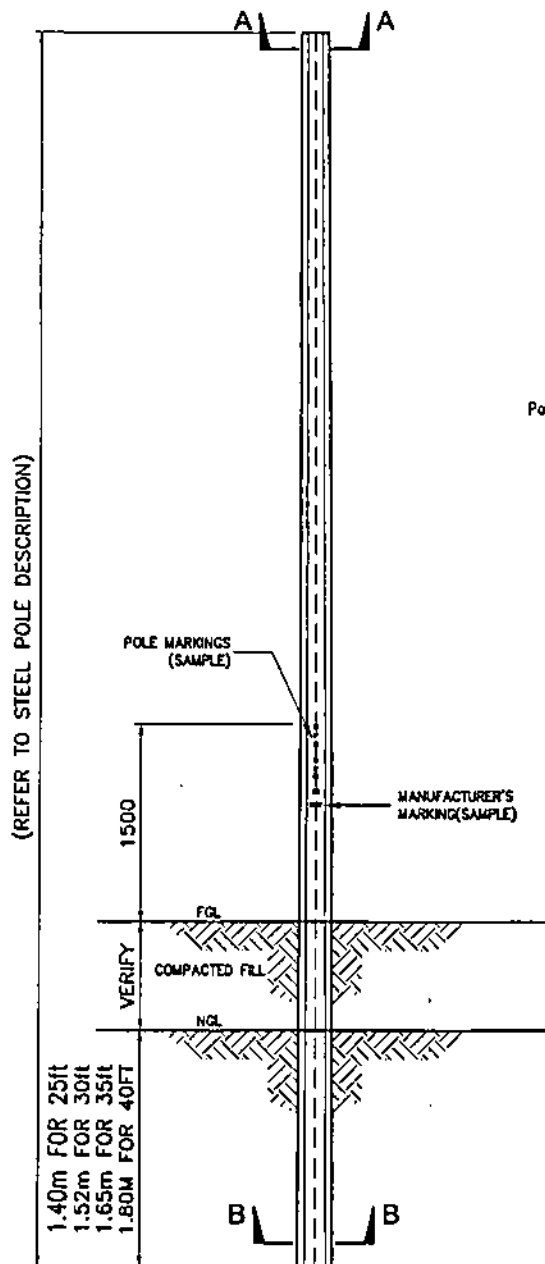
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE INDICATED.
2. PLAN/LAYOUT OF SECLUSION FENCE TO BE CONSTRUCTED ARE INDICATED IN ELECTRICAL DRAWING.
3. WORK THIS WITH ELECTRICAL DRAWINGS.

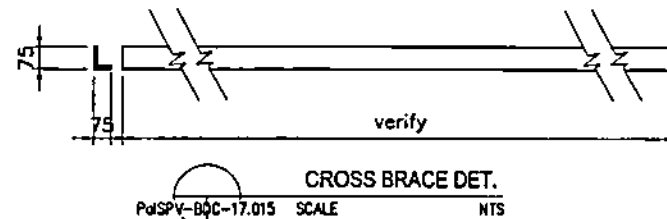
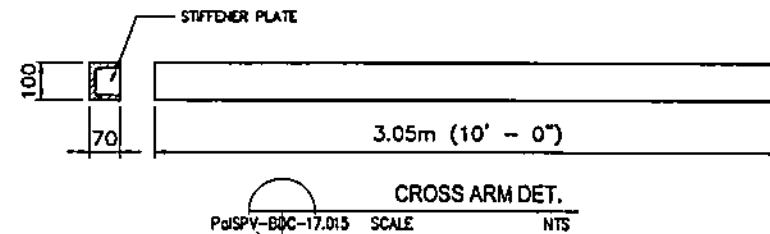
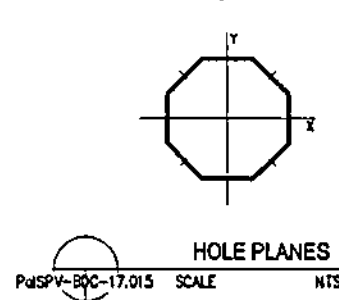
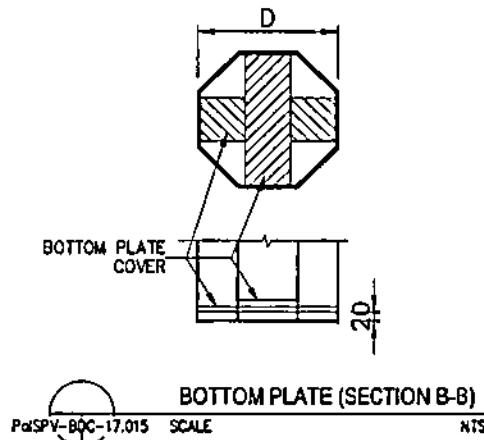
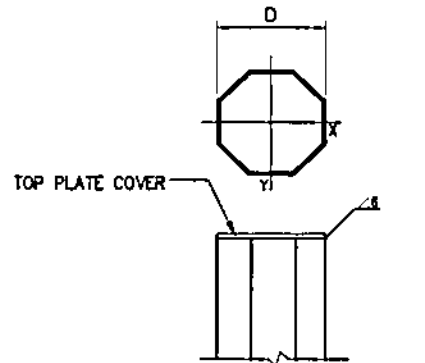
OWNER		 NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAH SOLAR PV DIESEL HYBRID SYSTEM (WITH E&S)			
LOCATION CULABEL, PALANAH, ISABELA			
TITLE SECLUSION FENCE & PEDESTRIAN GATE (PLAN, SECTIONS & DETAILS)			
DESIGNED	BY	CHKD	DATE
DRAWN	BY	CHKD	DATE
REVIEWED	PRINCIPAL ENGINEER / ARCHT.		RECOMMENDED
CONTRACT			APPROVED
ELEC.			
MECH.			
DWG NO PaISPV-BDC-17.014		SPECS NO LUZP21Z1221S@	
SCALE: AS SHOWN		BID DRAWING	
REV.		REV. 0	

REV.	DATE	NATURE OF REVISION	BY	CHKD	RECD	APPD

(REFER TO STEEL POLE DESCRIPTION)



ELEVATION OF STEEL POLE
PaSPV-BDC-17.015 SCALE 1:40



SHAFT INFORMATION

LENGTH	25 ft.	30 ft.	35ft.	40ft.
DESCRIPTION				
TIP DIAMETER	150mm	200mm	200mm	200mm
BUTT DIAMETER	240mm	260mm	300mm	320mm
THICKNESS	4mm	4mm	4mm	4mm

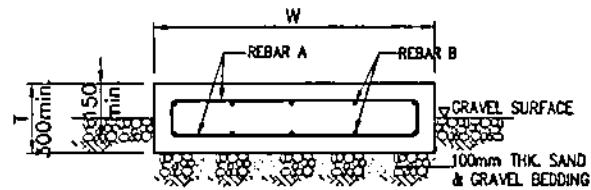
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. DRILL HOLES ON CENTERLINE OF POLE FACES.
3. HOLE LOCATION AND DIAMETER SHALL BE REFERRED TO ELECTRICAL DRAWINGS FOR DIFFERENT TYPES OF POLE.
4. POLES SHALL BE OCTAGONAL (8 SIDES) AND THE DIAMETERS ARE MEASURED ON THE OUTSIDE AND ACROSS THE FLAT SURFACES.
5. THE MATERIAL FOR POLE SHALL BE J45MPa (50ksi) MINIMUM YIELD STRENGTH OF ROLLED STEEL PLATE.
6. ALL POLES ARE HOT DIP GALVANIZED IN ACCORDING WITH ASTM A123M WITH MINIMUM COATING THICKNESS OF 85 MICRONS.
7. TIP AND BUTT OF POLES SHALL BE COVERED WITH PLATE SIMILAR TO SHAFT BODY THICKNESS.
8. CROSSARMS SHALL BE 6MM THICK BENDED CHANNEL SECTION PROVIDED WITH 6MM THICK STIFFENER PLATE WELDED AT 300MM ON CENTERS.
9. CROSS BRACES SHALL BE 6MM THICK ANGULAR SECTION, LENGTHS AND HOLE LOCATIONS SHALL BE REFERRED TO ELECTRICAL DRAWINGS.

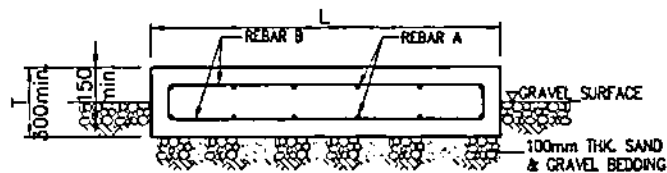
OWNER		NATIONAL POWER CORPORATION AGHAM ROAD, OILIMAN, QUEZON CITY	
PROJECT: DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH E&C)			
LOCATION: CULAR, PALANAN, ISABELA			
TITLE: DIRECT BURIED STEEL POLE (SECTION & DETAILS)			
DESIGNED	BY	CHKD	DATE
DRAWN	BY	CHKD	DATE
REVIEWED	PRINCIPAL ENGR./ARCHT.		RECOMMENDED
CIVIL/ARCHT			APPROVED
ELEC.			
MECH			
DWG NO PaSPV-BDC-17.015		SPEC NO Lu2P21Z1221S0	
SCALE: AS SHOWN		BID DRAWING	
REV. DATE		NATURE OF REVISION	
BY		CHKD. RECD. APPD.	

NOTES:

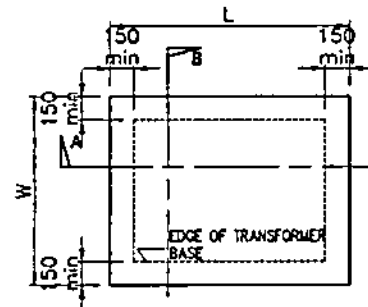
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE INDICATED IN THE DRAWING.
2. USE 17.30MPa CONCRETE FOR ALL APPURTENANT STRUCTURES UNLESS OTHERWISE INDICATED.
3. REINFORCING STEEL BARS SHALL CONFORM TO THE REQUIREMENTS OF THE PNS FOR DEFORMED STEEL BARS GRADE 275.



SECTION A




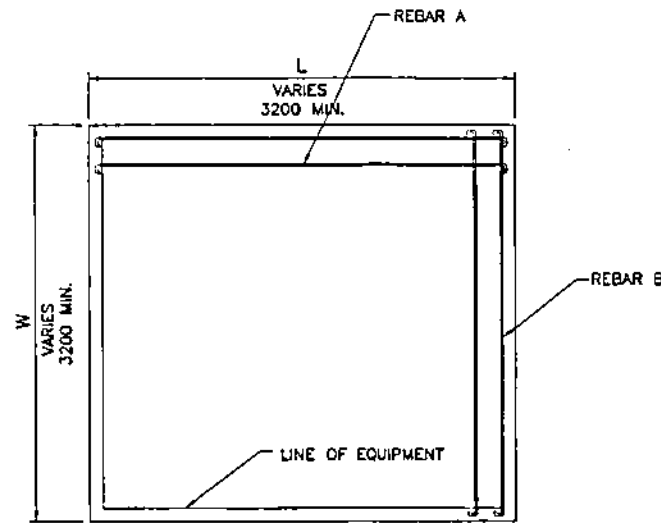
SECTION B



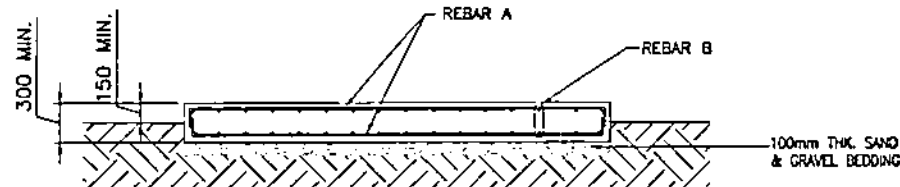
TRANSFORMER PAD

PaISPV-BDC-17.016 SCALE NTS

OWNER:		 NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT: DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV-DESEL HYBRID SYSTEM (PHASE 1)			
LOCATION: CULASE, PALANAN, TRABELLA			
TITLE: TRANSFORMER PAD (PLAN, SECTIONS & DETAILS)			
DESIGNED	BY	CHKD	DATE
DRAWN	BY	CHKD	DATE
REVIEWED	PRINCIPAL ENGR. / ARCHT.		RECOMMENDED
CHECKED			APPROVED
ELEC.			
MECH.			
DWG. NO PaISPV-BDC-17.016		SPEC. NO LUZP21Z1221S	
SCALE: AS SHOWN		BID DRAWING	
REV.	DATE	NATURE OF REVISION	BY
CHKD	RECD	APPD	



PLAN




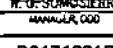


SECTION

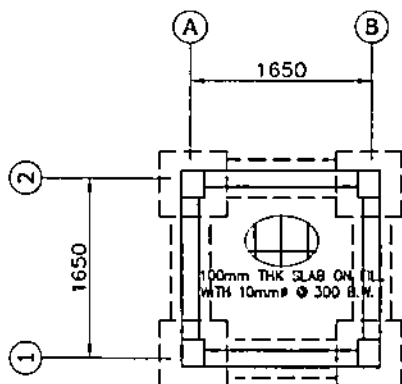
ESS FOUNDATION DETAIL
PaiSPV-BDC-17.017 SCALE 1:40

NOTES:

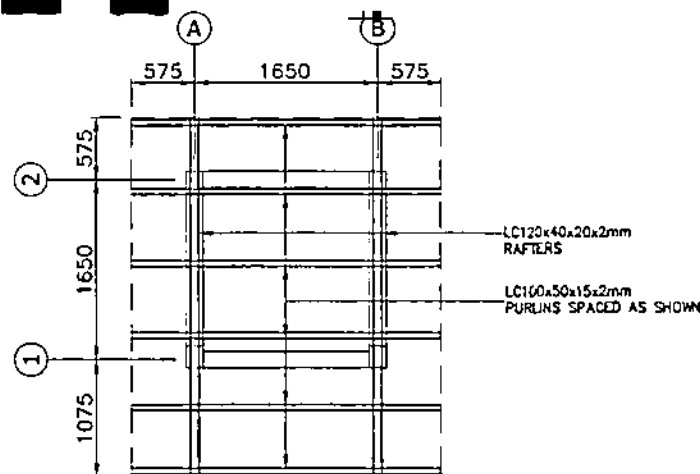
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. FOOTING DESIGN BASED ON ALLOWABLE SOIL PRESSURE OF 2,083 psf (100 KPa) AND TO BE VERIFY BASED ON ACTUAL SOIL CONDITION.
3. UNLESS OTHERWISE INDICATED IN THE PLANS OR NOTED IN THE SPECIFICATIONS, THE MINIMUM 28 DAY CYLINDER COMPRESSIVE STRENGTH OF CONCRETE SHALL BE 20.7MPa.
4. UNLESS OTHERWISE INDICATED SPECIFIED IN THE PLANS, THE MINIMUM YIELD STRENGTH OF REINFORCEMENT TO BE USED SHALL BE GRADE 40 (276MPa).
5. ALL REINFORCING STEEL SHALL BE DETAILED AND PLACED IN CONFORMANCE WITH ACI-318.
6. THE DESIGN OF THE FOUNDATION SHALL BE PREPARED BY THE SUPPLIER SUBJECT TO NPC'S REVIEW AND APPROVAL. FINAL DIMENSION SHALL BE IN CONSIDERATION OF THE MINIMUM REQUIREMENTS.

OWNER		 NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT: DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALAMAN SOLAR PV DESIGNED HYBRID SYSTEM WITH ESS			
LOCATION: CULASI, PALAMAN ISABELA			
TITLE: ENERGY STORAGE SYSTEM (ESS FOUNDATION DETAIL)			
DESIGNED	BY	CHKD	DATE
DRAWN	BY	CHKD	DATE
REVIEWED	PRINCIPAL ENGR / ARCHT.		RECOMMENDED
CIVIL/ARCHT			
ELEC.			
MECH.			
APPROVED:		 H. L. MENDOZA PROJECT MANAGER / CEO 9/24  P. A. C. ESPIRITU MANAGER / LEAD  H. O. SOMOLERA MANAGER / OOD	
DWG NO PaiSPV-BDC-17.017		SPECS NO LuzP21Z12215a	
SCALE: AS SHOWN		BID DRAWING	
REV. 0		REV. 0	

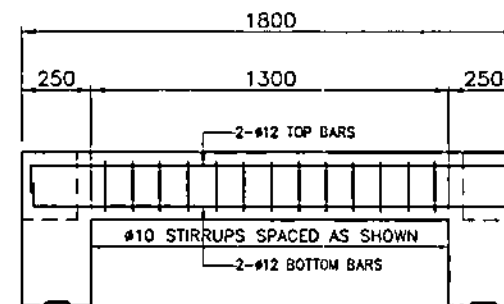
REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.



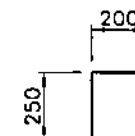
FOUNDATION PLAN
PaISPV-BDC-17.018 SCALE 1:50



ROOF FRAMING PLAN
PaISPV-BDC-17.018 SCALE 1:50

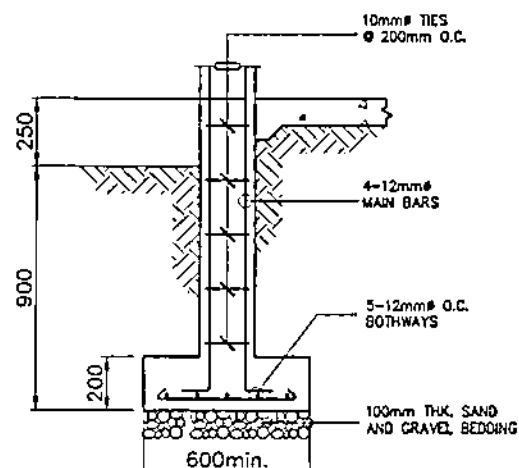


ELEVATION

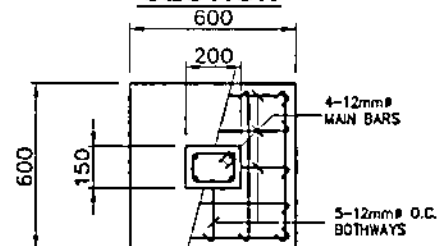


SECTION

ROOF BEAM
PaISPV-BDC-17.018 SCALE 1:50



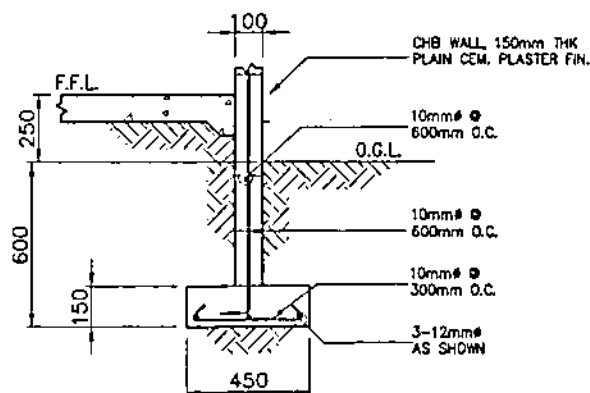
SECTION



PLAN

COLUMN FOOTING

PaISPV-BDC-17.018 SCALE 1:50



WALL FOOTING
PaISPV-BDC-17.018 SCALE 1:50

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE INDICATED.
2. WORK THIS DRAWING WITH ARCHITECTURAL DRAWINGS.

		NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT: DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PHOTOVOLTAIC SYSTEM (WITH E&S)			
LOCATION: CULABEL PALANAN, ISABELA			
TITLE: GUARDPOST (SOLAR POWER PLANT)			
DESIGNED	BY	CHKD	DATE
DRAWN	BY	CHKD	DATE
REVIEWED	PRINCIPAL ENGR / ARCHT.		RECOMMENDED
CHECKED			APPROVED
ELEC			
MECH			
DWG NO PaISPV-BDC-17.018		SPECS NO LuzP2121221S0	
SCALE AS SHOWN		BID DRAWING	
REV	DATE	NATURE OF REVISION	BY
CHKD			
REC'D			
APP'D			

SECTION IX

BID DRAWINGS

ELECTRICAL WORKS



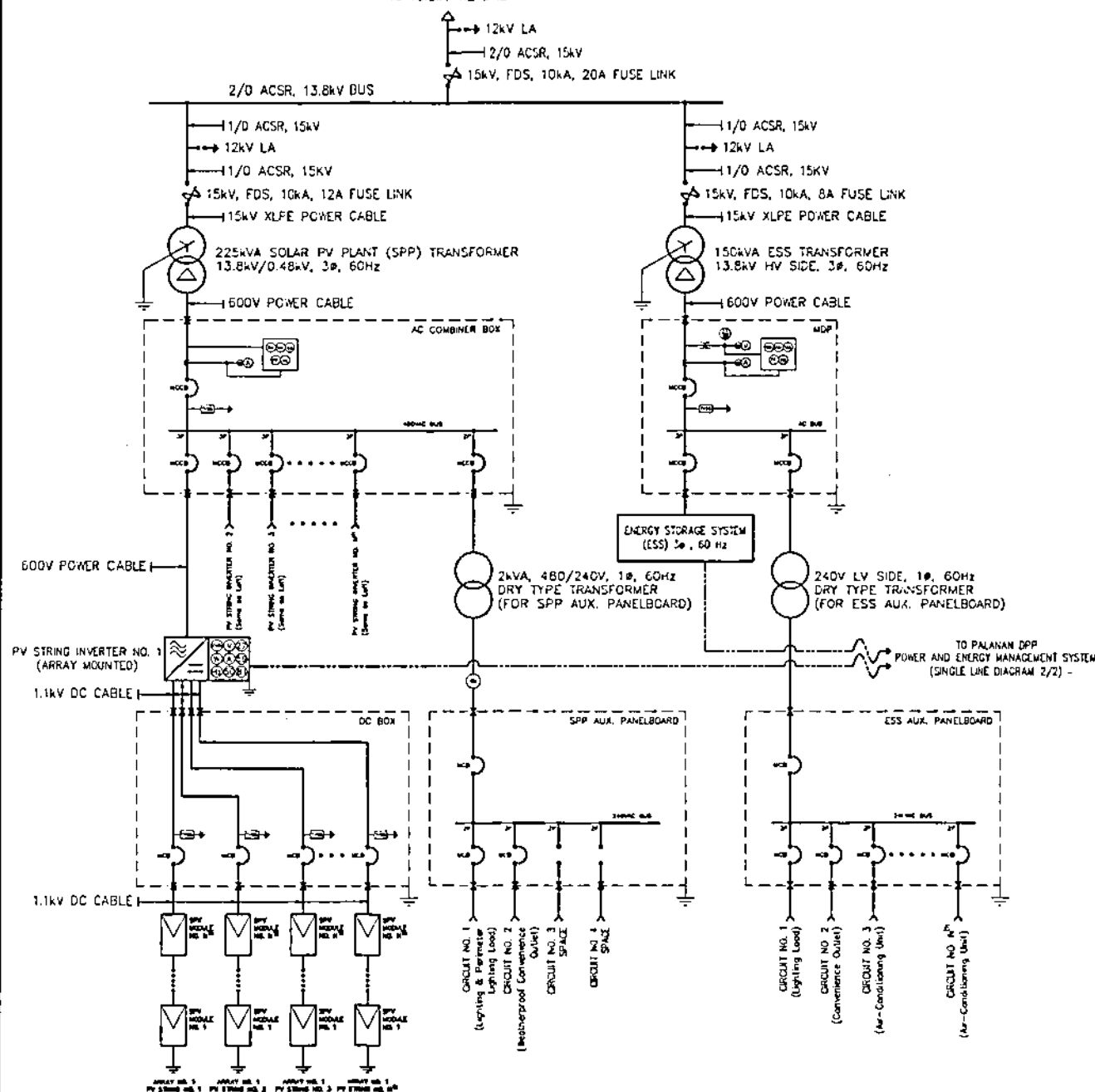
**TABLE OF CONTENTS
BID DRAWINGS****EW – ELECTRICAL WORKS**

<u>DRAWING NO.</u>	<u>TITLE</u>
PalSPV-BDE-17.001	SINGLE LINE DIAGRAM (1/2) (Solar PV System)
PalSPV-BDE-17.002	SINGLE LINE DIAGRAM (2/2) (Solar PV-Diesel Hybrid System)
PalSPV-BDE-17.003	EQUIPMENT LAYOUT (SPP)
PalSPV-BDE-17.004	DETAILS OF TAKE-OFF STRUCTURE (SPP) (1/2)
PalSPV-BDE-17.005	DETAILS OF TAKE-OFF STRUCTURE (SPP) (2/2)
PalSPV-BDE-17.006	SOLAR PV GROUNDING SYSTEM LAYOUT
PalSPV-BDE-17.007	DETAILS OF GROUNDING CONNECTION
PalSPV-BDE-17.008	LIGHTNING PROTECTION SYSTEM
PalSPV-BDE-17.009	LIGHTING AND POWER LAYOUT OF GUARDHOUSE (SPP)
PalSPV-BDE-17.010	PERIMETER LIGHTING LAYOUT (SPP)
PalSPV-BDE-17.011	DETAILS OF LIGHTING FIXTURES AND PERIMETER LIGHTING CONNECTION
PalSPV-BDE-17.012	SCHEDULE OF LOADS AND RISER DIAGRAM
PalSPV-BDE-17.013	13.8 KV OVERHEAD TIE-LINE CABLE ROUTE



PaISPV-BDE-17.014	13.8 KV TIE-LINE "STEEL POLE" General Design Data
PaISPV-BDE-17.015	13.8 KV TIE-LINE THREE PHASE CROSSARM CONSTRUCTION Type NC7 (C7)
PaISPV-BDE-17.016	13.8 KV TIE-LINE THREE PHASECROSSARM CONSTRUCTION Type N2C7 (2XC7)
PaISPV-BDE-17.017	13.8 KV TIE-LINE THROUGH BOLT TYPE Type NE1-2 (E1-2)
PaISPV-BDE-17.018	LOG ANCHOR ASSEMBLY Type NF2-2 (F2-2)
PaISPV-BDE-17.019	TRUSS GUY DETAIL E1-2A, F2-2A
PaISPV-BDE-17.020	13.8 KV TIE-LINE MATERIAL SPECIFICATIONS AND DRAWINGS (1/2)
PaISPV-BDE-17.021	13.8 KV TIE-LINE MATERIAL SPECIFICATIONS AND DRAWINGS (2/2)

TO 13.8kV TIE LINE



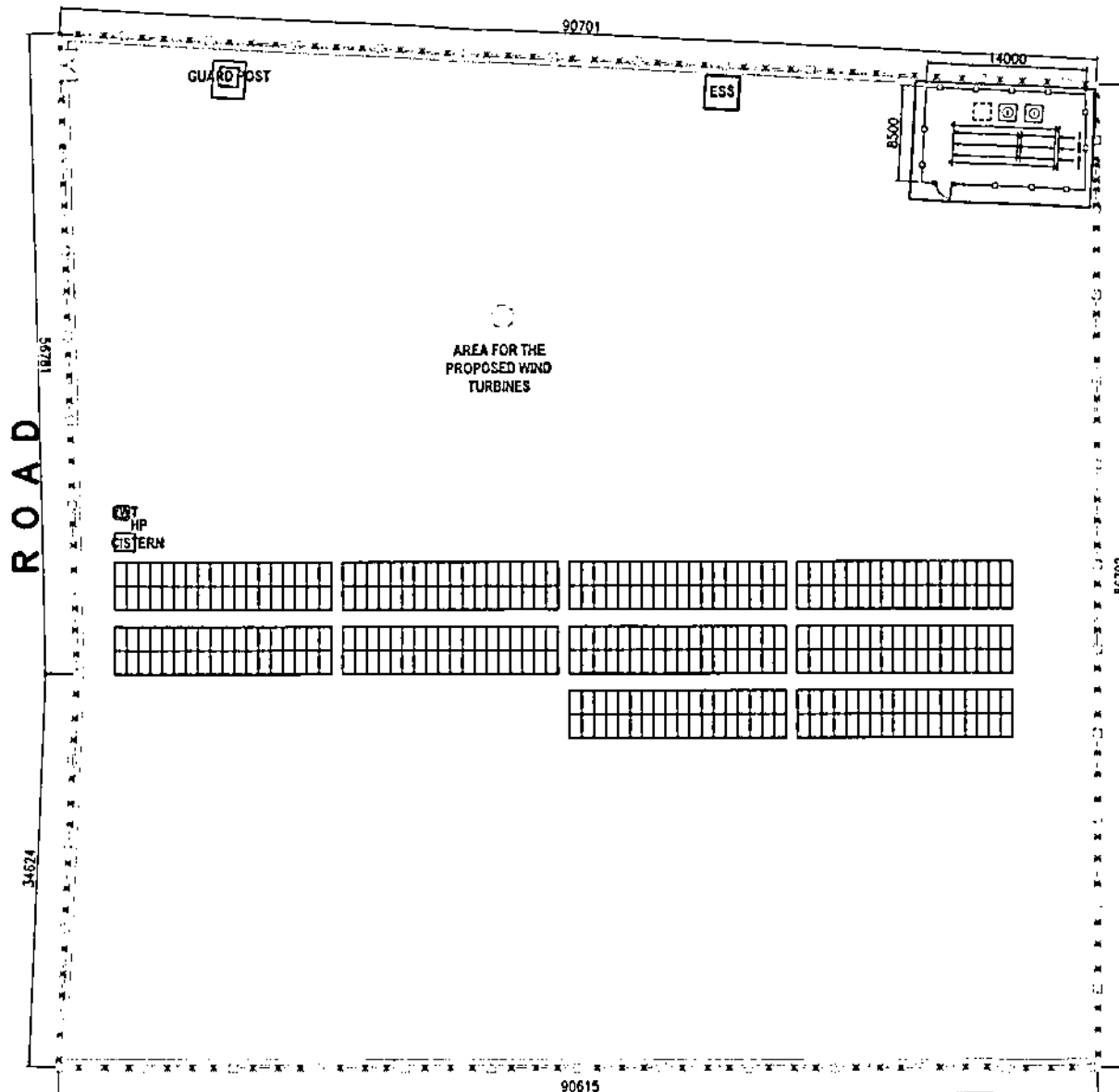
NOTES:

1. ALL EQUIPMENT RATINGS EXCEPT FOR THE SPP, ESS AND DRY TYPE TRANSFORMER AS SHOWN ARE INDICATIVE AND FOR BIDDING PURPOSES ONLY. ACTUAL QUANTITIES, RATING AND SIZES OF PV-ARRAYS, INVERTERS, CIRCUIT BREAKERS, WIRES INCLUDING ALL NECESSARY MATERIALS AND ACCESSORIES TO FUNCTION AS INTENDED SHALL BE DETERMINED BY THE SUPPLIER BASED ON THE ACTUAL SYSTEM REQUIREMENTS.
2. THE DETAILED DESIGN AND NECESSARY CALCULATION FOR THE REQUIRED NUMBER AND SIZES OF PV-ARRAYS, INVERTERS, WIRES, CONDUITS AND CIRCUIT BREAKERS INCLUDING INDOOR AND OUTDOOR LIGHTING SHALL BE SUBMITTED FOR NPC'S REVIEW AND APPROVAL.
3. ALL ELECTRICAL WORKS SHALL BE DONE IN ACCORDANCE WITH THE LATEST PROVISIONS OF THE PHILIPPINE ELECTRICAL CODE AND SHALL COMPLY WITH THE RULES AND REGULATIONS OF THE LOCAL CODES AND STANDARDS.
4. PULL BOXES OF APPROPRIATE SIZE SHALL BE PROVIDED TO ACCOMMODATE THE NUMBER OF SPLICES OF WIRES.
5. EXPOSED NON CURRENT-CARRYING METAL PARTS OF MODULE FRAMES, EQUIPMENT, AND CONDUCTOR ENCLOSURES SHALL BE PROPERLY GROUNDING.
6. THE SUPPLIER SHALL PROVIDE THE VOLTAGE RATING OF THE ESS, THE LOW VOLTAGE RATING OF THE ESS TRANSFORMER AND HIGH VOLTAGE RATING OF THE DRY TYPE TRANSFORMER FOR THE ESS AUXILIARY PANEL BOARD SHALL VARY ACCORDINGLY.
7. THE KVA RATING OF THE DRY TYPE TRANSFORMER (DTT) FOR SPP AUXILIARIES IS ONLY BE INTENDED FOR THE POWER AND LIGHTING LOADS OF THE SOLAR PV PLANT.

LEGEND:

TVSS	TRANSIENT VOLTAGE SURGE SUPPRESSOR	MCB	MINIATURE CIRCUIT BREAKER
LA	LIGHTNING ARRESTER	MCCB	MOLDED CASE CIRCUIT BREAKER
Wh	WATT-HOUR METER	27	UNDERVOLTAGE RELAY
KWh	KILO-WATT-HOUR METER	59	OVERVOLTAGE RELAY
VAR	VAR METER	50	INSTANTANEOUS OVERCURRENT RELAY
VA	VA METER	BI	FREQUENCY RELAY
PF	POWER FACTOR	⏏	GROUND/EARTH
H _z	FREQUENCY METER	~	ALTERNATING CURRENT
V	VOLTMETER	---	DIRECT CURRENT
A	AMMETER	----	CONTROL/SIGNAL CONNECTIONS
AS	AMMETER SELECTOR SWITCH		

NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS) LOCATION: CULAB, PALANAN, ISABELA	
TITLE: SINGLE LINE DIAGRAM (1/2) (SOLAR PV SYSTEM)	
DESIGNED: <i>[Signature]</i> DRAWN: <i>[Signature]</i> REVIEWED: <i>[Signature]</i> CIVIL/ARCHT: <i>[Signature]</i> SLEC: <i>[Signature]</i> MECH: <i>[Signature]</i>	BY: <i>[Signature]</i> CHD DATE: <i>[Signature]</i> SUBMITTED: <i>[Signature]</i> B. M. REJULA RECOMMENDED: <i>[Signature]</i> Z. C. LUGOD JR. APPROVED: <i>[Signature]</i> N. G. BONGIORNO
SHG NO PalSPV-BDE-17.001	SPECS NO LuzP2121221S
SCALE: NTS	BID DRAWING
REV. DATE NATURE OF REVISION BY CHD RECD APPD	REV. 0



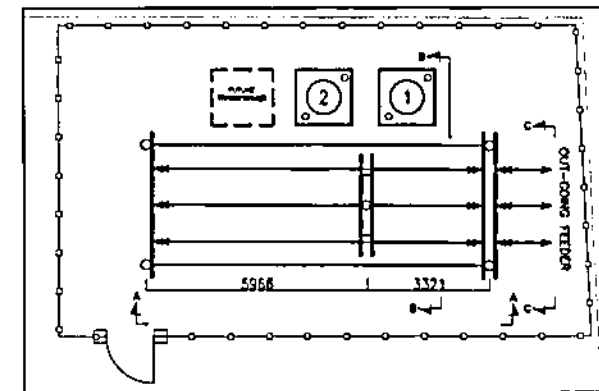
SOLAR PV PLANT (SPP)
PaISPV-BDE-17.003 SCALE NTS

NOTES:

1. REFER TO DRAWING NO. PaISPV-BDE-17.004 AND PaISPV-BDE-17.005 FOR THE SOLAR PV PLANT TAKE OFF STRUCTURE DETAILS.
2. ALL DIMENSIONS INDICATED ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
3. THIS DRAWING IS CONCEPTUAL AND FOR BIDDING PURPOSES ONLY. THE SUPPLIER SHALL IDENTIFY THE APPROPRIATE AND SUITABLE LOCATION OF EQUIPMENT/STRUCTURES, PULLBOX (PB), COMMUNICATION, AND POWER LINE ROUTE AS SHOWN TO SUIT ACTUAL FIELD REQUIREMENTS AND TO BE SUBMITTED FOR NPC'S REVIEW AND APPROVAL.
4. ALL EQUIPMENT IN BROKEN [---] LINES ARE FOR FUTURE INSTALLATION. ALL OTHERS ARE INCLUDED IN THE CONTRACT.


LEGEND:

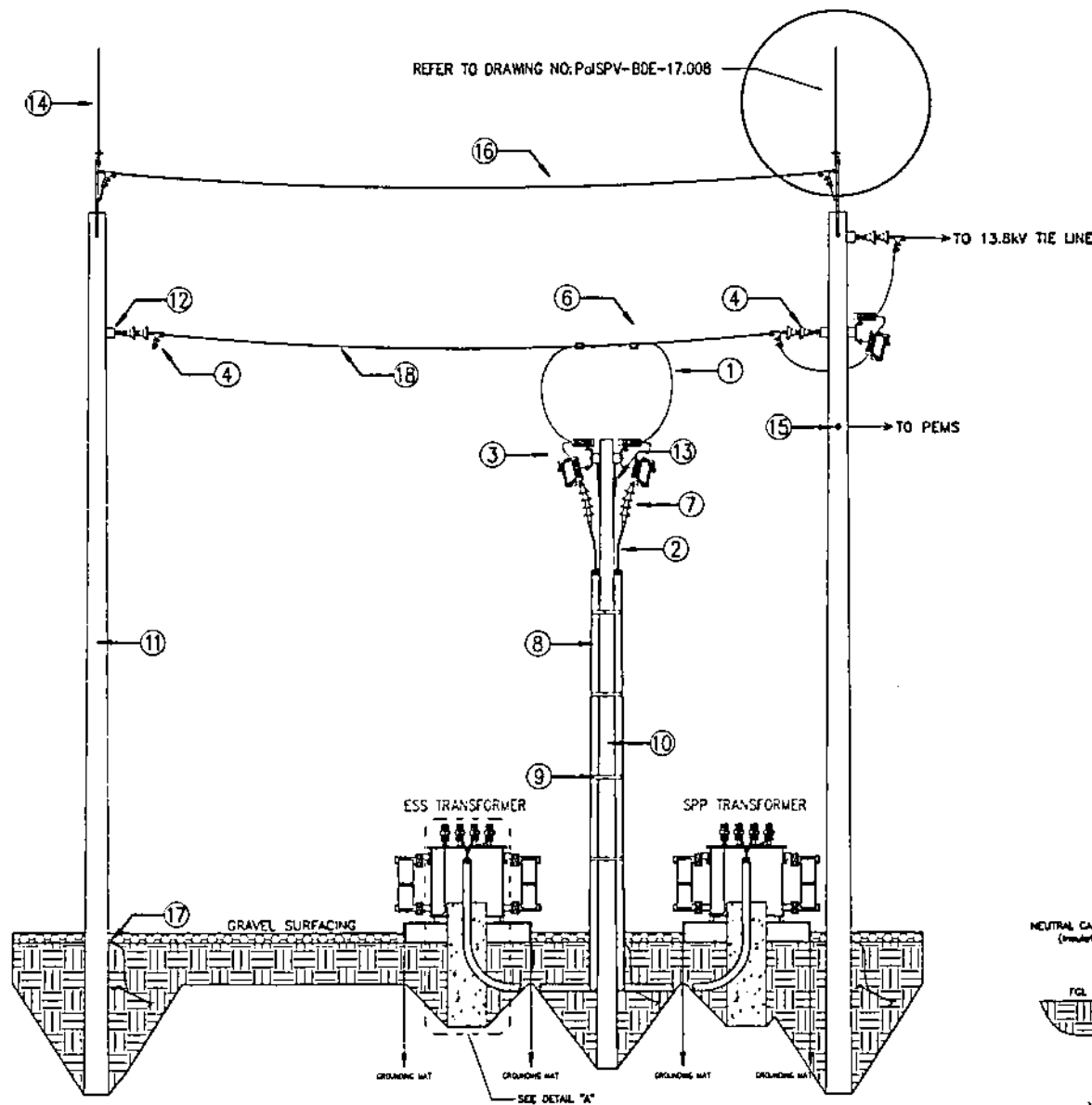
- ① — SPP TRANSFORMER
- ② — ESS TRANSFORMER
- EW — ELEVATED WATER TANK
- CS — CISTERN
- [Grid Symbol] — SOLAR PV ARRAY
- HP — HAND PUMP



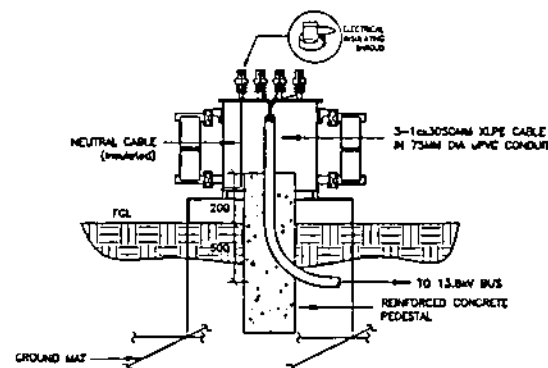
SWITCHYARD
PaISPV-BDE-17.003 SCALE NTS



OWNER:		 NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS)			
LOCATION: CULAM, PALANAN, ISABELA			
TITLE: EQUIPMENT LAYOUT (SPP)			
DESIGNED	BY	CHKD	DATE
DRAWN	BY	CHKD	DATE
REVIEWED	PRINCIPAL ENGINEER / ARCHT.		SUBMITTED
CHECKED	ELECT.		RECOMMENDED
ELEC.	ELEC.		APPROVED
MECH.	MECH.		APPROVED
DWG. NO. PaISPV-BDE-17.003		SPEC. NO. LuzP21Z1221S	
SCALE NTS		BID DRAWING	
REV. DATE		NATURE OF REVISION	
BY		CHKD. RECD. APPD.	



SECTION "A-A"
PalSPV-BDE-17.004 SCALE 1:70



DETAIL "A"
PalSPV-BDE-17.004 SCALE 1:50

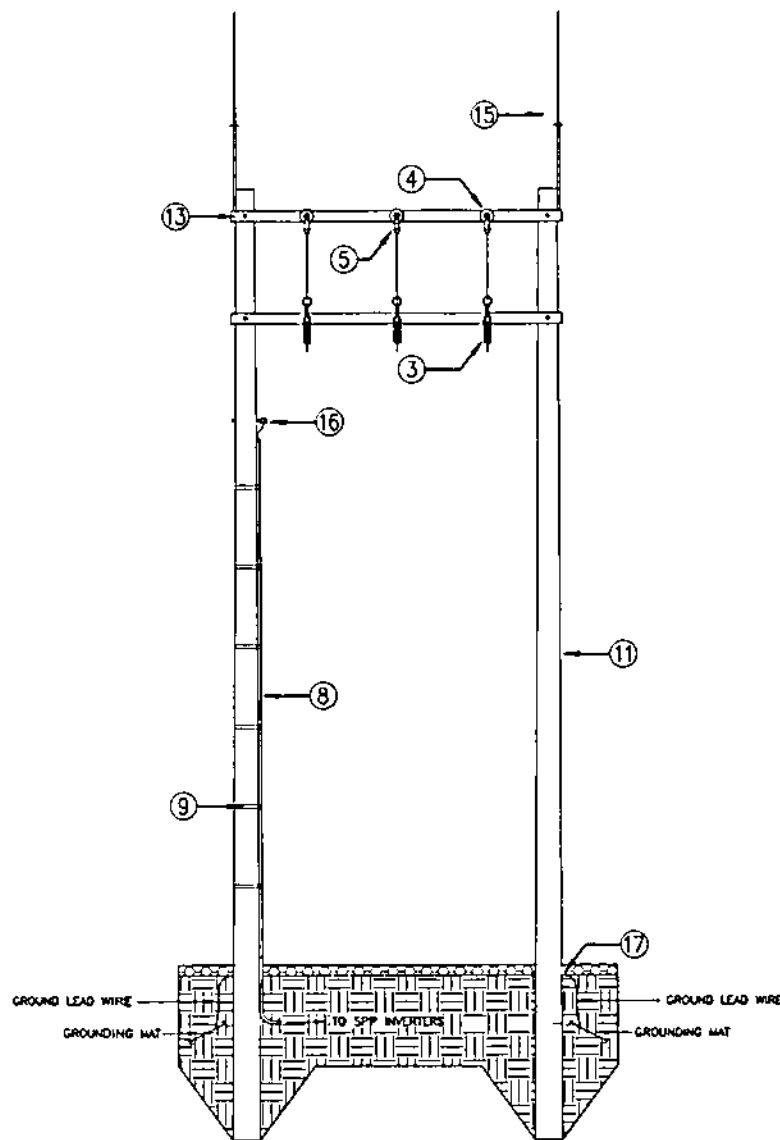
NOTES:

1. THIS DRAWING IS CONCEPTUAL AND FOR BIDDING PURPOSES ONLY. THE SUPPLIER SHALL IDENTIFY THE APPROPRIATE AND SUITABLE LOCATION OF EQUIPMENT/STRUCTURES, COMMUNICATION, AND POWER LINE ROUTE AS SHOWN TO SAT ACTUAL FIELD REQUIREMENTS AND TO BE SUBMITTED FOR NPC'S REVIEW AND APPROVAL.
2. TRANSFORMER LOW VOLTAGE AND HIGH VOLTAGE BUSHINGS SHALL BE PROVIDED WITH INSULATING SHROUD AND ALL NECESSARY ACCESSORIES FOR TERMINATION OF SINGLE OR MULTIPLE CABLES.
3. TRANSFORMER TANKS SHALL BE GROUNDED AT TWO POINTS DIAGONALLY OPPOSITE EACH OTHER. THESE CONNECTIONS SHALL BE MADE FROM TWO DIFFERENT POINTS OF THE GROUNDING GRID. TRANSFORMER NEUTRAL CONDUCTOR SHALL PROVIDED WITH COPPER-CLAD STEEL GROUND ROD.
4. THE NUMBER OF LIGHTNING ARRESTER SHOWN IN THE BID DRAWING IS INDICATIVE ONLY. THE SUPPLIER SHALL PROVIDE SUFFICIENT NUMBER OF LIGHTNING ARRESTERS WHICH ARE TO BE STRATEGICALLY LOCATED TO PROTECT THE ENTIRE SOLAR PV PLANT SWITCHYARD FROM LIGHTNING STRIKES. THE LOCATION OF LIGHTNING ARRESTERS SHALL NOT CAUSE SHADING ON THE SOLAR PV ARRAYS.
5. ALL DIMENSIONS AS SHOWN ARE IN MILLIMETERS UNLESS OTHERWISE INDICATED.

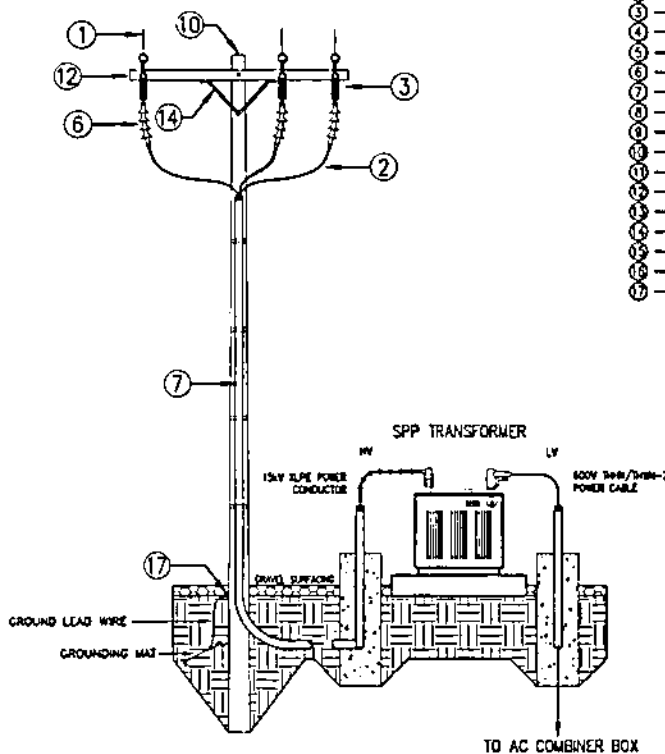
LEGEND:

- | | |
|--|---------------------------------|
| ① — 1/2 ANG ACSF | ⑪ — 35FT. STEEL POLE |
| ② — POWER CABLE, 13KV XLPE | ⑫ — CROSSARM, STEEL, HDG |
| ③ — FUSE DISCONNECT SWITCH WITH LA COMBINATION | ⑬ — BRACE, STEEL, HDG |
| ④ — STRAIN TYPE, INSULATOR | ⑭ — LIGHTNING ROD |
| ⑤ — STRAIN CLAMP | ⑮ — EYE BOLT |
| ⑥ — COMPRESSION CLAMP | ⑯ — 7/16" # HIGH STRENGTH GRADE |
| ⑦ — TERMINATION KIT | STEEL GALVANIZED CUT WIRE |
| ⑧ — 75MM DIA. UPVC CONDUIT | ⑰ — GROUND CLAMP |
| ⑨ — CONDUIT SUPPORT | ⑱ — 2/0 ANG ACSF |
| ⑩ — 25FT. STEEL POLE | |

OWNER		NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS)			
LOCATION: CULAB, PALANAN, HARELA			
TITLE: DETAILS OF TAKE-OFF STRUCTURE (SPP) (1/2)			
DESIGNED	BY	CHKD	DATE
DRAWN	BY	CHKD	DATE
REVIEWED	PRINCIPAL ENGR (ARCHT.)		RECOMMENDED
CIVIL/ARCHT			RECOMMENDED
ELEC.			APPROVED
MECH.			APPROVED
DWG. NO. PalSPV-BDE-17.004		SPECS. NO. LuzP21Z1221S	
SCALE: AS SHOWN		BID DRAWING	
REV.		REV. 0	



SECTION "C - C"
PalSPV-BDE-17.005 SCALE 1:70




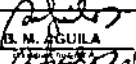
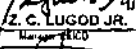

SECTION "B - B"
PalSPV-BDE-17.005 SCALE 1:70

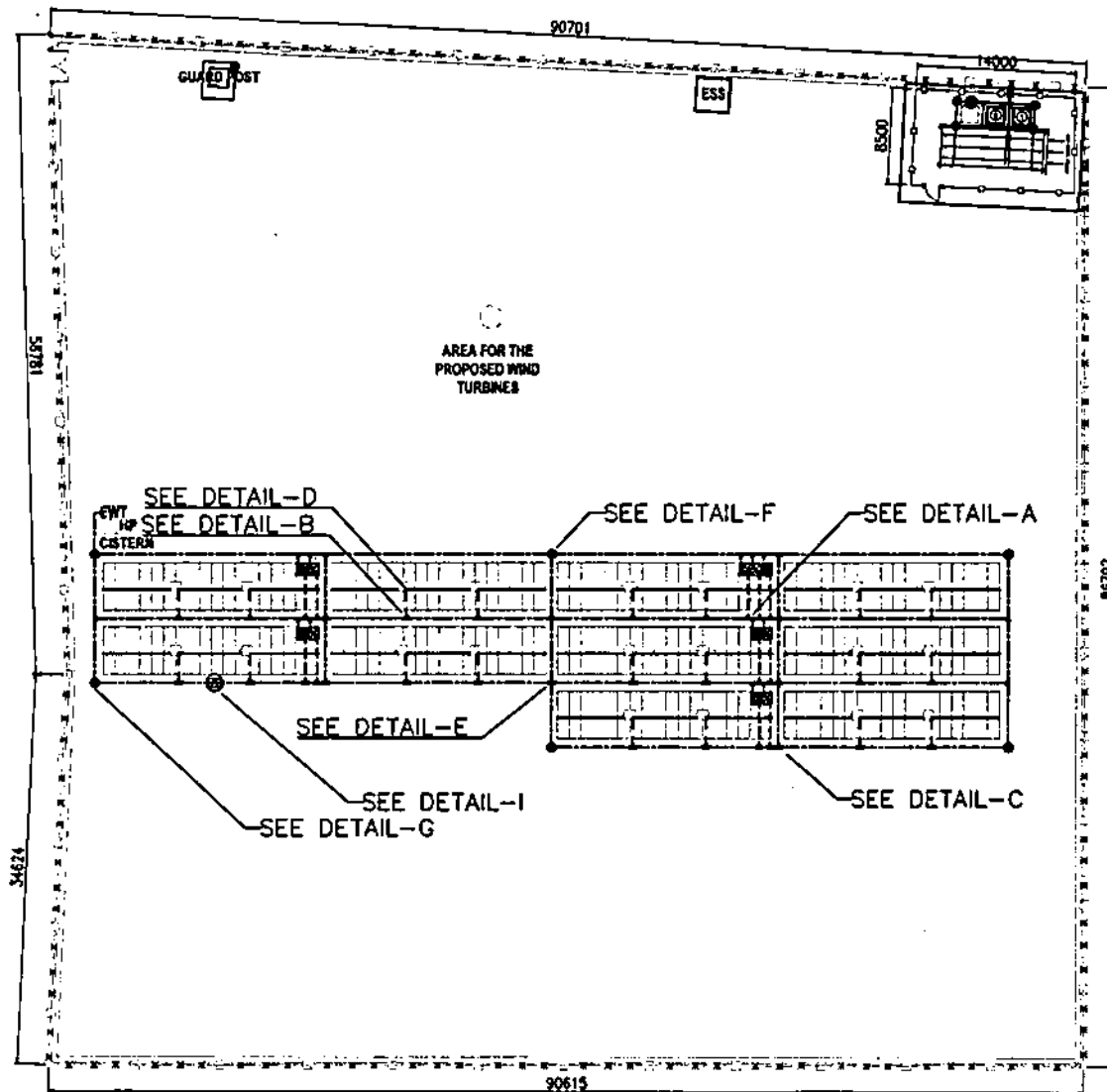
NOTES:

1. THIS DRAWING IS CONCEPTUAL AND FOR BIDDING PURPOSES ONLY. THE SUPPLIER SHALL IDENTIFY THE APPROPRIATE AND SUITABLE LOCATION OF EQUIPMENT/STRUCTURES, PULLBOX (PB), COMMUNICATION, AND POWER LINE ROUTE AS SHOWN TO SUIT ACTUAL FIELD REQUIREMENTS AND TO BE SUBMITTED FOR NPC'S REVIEW AND APPROVAL.
2. TRANSFORMER LOW VOLTAGE AND HIGH VOLTAGE BUSHINGS SHALL BE PROVIDED WITH INSULATING SHROUD AND ALL NECESSARY ACCESSORIES FOR TERMINATION OF SINGLE OR MULTIPLE CABLES.
3. TRANSFORMER TANKS SHALL BE GROUNDED AT TWO POINTS DIAGONALLY OPPOSITE EACH OTHER. THESE CONNECTIONS SHALL BE MADE FROM TWO DIFFERENT POINTS OF THE GROUNDING GRID. TRANSFORMER NEUTRAL CONDUCTOR SHALL PROVIDED WITH COPPER-CLAD STEEL GROUND ROD.
4. ALL DIMENSIONS AS SHOWN ARE IN MILLIMETERS UNLESS OTHERWISE INDICATED.

LEGEND:

- 1 — 1/0 AWG ACSR
- 2 — POWER CABLE, 15KV XLPE
- 3 — FUSE DISCONNECT SWITCH WITH LA COMBINATION
- 4 — STRAIN TYPE, INSULATOR
- 5 — STRAIN CLAMP
- 6 — TERMINATION KIT
- 7 — 75MM DIA. UPVC CONDUIT
- 8 — 20MM DIA. UPVC CONDUIT (FOR COMMUNICATION CABLE)
- 9 — CONDUIT SUPPORT
- 10 — 25FT. STEEL POLE
- 11 — 35FT. STEEL POLE
- 12 — 8FT CROSSARM, STEEL, HOG
- 13 — 12FT CROSSARM, STEEL, HOG
- 14 — BRACE, STEEL, HOG
- 15 — LIGHTNING ROD
- 16 — EYE BOLT
- 17 — GROUND CLAMP

OWNER:		 NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALAMAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS)			
LOCATION: CULAB, PALAMAN, MARABELA			
TITLE: DETAILS OF TAKE-OFF STRUCTURE (SPP) (2/2)			
DESIGNED	BY	CHKD	DATE
DRAWN			
REVIEWED	PRINCIPAL ENGINEER (ARCHT.)		
CIVIL/ARCHT			
ELEC.			
MECH.			
SUBMITTED		 B. M. AGUILA	
RECOMMENDED		 C. Z. C. LUGOD JR.	
APPROVED		 N. G. SORIANO JR.	
DWG NO. PalSPV-BDE-17.005		SPEC NO. LuzP21Z1221S	
SCALE: AS SHOWN		BID DRAWING	
REV. 0			



SOLAR PV PLANT (SPP)
PaISPV-BDE-17.006 SCALE NTS

LEGENDS:

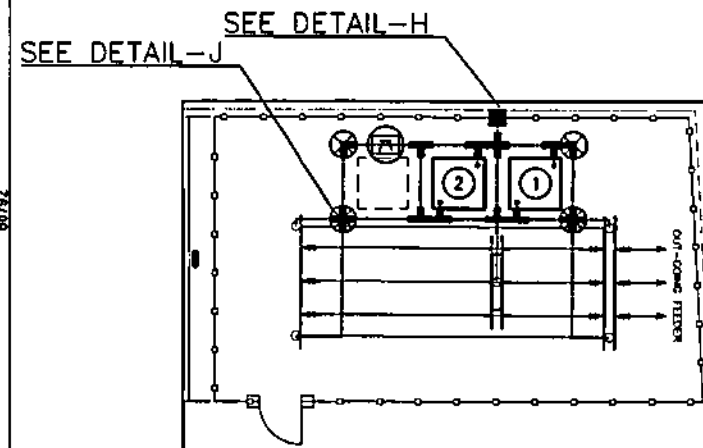
- 100 mm² BARE STRANDED COPPER, TIN ANNEALED
- 100 mm² INSULATED STRANDED COPPER, TIN ANNEALED
- 22 mm² INSULATED STRANDED COPPER, TIN ANNEALED
- 3.5 mm² INSULATED STRANDED COPPER, TIN ANNEALED
- ⊕ — GROUNDING TEST PIT

- ⊕ — DC BOX
- ⊕ — STRING INVERTER
- ⊕ — SPP TRANSFORMER
- ⊕ — GROUND ROD CONNECTION
- ⊕ — HORIZONTAL TEE CONNECTION

- ⊕ — HORIZONTAL 90° CONNECTION
- ⊕ — HORIZONTAL CROSS CONNECTION
- CS — CISTERNA
- EW — ELEVATED WATER TANK
- HP — HAND PUMP

NOTES:

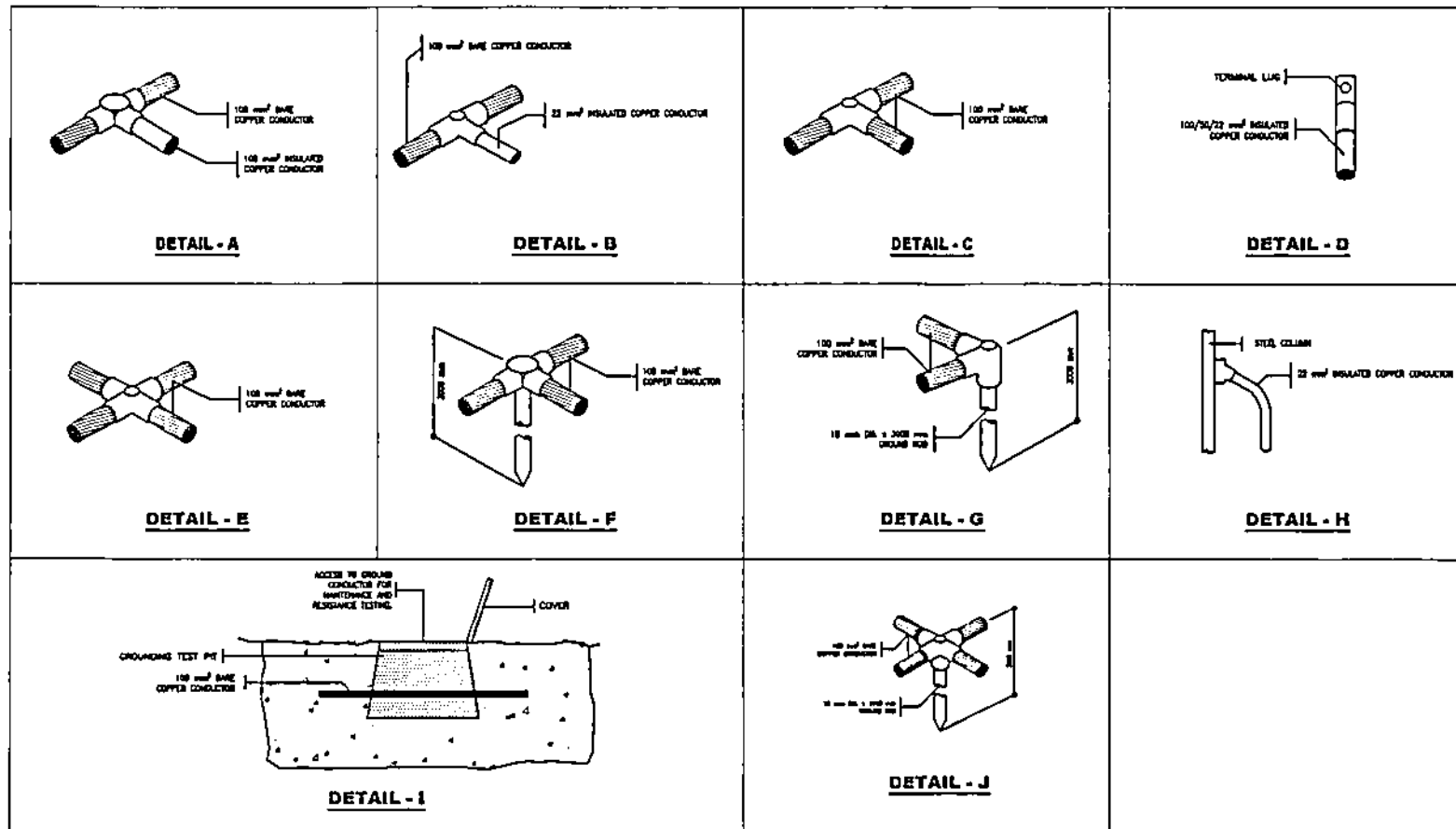
1. DETAIL "A" SHALL BE APPLIED TO ALL MAJOR EQUIPMENT SUCH AS INVERTER, DC BOX, AC COMBINER BOX AND TRANSFORMERS.
2. DETAIL "B" SHALL BE APPLIED TO MOUNTING STRUCTURE GROUNDING.
3. DETAIL "E" SHALL BE APPLIED TO FUSE DISCONNECT SWITCH, LIGHTNING PROTECTION SYSTEM, SECLUSION FENCE GROUNDING.
4. GROUNDING CONDUCTOR SHALL BE EMBEDDED AT LEAST 0.60M.
5. THIS DRAWING SHALL BE WORKED WITH DRAWING NO. PaISPV-BDE-17.007.
6. ALL EQUIPMENT IN SHADED [] PORTION ARE FOR FUTURE INSTALLATION. ALL OTHERS ARE INCLUDED IN THE CONTRACT.
7. ALL DIMENSIONS INDICATED ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.



SWITCHYARD
PaISPV-BDE-17.006 SCALE NTS

OWNER		NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS)			
LOCATION: CULAB, PALANAN, ISABELA			
TITLE SOLAR PV GROUNDING SYSTEM LAYOUT			
DESIGNED	BY	CHD	DATE
DRAWN	BY	CHD	DATE
REVIEWED	PRINCIPAL ENGR. (ARCHT.)		SUBMITTED
CIVIL/ARCHT.			RECOMMENDED
ELEC.			APPROVED
MECH.			
DWG. NO. PaISPV-BDE-17.006		SPEC. NO. LuzP21Z1221S	
SCALE: NTS		BID DRAWING	
REV. 0			

DETAILS OF GROUND CONNECTIONS

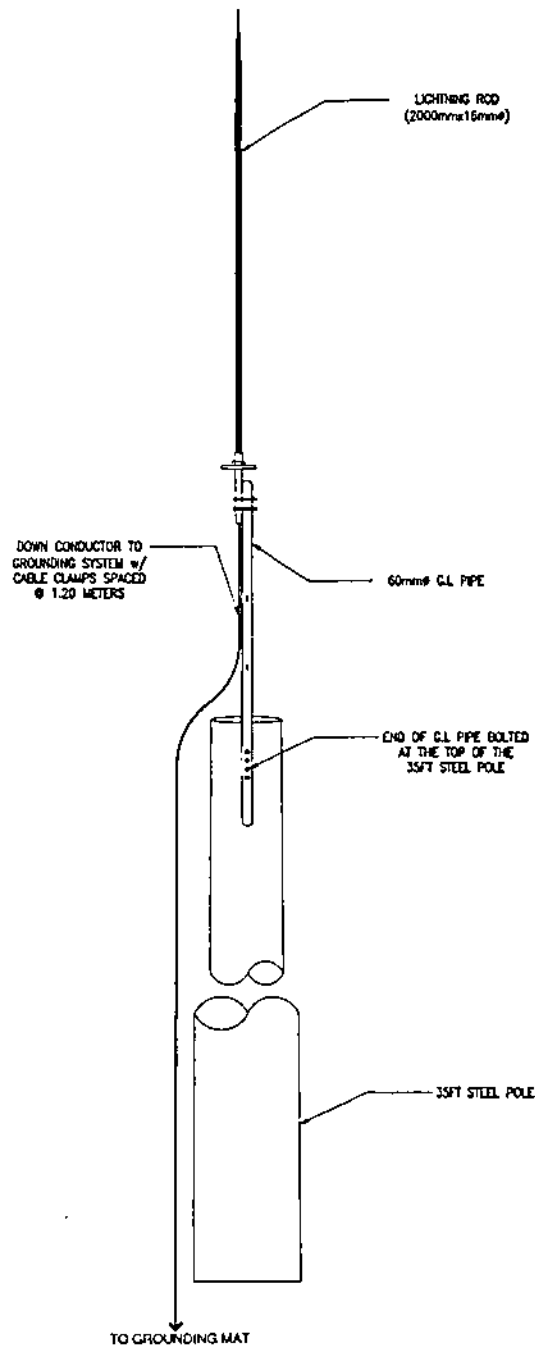


NOTES:

1. DETAIL "A" SHALL BE APPLIED TO ALL MAJOR EQUIPMENT SUCH AS INVERTER, DC BOX, AC COMBINER BOX, TRANSFORMER.
2. DETAIL "B" SHALL BE APPLIED TO MOUNTING STRUCTURE GROUNDING.
3. DETAIL "E" SHALL BE APPLIED TO FUSE DISCONNECT SWITCH, LIGHTNING PROTECTION SYSTEM, SECLUSION FENCE GROUNDING.
4. GROUNDING CONDUCTOR SHALL BE EMBEDDED AT LEAST 0.60M.
5. THIS DRAWING SHALL BE WORKED WITH DRAWING NO. PdPV-BDE-17.008.


NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY																																																													
PROJECT DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS) LOCATION: CULASI, PALANAN, ISABELA																																																													
TITLE DETAILS OF GROUNDING CONNECTION																																																													
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>DESIGNED</th> <th>BY</th> <th>CHKD</th> <th>DATE</th> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <th>DRAWN</th> <th>BY</th> <th>CHKD</th> <th>DATE</th> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <th>REVIEWED</th> <th>PRINCIPAL ENGINEER / ARCHT.</th> <th></th> <th></th> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <th>CIVIL/ARCHT.</th> <th></th> <th></th> <th></th> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <th>ELEC.</th> <th></th> <th></th> <th></th> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <th>MECH.</th> <th></th> <th></th> <th></th> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </table>	DESIGNED	BY	CHKD	DATE					DRAWN	BY	CHKD	DATE					REVIEWED	PRINCIPAL ENGINEER / ARCHT.							CIVIL/ARCHT.								ELEC.								MECH.								<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>SUBMITTED</th> <th>RECOMMENDED</th> <th>APPROVED</th> </tr> <tr> <td><i>[Signature]</i></td> <td><i>[Signature]</i></td> <td><i>[Signature]</i></td> </tr> <tr> <td>B. M. AGUILA</td> <td>C. Z. C. LUGOD JR.</td> <td>N. G. COMESIERA</td> </tr> <tr> <td></td> <td></td> <td></td> </tr> </table>	SUBMITTED	RECOMMENDED	APPROVED	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	B. M. AGUILA	C. Z. C. LUGOD JR.	N. G. COMESIERA			
DESIGNED	BY	CHKD	DATE																																																										
DRAWN	BY	CHKD	DATE																																																										
REVIEWED	PRINCIPAL ENGINEER / ARCHT.																																																												
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SUBMITTED	RECOMMENDED	APPROVED																																																											
<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>																																																											
B. M. AGUILA	C. Z. C. LUGOD JR.	N. G. COMESIERA																																																											
DWG NO. PaISPV-BDE-17.007 SPEC. NO. LuzP21Z1221Se																																																													
SCALE: NTS BID DRAWING REV. 0																																																													

REV.	DATE	NATURE OF REVISION	BY	CHKD	RECD	APPD.

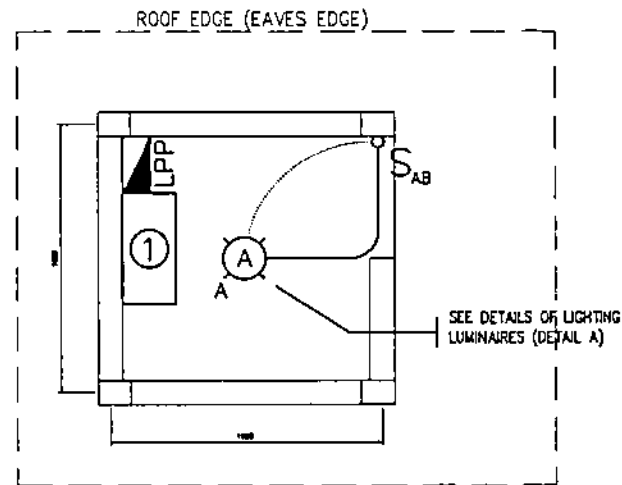


NOTES:

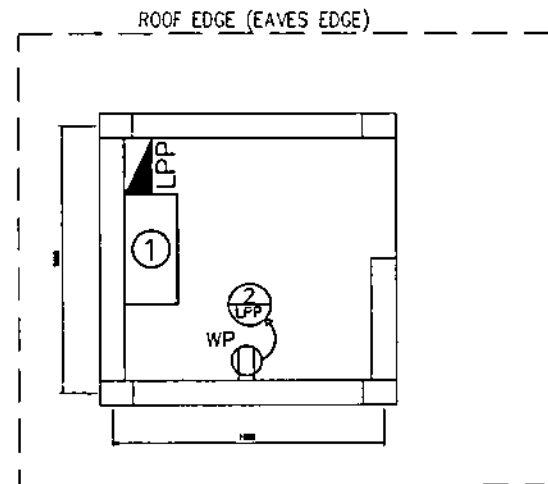
1. THE LIGHTNING PROTECTION SYSTEM SHALL BE INSTALLED APPROXIMATELY AS SHOWN ON THE DRAWING.
2. THE DOWN CONDUCTOR SHALL BE CONNECTED TO THE GROUNDING MAT.
3. THE SUPPLIER SHALL SUBMIT SPECIFICATION, FABRICATION AND INSTALLATION DRAWING FOR APPROVAL OF NPC.
4. THE G.L. PIPE SHALL HAVE AN INTERNAL DIAMETER OF 60mm AND SHALL HAVE A MINIMUM LENGTH OF 3.0 M

OWNER:		 NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS)			
LOCATION: CULAM, PALANAN, ISABELA			
TITLE: LIGHTNING PROTECTION SYSTEM			
DESIGNED	BY	CHKD	DATE
DRAWN	BY	CHKD	DATE
REVIEWED	PRINCIPAL ENGINEER (ARCHT.)		RECOMMENDED
CIVIL/ARCHT.			RECOMMENDED
ELEC.			APPROVED
MECH.			APPROVED
DWG NO. PalSPV-BDE-17.008		SPECS NO. LuzP21Z1221S	
SCALE: 1:15		BID DRAWING	
REV. 0		REV. 0	

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.



LIGHTING LAYOUT
PaISPV-BDE-17.009 SCALE 1:50



POWER LAYOUT
PaISPV-BDE-17.009 SCALE 1:50

NOTES:

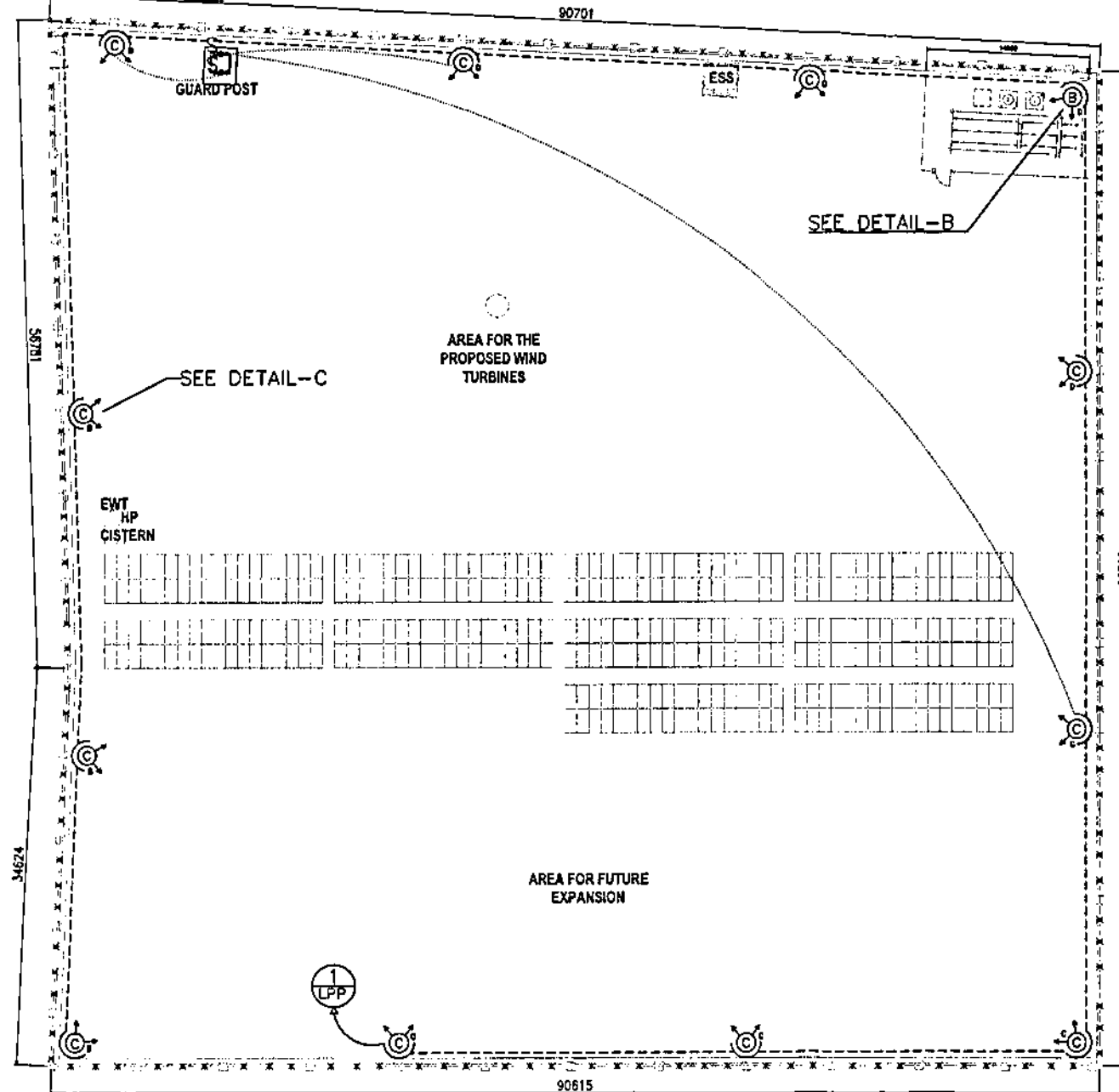
1. THIS DRAWING SHALL BE WORKED WITH DRAWING PaISPV-BDE-17.011 AND PaISPV-BDE-17.012 FOR THE LEGEND, DETAILS OF LIGHTING FIXTURES AND SCHEDULE OF LOADS.
2. ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE LATEST PROVISIONS OF THE PHILIPPINE ELECTRICAL CODE, LOCAL ORDINANCES AND REGULATIONS.
3. LIGHTING CONTROL SWITCHES SHALL HAVE A PROTECTION RATING AGAINST RAIN WATER DROPLETS PENETRATION OR OTHER APPROVED EQUIVALENT ACCESSORY.
4. CONDUIT RUNS ARE INDICATIVE ONLY. THE ACTUAL LOCATION SHALL BE DETERMINED IN THE FIELD.
5. ALL WIRES SHALL BE TYPE THHN/THWN-2 600V INSULATION, 90°C OPERATING TEMP., STRANDED COPPER CONDUCTOR.
6. CONDUIT SHALL BE UPVC, SCH.40.
7. THIS DRAWING SHALL BE WORKED WITH CIVIL AND MECHANICAL BID DRAWINGS.

LEGEND:

- Ⓐ — FIXTURE TYPE A
- S_{AB} — DUPLEX POLE SWITCH (SUBSCRIPT DENOTES LAMP BEING CONTROLLED)
- Ⓚ — 200 VA DUPLEX WEATHERPROOF CONVENIENCE OUTLET
- — — — — CIRCUIT RUNNING ON CEILING
- — — — — CIRCUIT RUNNING UNDERNEATH THE FLOOR
- — — — — CONTROL CIRCUIT
- — — — — CIRCUIT HOMERUN
- LPPB — LIGHTING AND POWER PANEL BOARD
- Ⓜ — 2KVA, 480/230V, 1 PHASE, 60 HERTZ, DRY TYPE TRANSFORMER

OWNER		NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS) LOCATION: CULABELA, PALANAN, MARABELA			
TITLE: LIGHTING AND POWER LAYOUT OF GUARDHOUSE (SPP)			
DESIGNED	BY	CHD	DATE
DRAWN	BY	CHD	DATE
REVIEWED	PRINCIPAL ELECTRICAL ARCHT.		RECOMMENDED
CIVIL ARCHT.			APPROVED
ELEC.			
MECH.			
DWG NO. PaISPV-BDE-17.009		SPEC. NO. LuzP21Z1221Se	
SCALE AS SHOWN		BID DRAWING	
REV. 0			

REV.	DATE	NATURE OF REVISION	BY	CHD	REC'D	APP'D



NOTES:

1. THIS DRAWING SHALL BE WORKED WITH DRAWING PalsPV-BDE-17.011 AND PalsPV-BDE-17.012 FOR THE LEGEND, DETAILS OF LIGHTING FIXTURES AND SCHEDULE OF LOADS.
2. ALL DIMENSIONS INDICATED ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
3. ALL EQUIPMENT IN BROKEN [---] LINES ARE FOR FUTURE INSTALLATION. ALL OTHERS ARE INCLUDED IN THE CONTRACT.

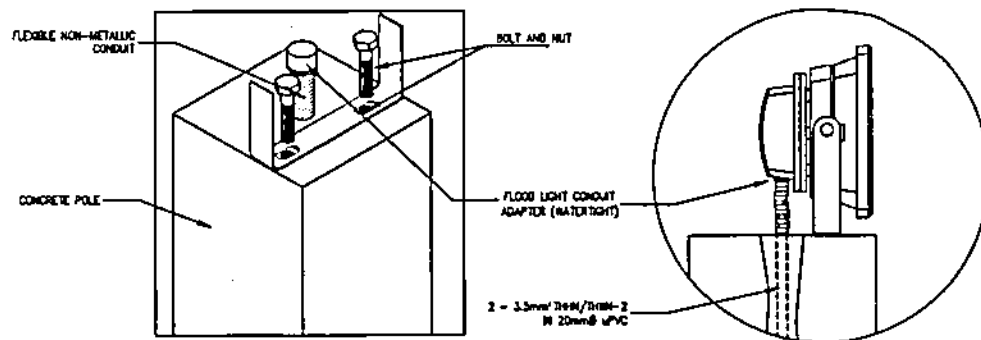
LEGEND:

- CIRCUIT RUNNING UNDERGROUND
- CONTROL CIRCUIT
- CIRCUIT HOMERUN
- Scd — DUPLEX POLE SWITCH (SUBSCRIPT DENOTES LAMP BEING CONTROLLED)
- ⊙ — FIXTURE TYPE B
- ⊙ — FIXTURE TYPE C

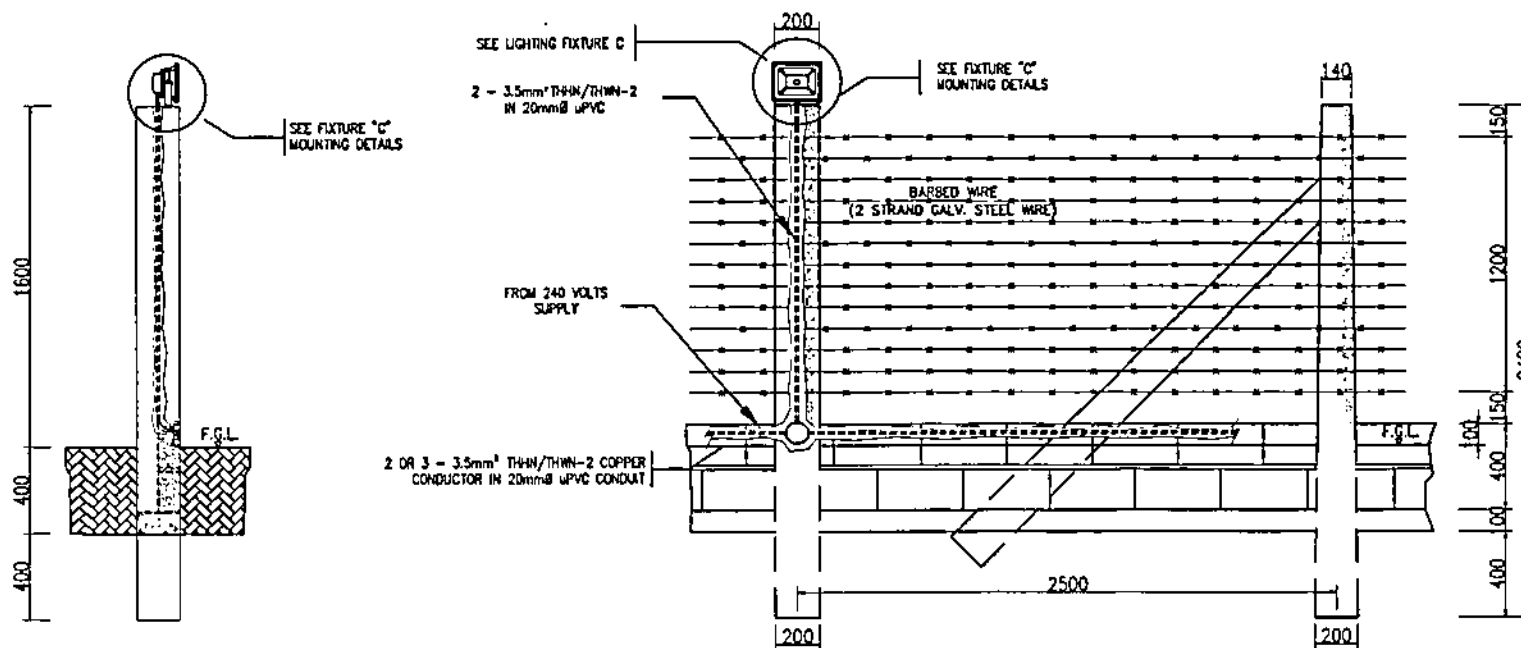
OWNER:		NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS)			
LOCATION: CULABEL, PALANAN, ISABELA			
TITLE: PERIMETER LIGHTING LAYOUT (SPP)			
DESIGNED	BY	CHKD	DATE
DRAWN	BY	CHKD	DATE
REVIEWED	PRINCIPAL ENGR./ARCHT.		RECOMMENDED
CIVIL/ARCHT			APPROVED
ELEC.			
MECH.			
DWG NO. PalsPV-BDE-17.010		SPEC. NO. LuzP21Z1221Se	
SCALE: NTS		BID DRAWING	
REV. 0			

SOLAR PV PLANT (SPP)
 PalsPV-BDE-17.010 SCALE NTS

REV.	DATE	NATURE OF REVISION	BY	CHKD	RECD	APPD.

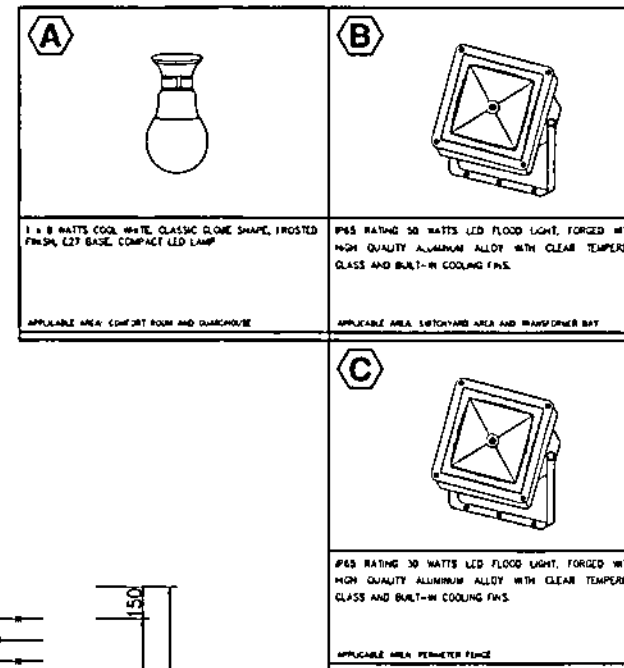


FIXTURE "C" MOUNTING DETAILS
PaISPV-BDE-17.011 SCALE NTS



DETAILS OF PERIMETER LIGHTING INSTALLATION
PaISPV-BDE-17.011 SCALE 1:25

DETAILS OF LIGHTING FIXTURES



LIGHTING FIXTURES
PaISPV-BDE-17.011 SCALE NTS

OWNER:		NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALAWAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS)			
LOCATION: GULAM, PALAWAN, MARIANA			
TITLE: DETAILS OF LIGHTING FIXTURES AND PERIMETER LIGHTING CONNECTION			
DESIGNED	BY	CHKD	DATE
DRAWN	BY	CHKD	DATE
REVIEWED	PRINCIPAL ENGR. I. ARCTO		RECOMMENDED
CIVIL/ARCHT			
ELEC.			
MECH			
DWG. NO. PaISPV-BDE-17.011		SPEC. NO. Lu2P2121	
SCALE AS SHOWN		BID DRAWING	

REV.	DATE	NATURE OF REVISION	BY	CHKD	RECD	APPD

SCHEDULE OF LOADS (SPP AUXILIARY PANELBOARD)

CMT NO.	DESCRIPTION	VA	VOLTS	AMPS	SWITCH		SIZE		
					S1	S2	BREAKER	WIRE	CONDUIT
1	1 - 9W COMPACT LED LAMP, TYPE A	485	240	2.02	0	2	50AF/15AT	2 - 3.5mm ² THHN/THWN-2	20mm ² uPVC
	1 - 50W FLOOD LED FLOOD LIGHT, TYPE B							2 - 8.0mm ² THHN/THWN-2	20mm ² uPVC
	11 - 30W FLOOD LED FLOOD LIGHT, TYPE C								
2	1 - 200VA WEATHERPROOF CONVENIENCE OUTLET	200	240	0.83			50AF/20AT	3 - 3.5mm ² THHN/THWN-2	20mm ² uPVC
3	SPACE	0	240	0.00			-	-	-
4	SPACE	0	240	0.00			-	-	-
	TOTAL	685	240	2.86	0	2			

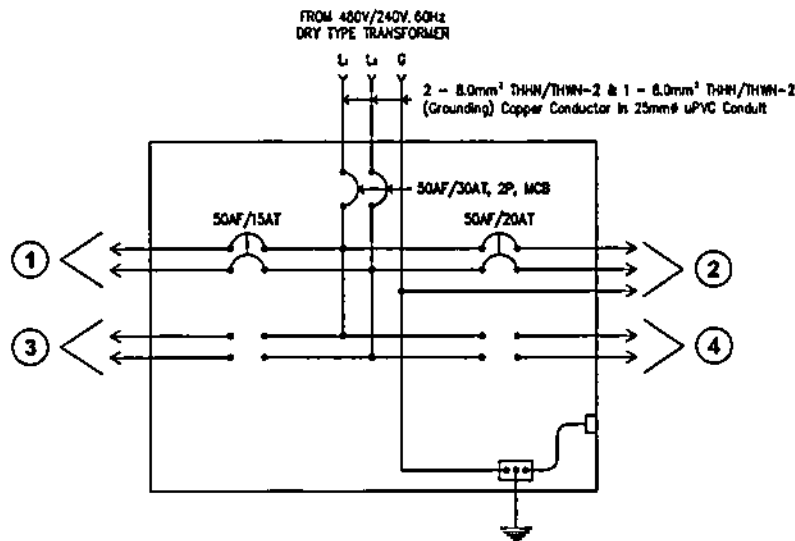
PROVIDE: 50AF/30AT, 2P, MCB
WITH BRANCH CIRCUIT OF:
1 - 50AF/20AT, 2P, MCB
1 - 50AF/15AT, 2P, MCB

PROVIDE: 2 - 8.0mm² THHN/THWN-2 Copper Conductor and
1 - 8.0mm² THHN/THWN-2 (Grounding) Copper
Conductor in 25mm² uPVC Conduit

NOTE:

- THE SUPPLIER SHALL SUBMIT DETAILED SCHEDULE OF LOADS WITH CALCULATION OF THE REQUIRED TRANSFORMER CAPACITY FOR NPC APPROVAL.

RISER DIAGRAM



OWNER:		NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS) LOCATION: CULASI, PALANAN, ISABELA			
TITLE: SCHEDULE OF LOADS AND RISER DIAGRAM			
DESIGNED	BY	CHKD	DATE
DRAWN	BY	CHKD	DATE
REVIEWED	PRINCIPAL ENGINEER/ARCHT		RECOMMENDED
CHIEF ARCHT			APPROVED
ELEC.			
MECH			
DWG. NO. PalSPV-BDE-17,012		SPEC. NO. LuzP21Z1221S6	
SCALE: NTS		BID DRAWING	
REV.		REV. 0	

STAKING SHEET

Project Title: DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV- DIESEL HYBRID SYSTEM (WITH ESS)

Specs No: LuzP21Z1221Se

Location: CULASI, PALANAN, ISABELA

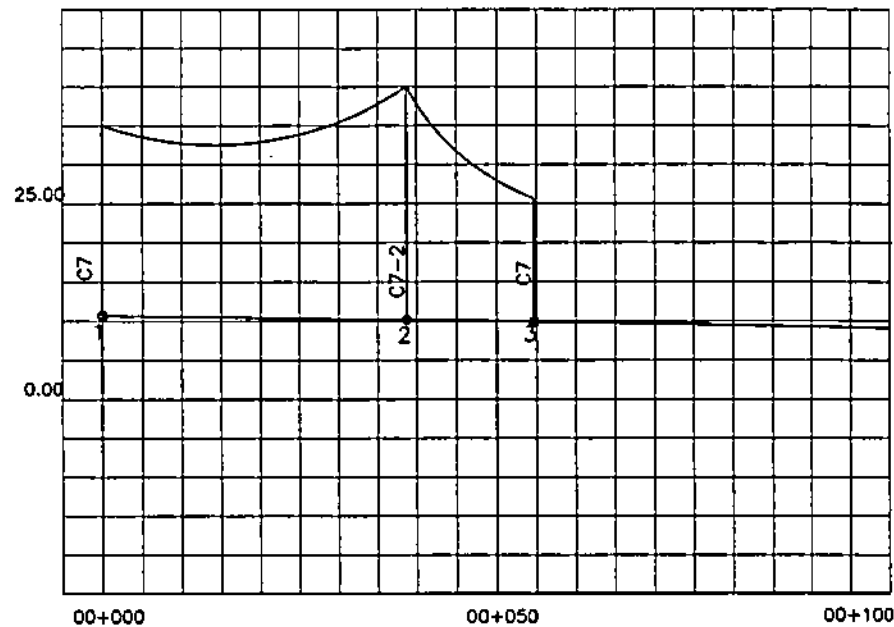
Primary Conductor: 2/0 AWG ACSR

Neutral Conductor: 2/0 AWG ACSR

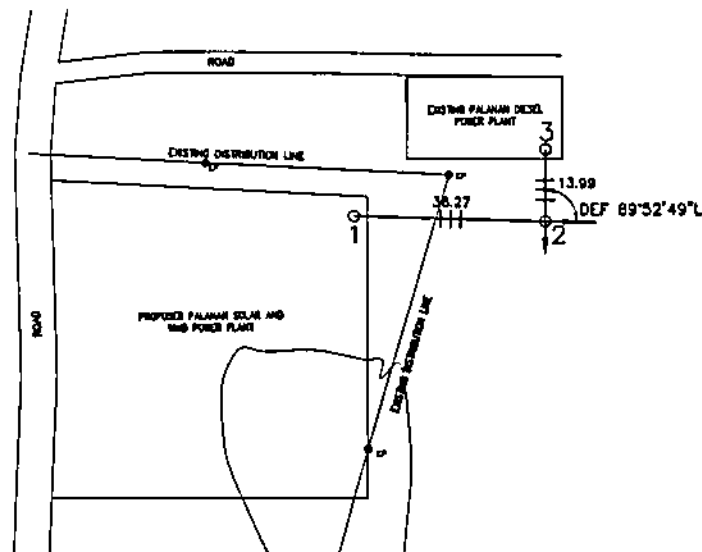
Secondary Conductor: N/AService Drop Wire: N/A

Ruling Span (meter): _____

[illegible]



SCALE: VERTICAL: 1:1000
HORIZONTAL: 1:1000



NOTES:

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE INDICATED.
2. FINAL TAPPING TO THE 13.8KV SWITCHYARD OF THE EXISTING PALANAN DPP SHALL BE DETERMINED BY THE SUPPLIER TO SUIT ACTUAL FIELD CONDITION SUBJECT TO NPC APPROVAL.
3. TYPES OF GUYING AND ANCHOR ASSEMBLY SHALL BE REFERRED TO THE BILL OF QUANTITIES AND STAKING SHEET.
4. CLEARANCES OF THE POWER CABLES AND COMMUNICATION TO THE GROUND ACCORDING TO LOCATION AS SPECIFIED IN THE TECHNICAL SPECIFICATIONS.
5. THIS DRAWING SHALL BE WORKED WITH CIVIL BID DRAWINGS.

LEGEND:

- - POLE STRUCTURE (NUMBER INDICATES POLE NUMBER)
- - GUYING
- ↗ - DEFLECTION ANGLE
- - THREE PHASE TIE LINE
- C7 - TYPE C7 POLE STRUCTURE
- 2C7 - TYPE 2C7 POLE STRUCTURE

OWNER		NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS)			
LOCATION CULABEL, PALANAN, ISABELA			
TITLE		13.8KV OVERHEAD TIE-LINE CABLE ROUTE	
DESIGNED	BY	CHKD	DATE
DRAWN			
REVIEWED	PRINCIPAL ENGR. / ARCHT.	RECOMMENDED	
CIVIL/ARCHT		APPROVED	
ELEC			
MECH			
DWG. NO. PaISPV-BDE-17.013		SPEC. NO. LuzP21212215e	
SCALE NTS		BID DRAWING	
REV. DATE		REV. 0	

GENERAL DESIGN DATA

SINGLE POLE

1. Nominal Voltage 13.8 kV

2. Conductors and Wires

CONDUCTORS AND WIRES	PRIMARY & NEUTRAL CONDUCTOR		GUY WIRE	
Type and Size	ACSR, 2/0 AWG		3/8" High Strength Grade Steel Galvanized	
Stranding	6/1		7-strand	
Outside Diameter	11.34 mm	0.446 in	9.53 mm	0.375 in
Area	100.64 mm ²	0.156 in ²	51.10 mm ²	0.0792 in ²
Weight	272.0 kg/km	0.1967 lb/ft	0.408 kg/m	0.273 lb/ft
Ultimate Strength	2,408 kg	5,310 lbs	4,900 kg	10,800 lbs

3. Maximum Loading:
Temperature 7.22 °C (45 °F)
Wind Velocity 270 KPH

4. Tension Limits (Percentage of Ultimate Tensile Strength):

	Unloaded Fnd @ 7.22 °C (45 °F)	Loaded Fnd @ 7.22 °C (45 °F)
Conductor	20	40
Neutral Wire	20	40
Insulator Assembly		40 M and E

5. Span Limitations (Meters):

	Structure Type	Maximum Span	Deflection Angle
Single Pole, Three-Phase	NC1 (C1)	50 m 100 m	0°-5°
	NC2 (C2)	50 m 100 m	5°-30°
	NC3 (C3)	50 m 100 m	30°-60°
	NC4-1 (C4-1)	50 m 100 m	60°-90°
	NC5-1 (C5-1)	50 m 100 m	
	NC7 (C7)	50 m 100 m	
	NC8 (C8)	50 m 100 m	
	NC14 (C14)	50 m 100 m	
	NC15 (C15)	50 m 100 m	

6. Clearances, Values Strictly Minimum:

Crossing Over @ 48.8 °C (120 °F), No Wind, Final Sag	Clearance	
Track Rails of Railroads	10.00 m	32.80 ft
Public Street and Highways	7.60 m	24.93 ft
Rural Road	6.70 m	21.98 ft
Cultivated Fields, Area Accessible only to Pedestrians	5.80 m	19.02 ft
Conductor Clearance to Support	Refer to Drawing	
Conductor Clearance to Guy	Refer to Drawing	

7. Guy:

Maximum Working Load on 1.5 m. (5') Log Anchor 4,550 Kgs. (10,000 lbs.)
 Guy Slope (L/H) 0.8 to 1.0
 Maximum Design Tension in Guy Wire 3,300 Kgs. (7,250 lbs.)

8. Crossarms and Braces

Material Galvanized Steel
 Galvanizing According to: ASTM A123

9. Steel Pole

Refer to Civil Drawings

10. Pole Setting:

Length of Pole		Depth of Pole Setting			
		In Earth		In Rock	
Meter	Feet	Meter	Feet	Meter	Feet
9.14	30	1.52	5.0	1.22	4.0
10.67	35	1.68	5.5	1.22	4.0
12.19	40	1.83	6.0	1.22	4.0
13.71	45	1.98	6.5	1.37	4.5
15.24	50	2.13	7.0	1.52	5.0

OWNER



NATIONAL POWER CORPORATION
 AGHAM ROAD, DILIMAN, QUEZON CITY

PROJECT: DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS)

LOCATION: CULABI, PALANAN, BABELA

TITLE:

13.8KV TIE LINE "STEEL POLE"
 GENERAL DESIGN DATA

	BY	CHKD	DATE	SUBMITTED
DESIGNED	JK			10. M. AGUILA
DRAWN	JK			
REVIEWED		PRINCIPAL ENGR. / ARCHT.		RECOMMENDED: S. Z. C. LUGO JR.
CIVIL/ARCHT				
ELEC.				APPROVED: N. O. SORIANO JR.
MECH.				

DWG. NO. PaISPV-BDE-17.014

SPEC. NO. LUZP212221Sb

SCALE: NTS

BID DRAWING

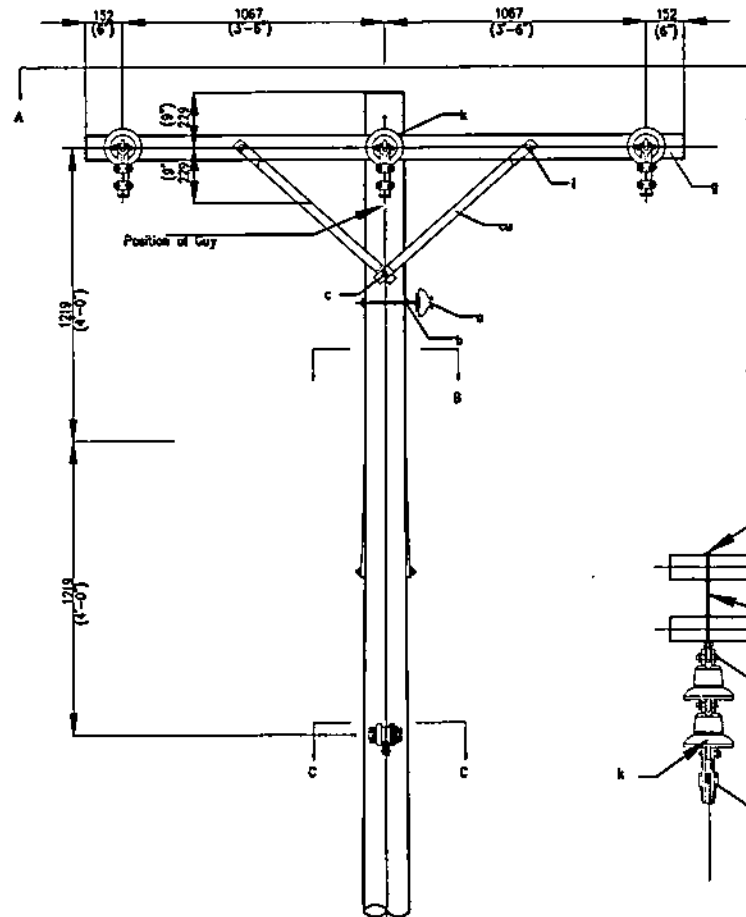
REV. 0

REV.	DATE	NATURE OF REVISION	BY	CHKD	RECD	APPL.

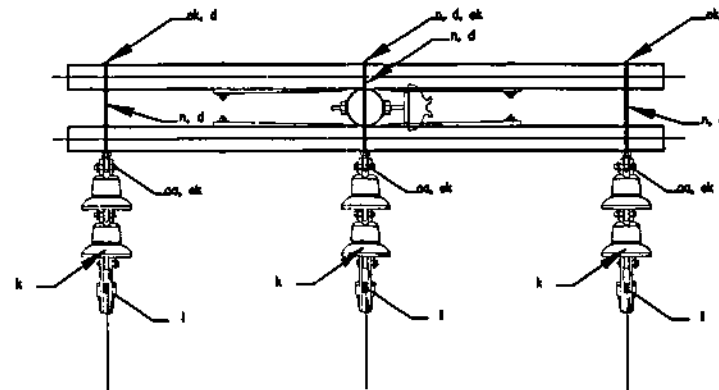
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. PRIMARY INSULATOR FOR THIS ASSEMBLY SHALL BE ANSI CLASS 52-2.
3. THIS DRAWING SHALL BE WORKED WITH CIVIL WORKS BID DRAWINGS.
4. * CONDUCTOR ACCESSORIES


ITEM	QTY	MATERIAL
cu	4	Brace, Crossarm, Standard 711 (26"), Steel (curve)
l	4	Bolt, Carriage, 10 x 114 (3/8" x 4-1/2")
n	3	Bolt, Double Armring, 18 x 559 (5/8" x 22")
o	1	Bolt, Eye, 16 x 305 (5/8" x 12")
c	7	Bolt, Machine, 13 x 254 (1/2" x 10")
i	3	Clamp, Deadend, Strain
bn	2	Clamp, Loop, Deadend
o	1	Clevis, Secondary, Swinging
u	2	Crossarm, 89 x 114 x 2440 (3-1/2" x 4-1/2" x 8'-0")
cm	1	Insulator, Spool, 76 (3") dia. Groove, Class 53 - 4
k	6	Insulator, Suspension, 152 (6") Clevis type, Class 52 - 1
ek	4	Locknut, 10 (3/8")
ek	11	Locknut, 16 (5/8")
ek	1	Locknut, 13 (1/2")
oo	3	Nut, Eye, 18 (5/8") Conventional
t	1	Wire, Tape, Armor, Al. Alloy, 13 x B (0.5" x 0.3")
d	11	Washer, 57 x 57 x 5 (2 1/4" x 2 1/4" x 3/16"), 21 (13/16") Hole
d	1	Washer, 51 x 51 x 3 (2" x 2" x 1/8"), 14 (9/16") Hole
d	4	Washer, Round, 32 (1 1/8") Outside diameter, 11 (7/16") Hole

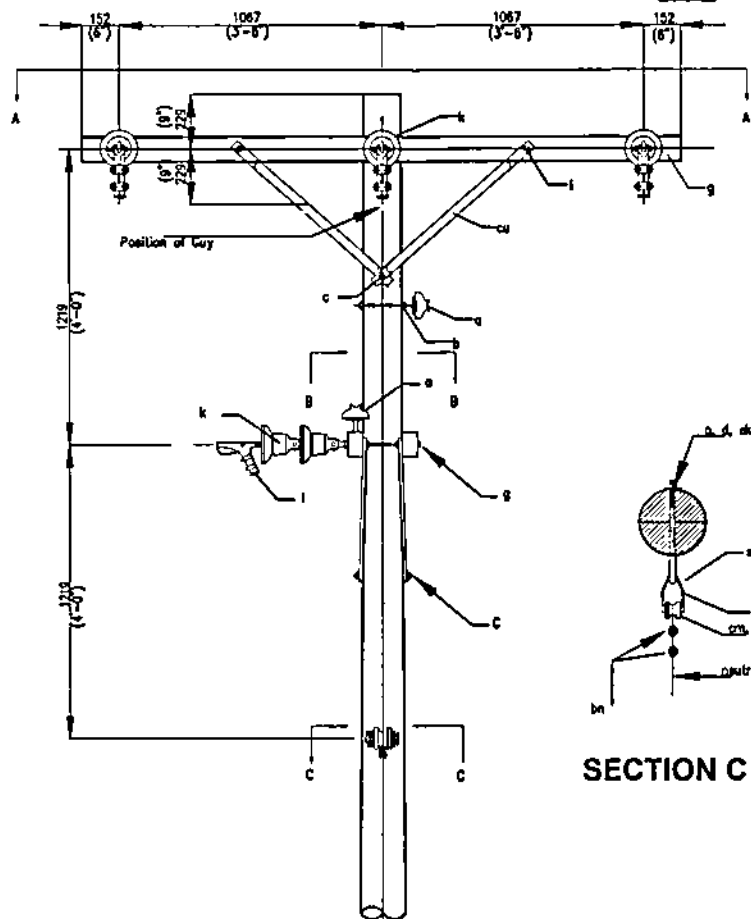


FRONT VIEW

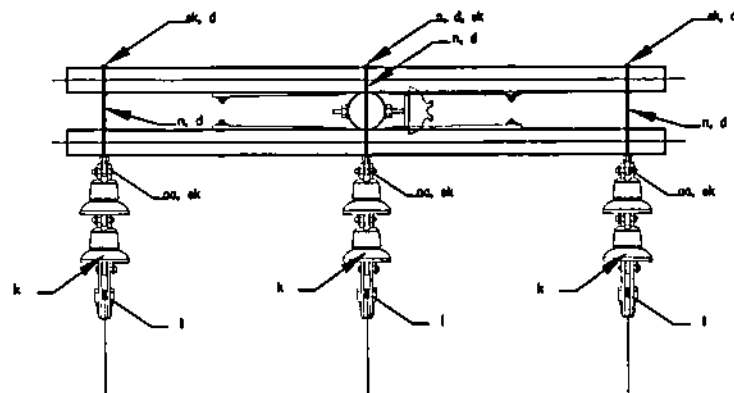


SECTION A-A

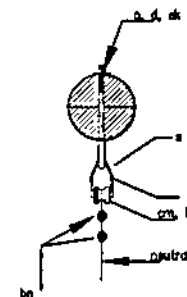
OWNER		 NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALAMAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS)			
LOCATION CULAB, PALAMAN, ISABELA			
TITLE 13.8KV TIE LINE THREE PHASE, CROSSARM CONSTRUCTION TYPE NCT (C7)			
DESIGNED	BY	CHKD	DATE
DRAWN			
REVIEWED	PRINCIPAL ENGINEER/TARGET		RECOMMENDED
CHECKED			
E.E.C.			APPROVED
MECH			
ENG NO. PalSPV-BDE-17.015		SPEC. NO. LuzP21Z12215a	
SCALE: NTS		BID DRAWING	
REV.	DATE	NATURE OF REVISION	REV. 0



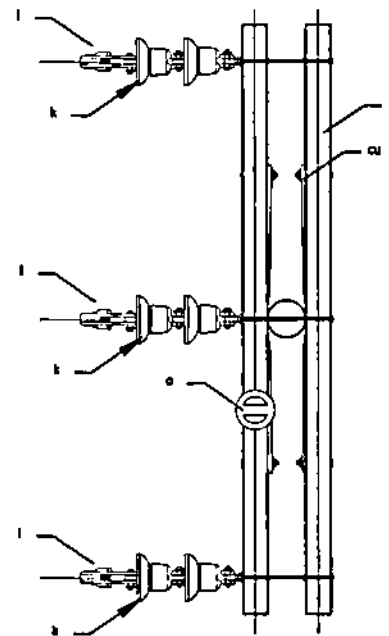
FRONT VIEW



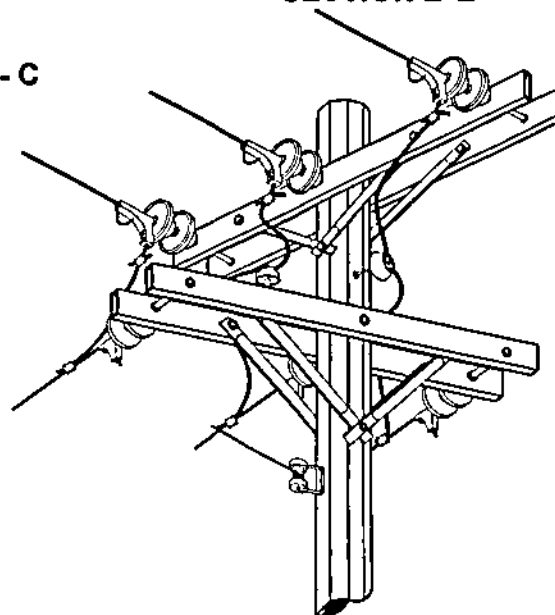
SECTION A-A



SECTION C - C



SECTION B-B



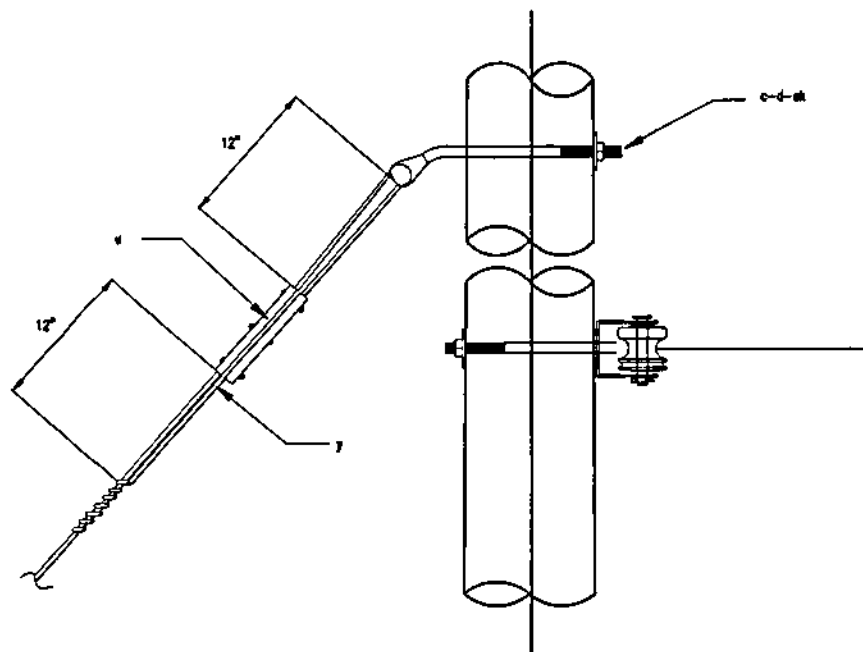
ISOMETRIC VIEW

NOTES:

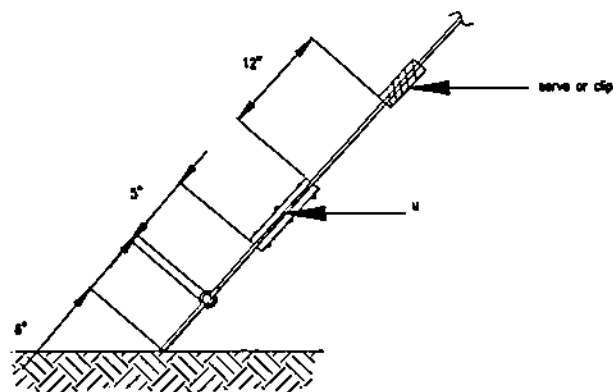
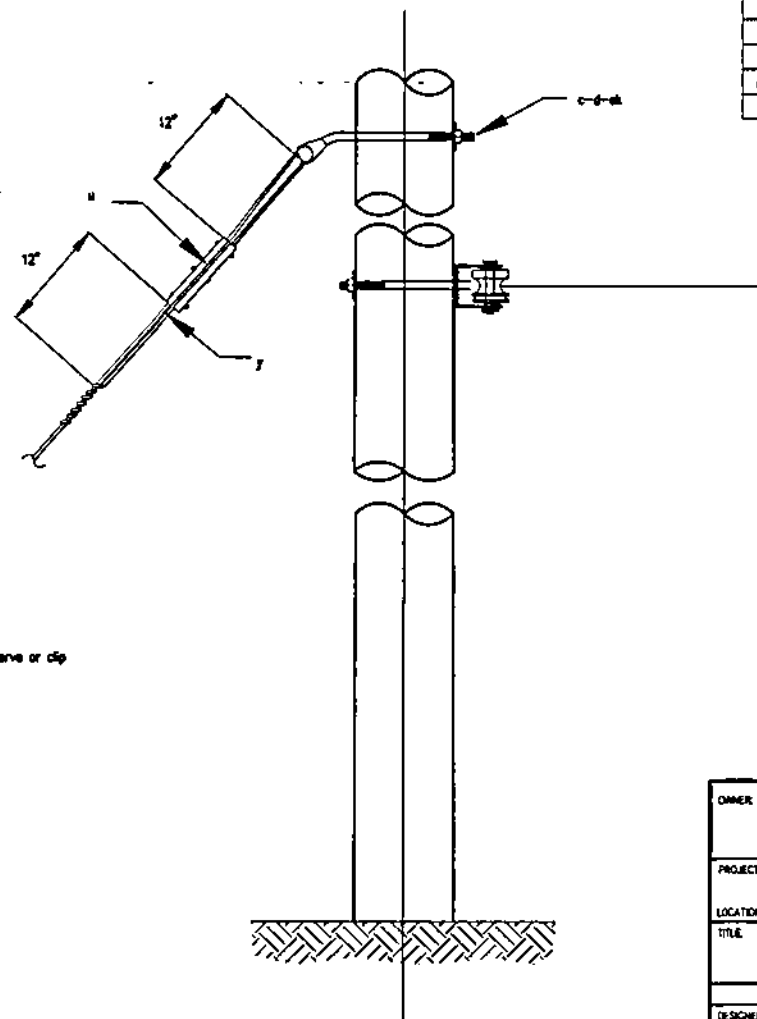
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. THIS DRAWING SHALL BE WORKED WITH CIVIL WORK'S BID DRAWINGS.
3. ALL END OF WIRES MUST BE PROPERLY WRAP 3(2") MINIMUM LENGTH.

ITEM	QTY	MATERIAL
cu	8	Brace, Crossarm, Standard 711 (28"), Steel (curve)
l	8	Bolt, Carriage, 10 x 114 (3/8" x 4-1/2")
a	6	Bolt, Double Arming, 18 x 358 (5/8" x 22")
o	2	Bolt, Eye, 16 x 305 (3/8" x 12")
c	12	Bolt, Machine, 13 x 254 (1/2" x 10")
l	6	Clamp, Deadend, Strain
bn	4	Clamp, Loop, Deadend
s	2	Clevis, Secondary, Swinging
g	4	Crossarm, 89 x 114 x 2440 (3-1/2" x 4-1/2" x 8'-0")
cm	2	Insulator, Spool, 76 (3") dia. Groove, Class 53 - 4
k	12	Insulator, Suspension, 152 (6") Clevis type, Class 52 - 1
ak	8	Locknut, 10 (3/8")
ak	14	Locknut, 18 (5/8")
ak	2	Locknut, 13 (1/2")
ao	6	Nut, Eye, 16 (5/8") Conventional
t	3'	Wire, Tape, Armor, Al. Alloy, 13 x 8 (0.5" x 0.3")
d	14	Washer, 57 x 57 x 5 (2 1/4" x 2 1/4" x 3/16"), 21 (13/16") Hole
d	2	Washer, 51 x 51 x 3 (2" x 2" x 1/8"), 14 (9/16") Hole
d	8	Washer, Round, 32 (1 1/8") Outside diameter, 11 (7/16") Hole

OWNER		NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS)			
LOCATION CULABI, PALANAN, ISABELA			
TITLE 13.8KV TIE LINE THREE PHASE CROSSARM CONSTRUCTION TYPE N2C7 (2XC7)			
DESIGNED	BY	CHKD	DATE
DRAWN			
REVIEWED	PRINCIPAL ENGR./ARCHT.	RECOMMENDED	
CIVIL/ARCHT		APPROVED	
ELEC.			
MECH.			
DNG NO PalSPV-BDE-17.016		SPEC NO LuzP2121221S	
SCALE NTS		BID DRAWING	
REV. DATE		NATURE OF REVISION	
BY		CHKD	
RECD		APPD	
		REV. 0	



POLE TOP PIN ASSEMBLY




PLAN

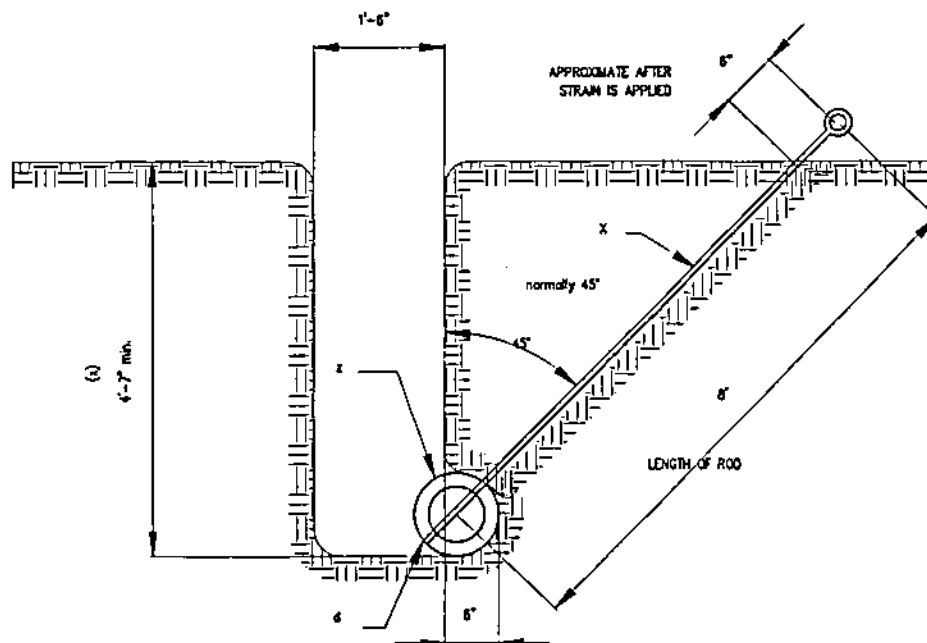
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. THIS DRAWING SHALL BE WORKED WITH CIVIL WORKS BID DRAWINGS.

ITEM	QTY	MATERIAL
SINGLE DOWN GUY, THROUGH BOLT TYPE		
e	1	timble eye, bolt
y	50R	3/8" guy wire, 7 strands
u	2	3-bolt, 6" long guy clamp
ak	1	Locknut, 5/8"
d	1	Washer 2 1/2" X 2 1/2" X 3/16", 13/16" hole

OWNER		 NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALAMAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS)			
LOCATION CULAB, PALAMAN, HABELA			
TITLE 13.8KV SINGLE DOWN GUY THROUGH BOLT TYPE TYPE NE1-2 (E1-2)			
DESIGNED	BY	CHKD	DATE
DRAWN			
REVIEWED	PRINCIPAL ENGR./ARCHT.		RECOMMENDED
CHALMERS			RECOMMENDED
ELEC.			APPROVED
MECH.			
DWG. NO. PalsPV-BDE-17.017		SPEC. NO. LuzP21Z12215e	
SCALE NTS		BID DRAWING	
REV. 0			

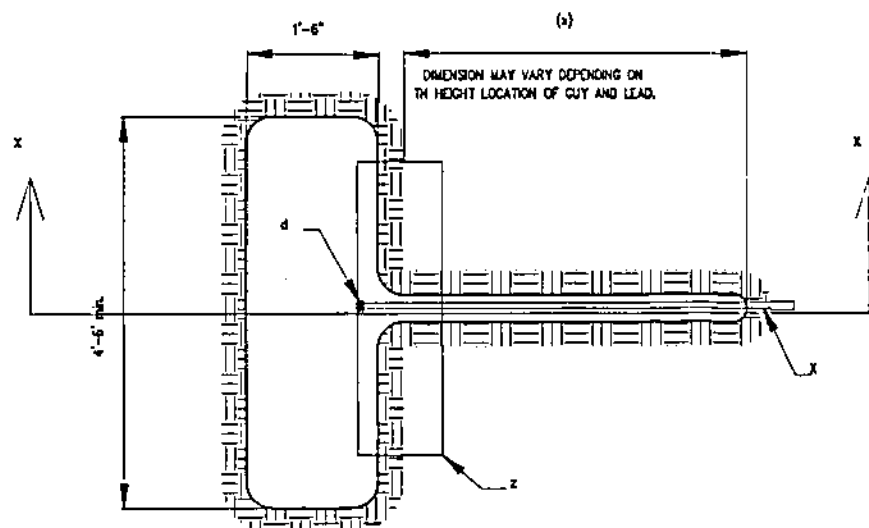
REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPD.




NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. THIS DRAWING SHALL BE WORKED WITH CIVIL WORKS BID DRAWINGS.
3. (X) DIMENSIONS MAY VARY DEPENDING ON THE HEIGHT LOCATION OF GUY AND LENGTH OF GUY LEAD.

ITEM	QTY	MATERIAL
ANCHOR LOG ASSEMBLY		
d	1	WASHER, 13/16 HOLE, TYPE 1/2" X 4" X 4"
z	1	ANCHOR LOG 8" X 4" - 8"
x	1	ANCHOR ROD THUMB EYE 3/4 - 8" W/ LOCKNUT



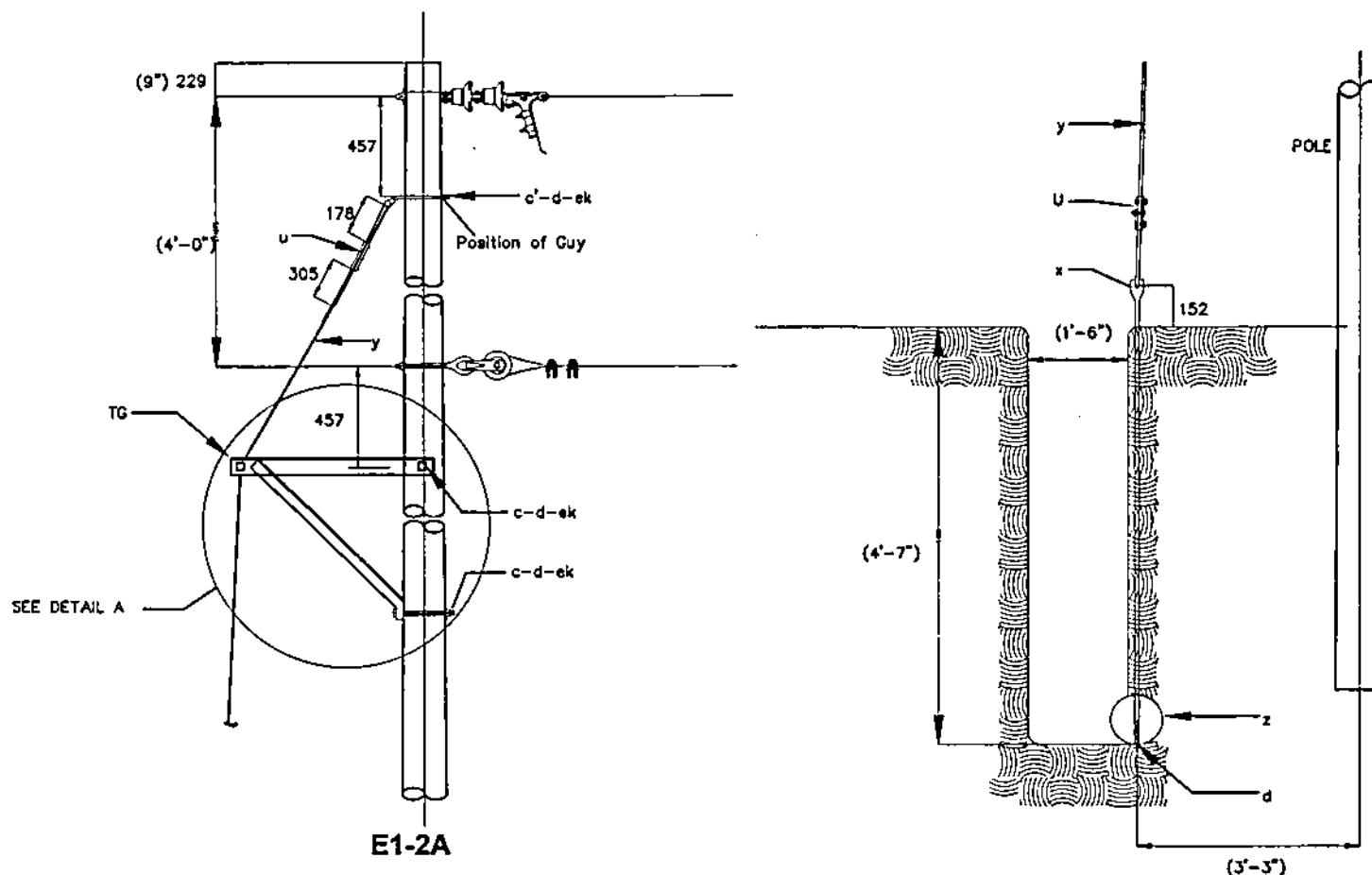
PLAN

OWNER		 NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS)			
LOCATION CULABI, PALANAN, ISABELA			
TITLE LOG ANCHOR ASSEMBLY TYPE NF2-2 (F2-2)			
DESIGNED	BY	CHKD	DATE
DRAWN			
REVIEWED	PERCEP/ENGR / ARCHT		RECOMMENDED
CIVIL/ARCHT			
ELEC			
MECH			
DWG NO. PalSPV-BDE-17.018		SPEC NO LuzP21Z1221S	
SCALE: NTS		BID DRAWING REV. 0	

REV.	DATE	NATURE OF REVISION	BY	CHKD	RECD	APPD

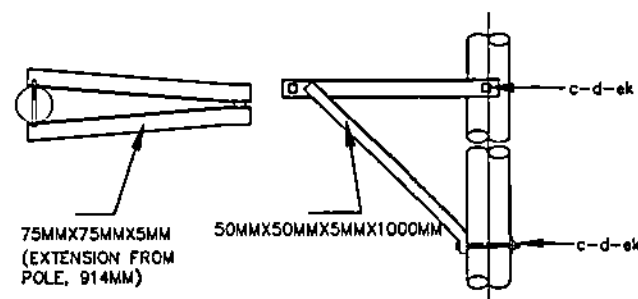
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. THIS DRAWING SHALL BE WORKED WITH CIVIL WORKS BID DRAWINGS.




ITEM	QTY	MATERIAL
E1-2A (TRUSS GUY detail)		
c'	1	Bolt, Thimble Eye, 5/8" x 10", Angle type (thread 5" from tip)
u	2	Clamp, Guy Straight, 3 Bolt Heavy Duty, Steel
ek	1	Locknut, 5/8"
ek	1	Locknut, 3/4"
ek	1	Locknut, 1/2"
d	3	Washer, 2 1/4" x 2 1/4" x 3/16", 13/16" hole
y	50'	Wire, Guy, Steel, 3/8", 7 Strand
TG	2	75mm X 75mm X 5mm, 914mm extension from pole
i	1	Angle Bar, 50mm X 50mm X 5mm X 1000MM
c	1	Bolt, Machine, 3/4" X 12"
c	1	Bolt, Machine, 1/2" X 12"

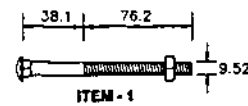
ITEM	QTY	MATERIAL
F2-2A (ANCHOR LOG detail)		
x	1	Anchor Log, 8" dia. x 4' - 6"
x	1	Rod, Anchor, Threaded, Thimble Eye, 3/4" x 8' with locknut
d	1	Washer, 13/16 hole, Type 4" x 4" x 1/2"
Holding power in ordinary soil (10,000 lb)		



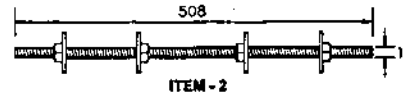
DETAIL A

OWNER		 NATIONAL POWER CORPORATION AGHAM ROAD, DELIMAN, QUEZON CITY	
PROJECT DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALAMAN SOLAR PV-DESEL HYBRID SYSTEM (NETH ESS)			
LOCATION: CULAME, PALAMAN, ISABELA			
TITLE: TRUSS GUY DETAIL E1-2A, F2-2A			
DESIGNED	BY	CHKD	DATE
DRAWN			
REVIEWED	PRINCIPAL ENGR. JARONTE		RECOMMENDED
CIVIL/ARCHT			RECOMMENDED
ELEC			APPROVED
MECH			
DWG NO. PalSPV-BDE-17.019		SPEC NO. LuzP21Z1221S	
SCALE: NTS		BID DRAWING	
REV. DATE		REV. 0	

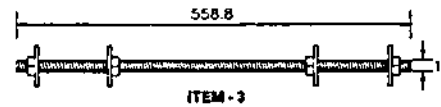
ITEM	MATERIALS DESCRIPTION/SPECIFICATIONS
1	BOLT, CARRIAGE 10 X 114 (5/8" X 4-1/2") THREADED AT LEAST 76 (3") FROM TOP WITH LOCKWASH AND WASHER, HOT DIP GALVANIZED AS PER ASTM A-153 MINIMUM COATING 301 G/M ² OF SURFACE OR 0.054 MM THICK, STEEL, AS PER ASTM A-307.
2	BOLT, DOUBLE ARMING 16 X 508 (5/8" X 20") FULL THREAD WITH AT LEAST 4 SETS OF NUT, LOCKWASH AND WASHER - 57 X 57 X 8 (2 1/4" X 2 1/4" X 3/16"), 21 (13/16") HOLE DIAMETER, STEEL PER ASTM A-307 FOR SHAFING, HOT DIP GALVANIZED PER ASTM A-153 MINIMUM COATING 301 G/M ² OF SURFACE OR 0.054MM THICK.
3	BOLT, DOUBLE ARMING 16 X 358 (5/8" X 22") FULL THREAD WITH AT LEAST 4 SETS OF NUT, LOCKWASH AND WASHER - 57 X 57 X 8 (2 1/4" X 2 1/4" X 3/16"), 21 (13/16") HOLE DIAMETER, STEEL PER ASTM A-307 FOR SHAFING, HOT DIP GALVANIZED PER ASTM A-153 MINIMUM COATING 301 G/M ² OF SURFACE OR 0.054MM THICK.
4	BOLT, OVAL EYE, 16 X 254 (5/8" X 10") FULL THREAD WITH AT LEAST 86 (3.5") FROM TOP WITH NUT, LOCKWASH AND WASHER - 57 X 57 X 5 (2 1/4" X 2 1/4" X 3/16"), 21 (13/16") HOLE DIAMETER, STEEL PER ASTM A-307, HOT DIP GALVANIZED PER ASTM A-153 MINIMUM COATING 301 G/M ² OF SURFACE OR 0.054 MM THICK.
5	BOLT, OVAL EYE, 16 X 308 (5/8" X 12") FULL THREAD WITH AT LEAST 140 (5.5") FROM TOP WITH NUT, LOCKWASH AND WASHER - 57 X 57 X 5 (2 1/4" X 2 1/4" X 3/16"), 21 (13/16") HOLE DIAMETER, STEEL PER ASTM A-307, HOT DIP GALVANIZED PER ASTM A-153 MINIMUM COATING 301 G/M ² OF SURFACE OR 0.054 MM THICK.
6	BOLT, OVAL EYE, 16 X 457 (5/8" X 18") FULL THREAD WITH AT LEAST 203 (8") FROM TOP WITH NUT, LOCKWASH AND WASHER - 57 X 57 X 5 (2 1/4" X 2 1/4" X 3/16"), 21 (13/16") HOLE DIAMETER, STEEL PER ASTM A-307, HOT DIP GALVANIZED PER ASTM A-153 MINIMUM COATING 301 G/M ² OF SURFACE OR 0.054 MM THICK.
7	BOLT, TRIPLE EYE, 16 X 254 (5/8" X 10") FULL THREAD WITH AT LEAST 86 (3.5") FROM TOP WITH NUT, LOCKWASH AND WASHER - 57 X 57 X 5 (2 1/4" X 2 1/4" X 3/16"), 21 (13/16") HOLE DIAMETER, STEEL PER ASTM A-307, HOT DIP GALVANIZED PER ASTM A-153 MINIMUM COATING 301 G/M ² OF SURFACE OR 0.054 MM THICK.
8	BOLT, MACHINE, 13 X 254 (1/2" X 10") THREADED WITH AT LEAST 86 (3.5") FROM TOP WITH NUT, LOCKWASH AND WASHER - 57 X 57 X 5 (2 1/4" X 2 1/4" X 3/16"), 21 (13/16") HOLE DIAMETER, STEEL PER ASTM A-307 FOR SHAFING, HOT DIP GALVANIZED AS PER ASTM A-153 MINIMUM COATING 301 G/M ² OF SURFACE OR 0.054 MM THICK, BOLTS STARTING FROM 150 (6") LENGTH MUST BE FURNISHED WITH BUTTER POINT (1/3 (1/2) OF BOLTS LENGTH), BOLTS LENGTH DOES NOT INCLUDE BUTTER POINT.
9	BOLT, MACHINE, 16 X 254 (5/8" X 10") THREADED WITH AT LEAST 86 (3.5") FROM TOP WITH NUT, LOCKWASH AND WASHER - 57 X 57 X 5 (2 1/4" X 2 1/4" X 3/16"), 21 (13/16") HOLE DIAMETER, STEEL PER ASTM A-307 FOR SHAFING, HOT DIP GALVANIZED AS PER ASTM A-153 MINIMUM COATING 301 G/M ² OF SURFACE OR 0.054 MM THICK, BOLTS STARTING FROM 150 (6") LENGTH MUST BE FURNISHED WITH BUTTER POINT (1/3 (1/2) OF BOLTS LENGTH), BOLTS LENGTH DOES NOT INCLUDE BUTTER POINT.
10	BOLT, MACHINE, 18 X 254 (3/8" X 10") THREADED WITH AT LEAST 140 (5.5") FROM TOP WITH NUT, LOCKWASH AND WASHER - 57 X 57 X 5 (2 1/4" X 2 1/4" X 3/16"), 21 (13/16") HOLE DIAMETER, STEEL PER ASTM A-307 FOR SHAFING, HOT DIP GALVANIZED AS PER ASTM A-153 MINIMUM COATING 301 G/M ² OF SURFACE OR 0.054 MM THICK, BOLTS STARTING FROM 150 (6") LENGTH MUST BE FURNISHED WITH BUTTER POINT (1/3 (1/2) OF BOLTS LENGTH), BOLTS LENGTH DOES NOT INCLUDE BUTTER POINT.
11	BOLT, MACHINE, 16 X 358 (5/8" X 14") THREADED WITH AT LEAST 152 (6") FROM TOP WITH NUT, LOCKWASH AND WASHER - 57 X 57 X 5 (2 1/4" X 2 1/4" X 3/16"), 21 (13/16") HOLE DIAMETER, STEEL PER ASTM A-307 FOR SHAFING, HOT DIP GALVANIZED AS PER ASTM A-153 MINIMUM COATING 301 G/M ² OF SURFACE OR 0.054 MM THICK, BOLTS STARTING FROM 150 (6") LENGTH MUST BE FURNISHED WITH BUTTER POINT (1/3 (1/2) OF BOLTS LENGTH), BOLTS LENGTH DOES NOT INCLUDE BUTTER POINT.
12	BOLT, SINGLE UPSET, 16 X 254 (5/8" X 10") THREADED WITH AT LEAST 86 (3.5") FROM TOP WITH NUT, LOCKWASH AND WASHER - 57 X 57 X 5 (2 1/4" X 2 1/4" X 3/16"), 21 (13/16") HOLE DIAMETER, STEEL PER ASTM A-307 FOR SHAFING, HOT DIP GALVANIZED AS PER ASTM A-153 MINIMUM COATING 301 G/M ² OF SURFACE OR 0.054 MM THICK.
13	BRACE, CROSSARM, 710 (28") STEEL, STEEL PER ASTM A36 - 77 A, HOT DIP GALVANIZED AS PER ASTM A123-76, MINIMUM COATING 702 G/M ² OF SURFACE OR 0.061 MM THICK.
14	BRACKET, CLEANS DEADEND WITHOUT SPOOL, FLAT STEEL PER ASTM A36, HOT DIP GALVANIZED PER ASTM A123
15	CLAMP, HOT LINE, 1/2" ACSR MARK TO #4.
16	CLAMP, HOT LINE, 1/2" ACSR MARK TO #10.
17	CLAMP, LOOP DEADEND STRAIN #4 HIGH STRENGTH ALUMINUM CASTING WITH GALVANIZED STEEL U-BOLT, EXTRA LONG SOFT ALUMINUM SPACER AND CAPS THAT CONFORM STRANDS HOLDING STRENGTH USING TWO DEADEND CLAMPS EXCEEDS RATED BREAKING STRENGTH OF CONDUCTORS.
18	CLAMP, DEADEND, STRAIN #4 - 1/2" ACSR, CLAMP BODIES AND KEEPER PIECES ARE CAST IN HIGH STRENGTH ALUMINUM ALLOY THAT IS NON COPPER BEARING, U BOLTS, CLEVIS PIN AND ASSOCIATED COMPONENT ARE STEEL, OUTER STEEL ARE STAINLESS STEEL, BALL CLEVIS IS DROP FORGE STEEL, SHAFT DIAMETER OF ANCH CLASS 52-3 AND 52-5 PIN IS CONSISTENT WITH ANCH INSULATOR W & E STRENGTH RATING OF 15000' AND 25000 LBS RESPECTIVELY.
19	CLAMP, GUY STRAIGHT, THREE BOLT HEAVY DUTY STEEL CLAMP STEEL AS PER ASTM A 36, BOLT AND NUT AS PER ASTM A 307, HOT DIP GALVANIZED AS PER ASTM A 153 MINIMUM COATING 301 G/M ² OF SURFACE OR 0.054MM THICK.



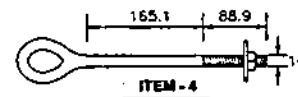
ITEM - 1



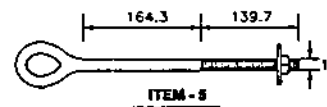
ITEM - 2



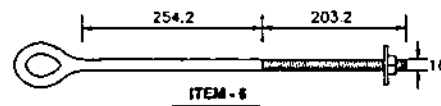
ITEM - 3



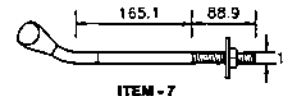
ITEM - 4



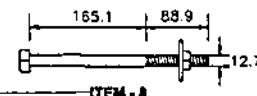
ITEM - 5



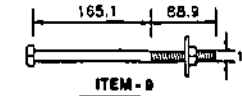
ITEM - 6



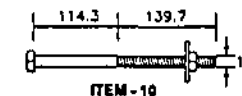
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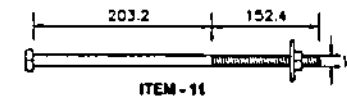
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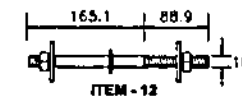
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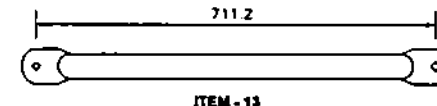
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ITEM - 11



ITEM - 12



ITEM - 13



ITEM - 14



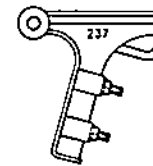
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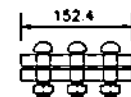
ITEM - 16



ITEM - 17



ITEM - 18



ITEM - 19

NOTES:

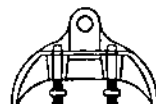
- ALL DIMENSIONS AS SHOWN ARE IN MILLIMETERS UNLESS OTHERWISE INDICATED.

OWNER		NATIONAL POWER CORPORATION	
		AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALAMAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS)			
LOCATION CULAB, PALAMAN, ISABELA			
TITLE 13.8KV TIE LINE MATERIAL SPECIFICATIONS AND DRAWINGS (1/2)			
DESIGNED	CHKD	DATE	
DRAWN			
REVIEWED	PRINCIPAL ENGR. / ARCHT.	RECOMMENDED	
CIVIL/ARCHT		APPROVED	
ELEC			
MECH			
DWG. NO. P-SPV-BDE-17-020		SPEC. NO. LUZP21Z1221Se	
SCALE: NTS		BID DRAWING	
REV.	DATE	NATURE OF REVISION	BY

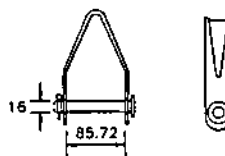
ITEM	MATERIALS DESCRIPTION/SPECIFICATIONS
20	CLAMP, SUSPENSION, ALUMINUM ALLOY CLEVIS, 2 BOLTS #2/0 ACSR MAXIMUM, ALL FORDUS TYPE ARE HOT-DIP GALVANIZED. ALL PARTS ARE FREE FROM CORROSION INCLUDING SHARP EDGES AND SURFACE ROUGHNESS, KEPPER AND ADAPTER ARE DROP FORGED FROM C-1010 S50 STEEL.
21	CLEVIS, SECONDARY SWINGING WITHOUT SPOOL.
22	SHACKLE, ANCHOR, DROP FORGE STEEL, HOT DIP GALVANIZED AS PER ASTM A-153 MINIMUM COATING 301 G/M ² OF SURFACE OR 0.05MM THICK, STEEL AS PER ASTM A-307.
23	CONDUCTOR, BARE ACSR (#2, AVG. 6/1 (MTRS))
24	CONDUCTOR, BARE ACSR (#4, AVG. 6/1 (MTRS))
25	CONDUCTOR, BARE ACSR (#2/0, AVG. 6/1 (MTRS))
26	CONDUCTOR, DUPLEX (#2, AVG. (MTRS))
27	CONNECTOR, COMPRESSION, #2/0 AVG RUN TO #2/0 ACSR.
28	CONNECTOR, COMPRESSION, #2 AVG RUN TO #2 AVG. ACSR.
29	CONNECTOR, COMPRESSION, #4 AVG ACSR RUN TO #4 AVG. ACSR.
30	CONNECTOR, COMPRESSION, 10 (#3/8"), (GROUND WIRE) RUN TO #4 AVG. ACSR.
31	CONNECTOR, COMPRESSION, 10 (#3/8"), (GROUND WIRE) RUN TO #2 AVG. ACSR.
32	PNL CROSS ARM, STEEL, 18 x 273 (5/8" x 10-3/4"), WITH NUT, LOCK NUT AND WASHER/STEEL PER ASTM A-307, HOT DIP GALVANIZED PER ASTM A-153 MINIMUM COATING 301 G/M ² OF SURFACE OR 0.054 MM THICK.
33	FUSE, CUT-OUT, 15 KV (FOR UNIVERSAL, BOTTOM HEAD, TYPE K, FUSE LINK) AND ARRESTER, COMBINATION (WITH MOUNTING BRACKET), STRUCTURAL STEEL AS PER ASTM A-36 77A, HOT DIP GALVANIZED AS PER ASTM A-123 78 MINIMUM COATING 0.8102 KG/M ² OF SURFACE OR 0.0860 MM.
34	INSULATOR, PIN TYPE, PORCELAIN, ANSI CLASS 55-4
35	INSULATOR, SPOOL, 44 (1-3/4"), ANSI CLASS 53-2
36	INSULATOR, SPOOL, 78 (2"), ANSI CLASS 53-4
37	INSULATOR, SUSPENSION, CLEVIS 152 (6"), CLEVIS TYPE, ANSI OR NEMA CLASS 53-1
38	LINK, FUSE, UNIVERSAL, BOTTOM HEAD, TYPE K, 4 AMP.
39	NUT, EYE, 16 (5/8"), CONVENTIONAL, HOT DIP GALVANIZED BOLTS MADE TO EED-NEMA SPECIFICATIONS.
40	PNL POLE TOP, CHANNEL, 25 (1"), THREAD, 508 (20") LONG.
41	ROD, ANCHOR, THREADED, SINGLE EYE, 18 x 2440 (3/4" x 8") WITH NUT LOCKNUT AND WASHER - 57 x 57 x 6 (4" x 4" x 1/2"), 21 (13/16") HOLE DIAMETER STEEL AS PER ASTM A-307 FOR SHAFING, HOT DIP GALVANIZED AS PER ASTM A-153 MINIMUM COATING 301 G/M ² OF SURFACE OR 0.054 MM THICK.
42	ROD, ANCHOR, PREFORMED, FOR #2 ACSR, SINGLE SUPPORT.
43	ROD, ANCHOR, PREFORMED, FOR #2/0 ACSR, SINGLE SUPPORT.
44	ROD, ANCHOR, PREFORMED, FOR #2/0 ACSR, DOUBLE SUPPORT.
45	SPOOL, PIPE, 18 x 30 (3/4" x 1-1/2")

NOTES:

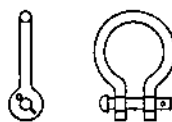
- ALL DIMENSIONS AS SHOWN ARE IN MILLIMETERS UNLESS OTHERWISE INDICATED.



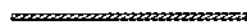
ITEM - 20



ITEM - 21



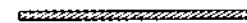
ITEM - 22



ITEM - 23



ITEM - 24



ITEM - 25



ITEM - 26



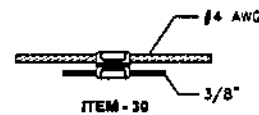
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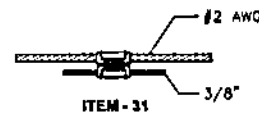
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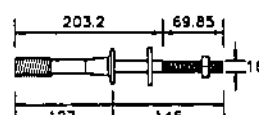
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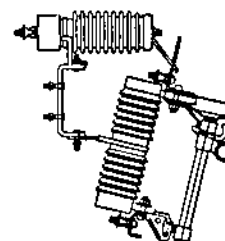
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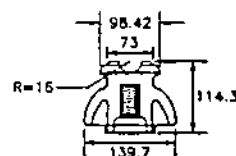
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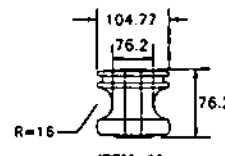
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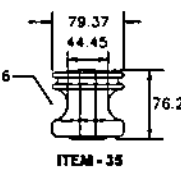
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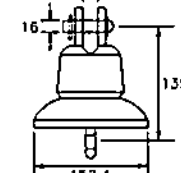
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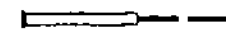
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ITEM - 36



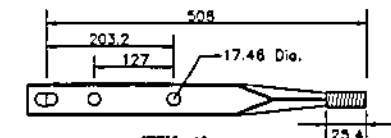
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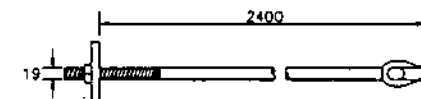
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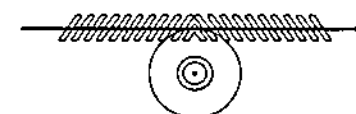
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ITEM - 40



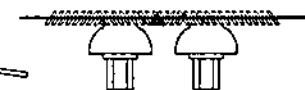
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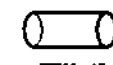
ITEM - 42



ITEM - 43



ITEM - 44



ITEM - 45

NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALAMAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS)	
LOCATION: CULAN, PALAMAN, ISABELA	
TITLE 13.8KV TIE LINE MATERIAL SPECIFICATIONS AND DRAWINGS (2/2)	
DESIGNED DRAWN REVIEWED CHECKED ELEC MECH	SUBMITTED RECOMMENDED APPROVED DNG NO. P-SPV-BDE-17.021 SCALE: NTS
SPEC NO. LUZP21212215	
BID DRAWING	
REV. 0	

REV.	DATE	NATURE OF REVISION	BY	CHKD.	RECD.	APPR.

SECTION IX

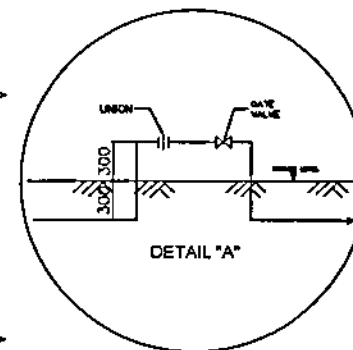
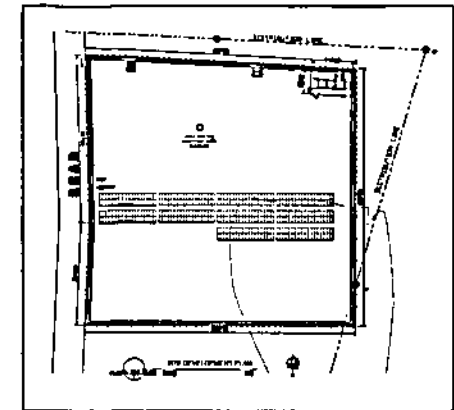
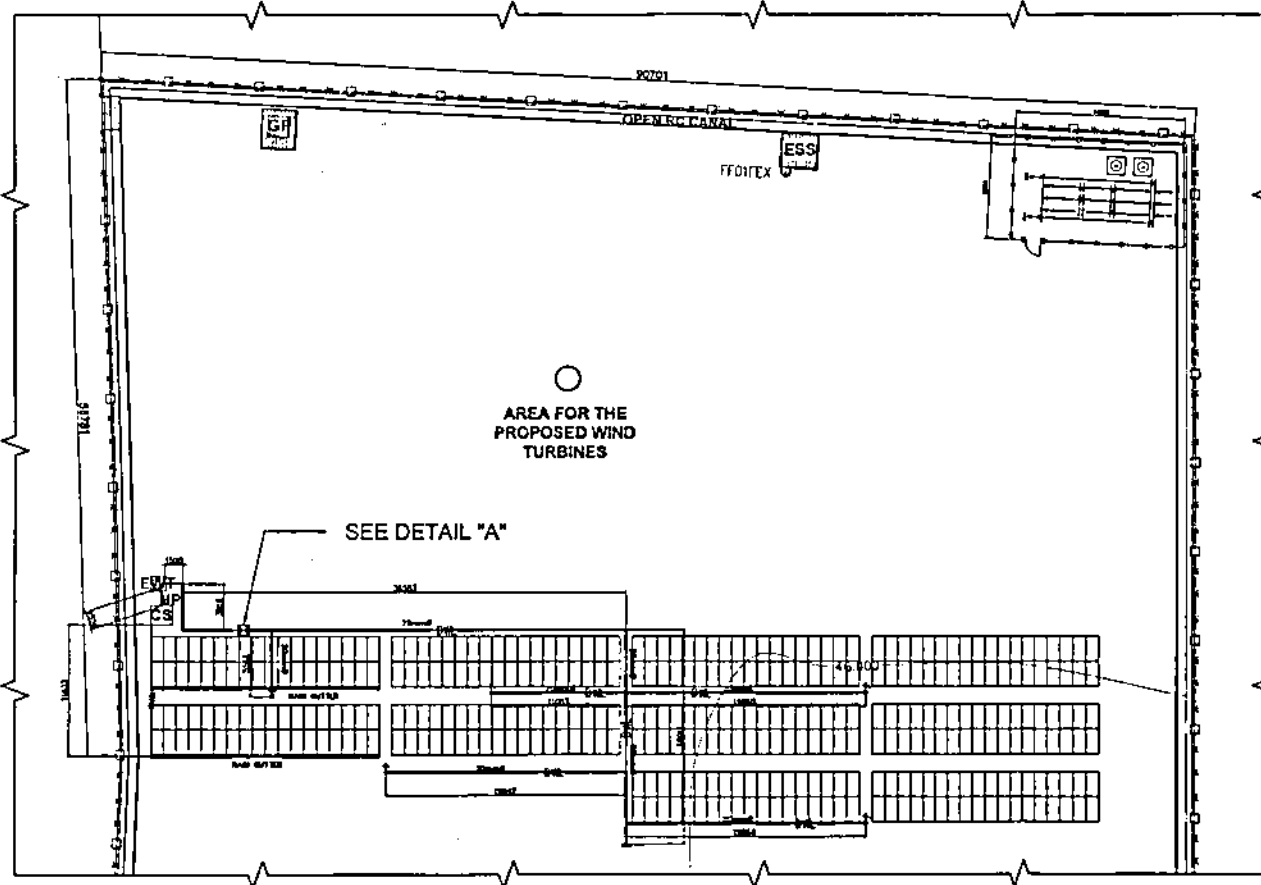
BID DRAWINGS

MECHANICAL WORKS

**TABLE OF CONTENTS
BID DRAWINGS****MW – MECHANICAL WORKS**

<u>DRAWING NO.</u>	<u>TITLE</u>
PaISPV-BDM-17.001	EQUIPMENT AND PIPING LAYOUT (Palanan Solar Power Plant)
PaISPV-BDM-17.002	WATER SYSTEM P & I Diagram




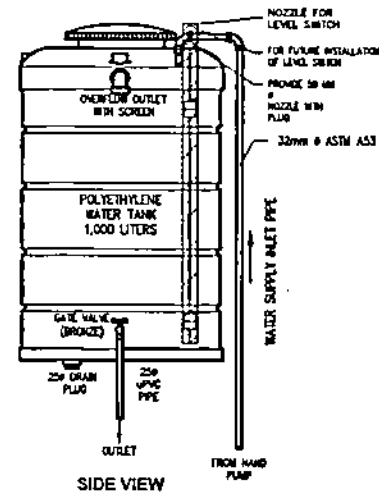


LEGEND	
GP	GUARDPOST
EWT	ELEVATED WATER TANK
ESS	ENERGY STORAGE SYSTEM
CS	COSTERN TANK
HP	HAND PUMP
DWL	DOMESTIC WATER LINE
RWL	RAIN WATER LINE
↑	HOSE BIBB
⊙	FIRE EXTINGUISHER

NOTES:

1. THIS DRAWING IS FOR REFERENCE PURPOSES ONLY.
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
3. THE CONTRACTOR SHALL SUBMIT DESIGN CALCULATIONS AND FOUNDATION DETAILS FOR ALL EQUIPMENT TO BE SUPPLIED UNDER THIS SCOPE FOR APPROVAL OF NPC INCLUDING STRUCTURAL SUPPORT OF WATER TANK.
4. ONE (1) SET OF 20MM DIAMETER GARDEN HOSE, 30M LONG WITH CONNECTOR FOR THE 20MM HOSE BIBB SHALL BE SUPPLIED BY THE CONTRACTOR.
5. THE DIMENSION SHOWN MAY BE ADJUSTED BASED ON THE ACTUAL DIMENSION OF THE EQUIPMENT TO BE SUPPLIED BY THE CONTRACTOR.
6. ONE FIRE EXTINGUISHER SHALL BE PLACED FOR EACH INSTALLED STRING INVERTER.

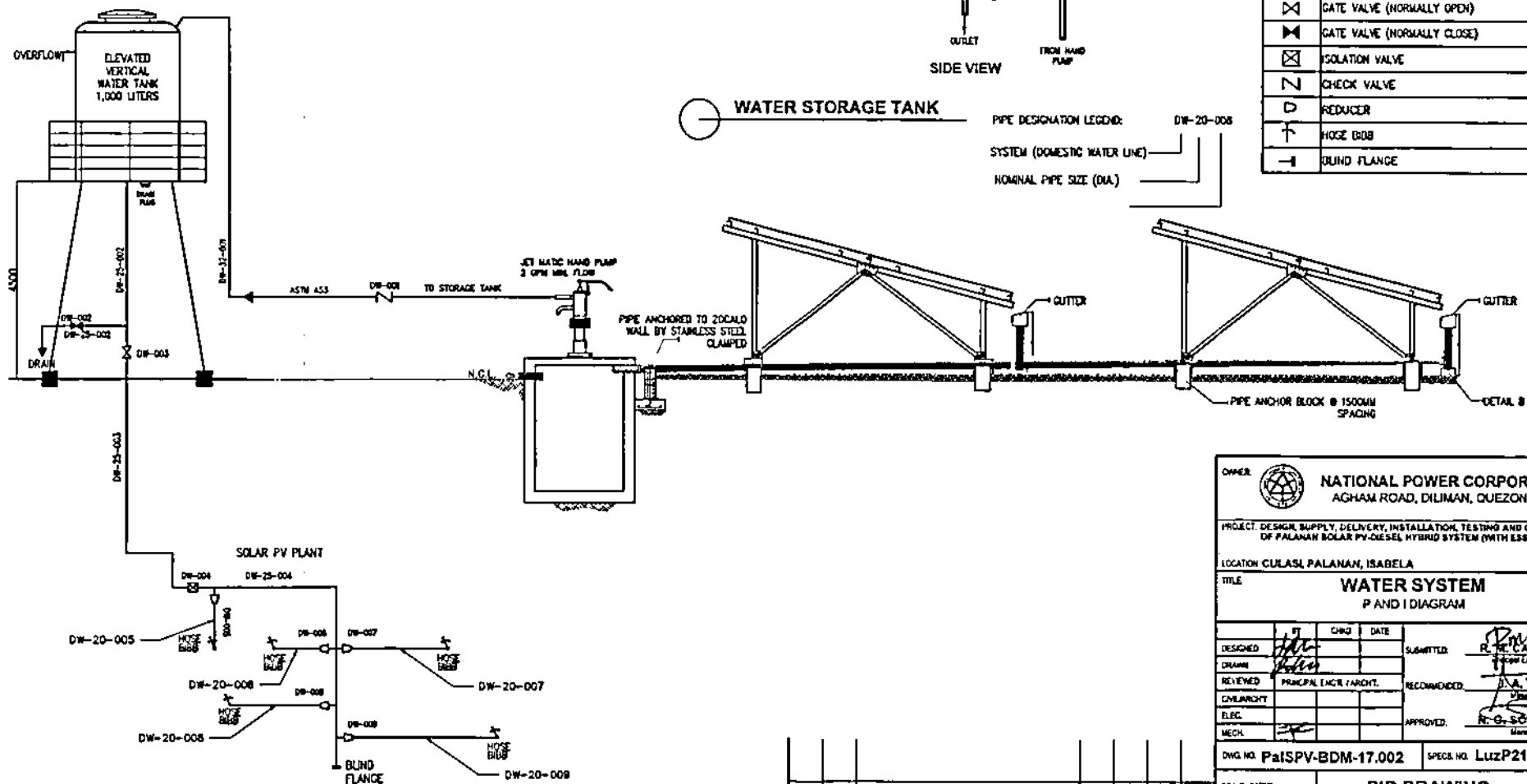
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PROJECT: DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS)					
LOCATION: CALABALAN BARBARA					
TITLE: EQUIPMENT AND PIPING LAYOUT (PALANAN SOLAR POWER PLANT)					
DESIGNED	BY	CHKD	DATE	SUBMITTER	<i>[Signature]</i> PROJECT ENGINEER, A, MDO
DRAWN	<i>[Signature]</i>			RECOMMENDED	<i>[Signature]</i> PROJECT ENGINEER, A, MDO
REVIEWED	PRINCIPAL ENGR. TAYOYT			APPROVED	<i>[Signature]</i> N. G. SCHROEDER MANAGER, E&C
CIVIL/MECH					
ELEC					
MECH	<i>[Signature]</i>				
DWG NO PaISPV-BDM-17.001				SPEC NO LUZP21Z121S#	
REV.	DATE	NATURE OF REVISION	BY	CHKD	RECD
SCALE: NTS			BID DRAWING		REV. 0




1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. ALL PIPING, PIPE FITTINGS AND SUPPORTS, VALVES AND OTHER ACCESSORIES REQUIRED SHALL BE SUPPLIED, INSTALLED AND TESTED BY THE CONTRACTOR INCLUDING THE REQUIRED EXCAVATION AND BACKFILLING WORKS.
3. DOMESTIC WATER PIPING AND FITTINGS SHALL BE MADE OF UNPLASTICIZED POLYVINYL CHLORIDE (PVC) SCHEDULE 80 OR CLASS 150 CONFORMING TO ASTM D-1784 OR APPROVED EQUIVALENT (EXCEPT OTHERWISE SHOWN).
4. WATER SYSTEM PIPE SHALL GENERALLY BE INSTALLED UNDERGROUND NO LESS THAN 300MM DEPTH.
5. ALL PVC/PE PIPE DIMENSIONS SHOWN ARE IN NOMINAL DIAMETER (MM) WITH THE FOLLOWING EQUIVALENTS:

50MM (2")	= 63MM O.D.
75MM (1 1/4")	= 90MM O.D.
100MM (1")	= 125MM O.D.
200MM (3/4")	= 250MM O.D.
150MM (1/2")	= 200MM O.D.
6. THIS DRAWING IS FOR BIDDING PURPOSES ONLY.

LEGEND	
—	DOMESTIC WATER LINE
	GATE VALVE (NORMALLY OPEN)
	GATE VALVE (NORMALLY CLOSE)
	ISOLATION VALVE
	CHECK VALVE
	REDUCER
	HOSE BIB
	ROUND FLANGE



OWNER		 NATIONAL POWER CORPORATION AGHAM ROAD, DILIMAN, QUEZON CITY	
PROJECT: DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING AND COMMISSIONING OF PALANAN SOLAR PV-DIESEL HYBRID SYSTEM (WITH ESS)			
LOCATION CULASI, PALANAN, ISABELA			
TITLE		WATER SYSTEM P AND I DIAGRAM	
DESIGNED	BY <i>[Signature]</i>	CHECK	DATE
DRAWN	<i>[Signature]</i>		
REVIEWED	PRINCIPAL ENGR. / ARCHT.	RECOMMENDED	<i>[Signature]</i>
CIVIL/ARCHT			<i>[Signature]</i>
ELEC.			
MECH.	<i>[Signature]</i>	APPROVED	<i>[Signature]</i>
DWG. NO. PAISPV-BDM-17.002		SPECS. NO. LuzP21Z1221S	