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GENERAL NOTES:
1-THE DRAWING IS NOT TO BE SCALED. ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED.
2-ALL DIMENSIONS ARE IN CENTIMETERS UNLESS OTHERWISE INDICATED.
3-ALL LEVELS ARE IN METERS.

KEY PLAN:

REV.	DATE	MODIFICATION	DRAWN	DESIGNED	CHECKED	APPROVED
3	13/01/2024	DESIGN	RS	RS	MMA	RH
2	06/12/2023	DESIGN	RS	RS	MMA	RH
1	18/10/2023	DESIGN	RS	RS	MMA	RH
0	30/09/2023	DESIGN	RS	RS	MMA	RH

LOT:
RAS EL MATN

Project Name
**COMPOSTING STATION
RAS EL MATN**

DRAWING TITLE:
**LIST OF DRAWINGS &
GENERAL NOTES**

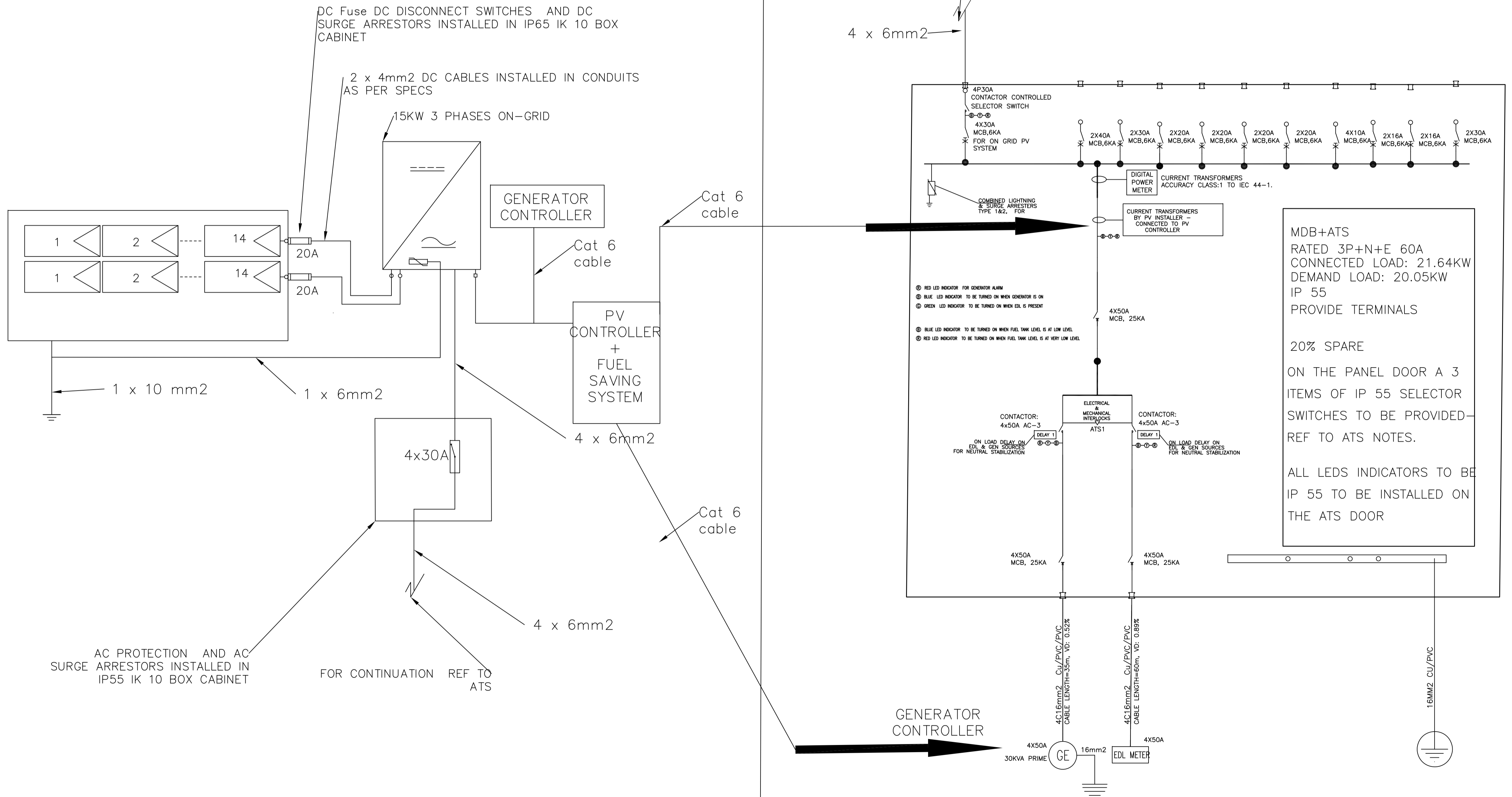
DRAWING NUMBER **PV-01**
SCALE : NTS DATE : 13/01/2024

LIST OF DRAWINGS	GENERAL NOTES
<p>PV-01 LIST OF DRAWINGS & GENERAL NOTES PV-02 PV RISER SYSTEM CONNECTION PV-03 LAYOUT/SECTION/ TYPICAL DETAILS</p>	<p>NOTE 1 :ALL SURFACE MOUNTED CONDUITS WILL BE EMT OR RGS CONDUITS TYPE. NOTE2: ALL WIRES AND CABLES ARE COPPER TYPE-UNLESS OTHERWISE SPECIFIED NOTE 3: FOR ATS CONTROL REF TO ATS NOTES AND DWGS- FOR INFO AND ACTION WHERE NEEDED NOTE 4: WHERE CONDUITS CANNOT BE PROTECTED, EMT OR RGS CONDUITS TO BE USED NOTE 5: ALL SURFACE MOUNTED MATERIAL TO BE AUTO EXTINGUISHABLE AND HIGH IMPACT PROTECTED TYPE NOTE 6: IN TECHNICAL AREAS ALL CONDUITS AND BOXES MUST BE WATERPROOF AND IK-10 PROTECTED NOTE 7:ALL RECESSED CONDUITS TO BE POLYETHYLENE HIGH IMPACT PROTECTED TYPE NOTE 8: MIN CONDUIT FOR POWER IS ø 20, AND ø 20 FOR LOW CURRENT</p> <p>NOTE 9:THE LAYOUT DRAWINGS ARE DESIGN DRAWINGS, AND DOESN'T COVER ALL THE NECESSARY DETAILS NEEDED FOR CONSTRUCTION PURPOSES. HENCE THE CONTRACTOR IS ASKED TO SUBMIT SHOP DRAWINGS PRIOR THE START OF CONSTRUCTION WORKS SHOWING ALL PIPING LEVELS AND EXACT ROUTING. IN ADDITION THE CONTRACTOR IS TO SUBMIT A FULL SET OF AS BUILT DRAWING SHOWING ALL THE DETAILS EXACTLY AS EXECUTED ON SITE</p> <p>NOTE 10: CHINESE PRODUCTS/BRANDS/MATERIAL ARE NOT APPROVED THE LIST OF MANUFACTURERS SHOULD FOLLOW USAID'S RULES AND REGULATION FOR FOREIGN POLICY RESTRICTED COUNTRIES.</p> <p>NOTE 11: -PVC CONDUIT AND CABLE TRAY SHALL NOT BE USED FOR OUTDOOR, EXPOSED ENVIRONMENTS. -ALL CONDUITS, FITTINGS AND BOXES SHALL BE RATED FOR THE AREA THEY WILL BE INSTALLED IN. -PROVIDE LIQUID TIGHT, FLEXIBLE CONDUIT AT ALL MOTOR CONNECTIONS. -DO NOT USE PVC FOR CONDUIT EXPOSED ON WALLS. PVC MAY BE EXPOSED TO DAMAGE. USE EMT OR RGS CONDUIT. -RGS CONDUIT SHALL BE USED FOR OUTDOOR, EXPOSED ENVIRONMENTS. -ALL RACEWAYS, CONDUITS, DUCTS AND MULTI-CONDUCTOR CABLES SHOULD CONTAIN EQUIPMENT EARTHING CONDUCTORS SIZED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE OR EQUIVALENT EUROPEAN STANDARD. MINIMUM SIZES SHALL BE 2.5 MM2.</p>
PROJECT ELECTRICAL SCOPE BRIEF	
<p>THE PROJECT CONSIST OF INSTALL AND CONNECT THE FOLLOWING SYSTEMS : PV SYSTEM-ON-GRID 15KWP INCLUDE STRUCTURE, PANELS, INVERTER INCLUDING MONITORING SCREEN, FUEL SAVING SYSTEM DC CABLES. AC CABLE FROM INVERTER TO ATS PANEL, CURRENT TRANSFORMER IN ATS EQUIPOTENTIAL BONDING, REF TO STRUCTURE DOCUMENTS FOR STRUCTURE WORKS, CONTROL CABLES IN COORDINATION WITH THE GENERATOR CONTROL PANEL, MONITORING, WEATHER SENSORS AND MONITORING SOFTWARE (FREE) , MANHOLES AND CONDUITS WITH THE PV SYSTEM ZONE- FOR STRUCTURE AND FENCE DETAILS REF TO STRUCTURE FILE- THE STRUCTURE SHOULD DEPEND ON THE WIND 130KM/H, AND NATURE OF THE SOIL</p> <p>PROVIDE SAFETY LINES ,IN COORDINATION WITH THE STRUCTURE</p>	<p>B. BY OTHERS. MANHOLES, CONDUITS UP TO ATS , CONNECTION ATS SIDE, ATS, GENERATOR, EARTH BAR</p>
GENERAL SPECIFICATIONS	
<ul style="list-style-type: none"> THE CONTRACTOR SHALL COMPLY WITH THE MOST RECENT VERSION OF DESIGN AND STANDARDS FOR ALL WORK, EQUIPMENT AND MATERIALS. THE FOLLOWING LIST OF STANDARDS IS PROVIDED AS A GUIDELINE: INTERNATIONAL ELECTRO TECHNICAL COMMISSION (IEC), EC STANDARDS, AND NL STANDARDS. THE CONTRACTOR WILL COMPLY WITH ALL APPLICABLE LEBANESE LAWS AND REGULATIONS, AND FUTURE AMENDMENTS. THE CONTRACTOR SHALL PROVIDE ALL LABOR, MATERIALS, TOOLS, EQUIPMENT'S, AND TRANSPORTATION; INSURANCE, ETC. FOR ALL WORK HEREIN SPECIFIED AND OR REQUIRED TO COMPLETE THE PROJECT. THE SYSTEM SHOULD BE FULLY OPERATIONAL IN THE FOLLOWING CONDITIONS: <ul style="list-style-type: none"> a. RELATIVE HUMIDITY UP TO 95%. b. AMBIENT TEMPERATURE FROM -10°C TO 45°C. c. RURAL ENVIRONMENT WITH PRESENCE OF DUST, INSECTS... d. 130KM/H WIND A WARRANTY OF ONE YEAR ON THE INSTALLED PRODUCTS SHALL BE PROVIDED. THE CONTRACTOR SHOULD DO ALL THE NEEDED COORDINATION BETWEEN TRADES . 	

PV RISER

NOTE:
 1-PV STRING CAN BE 2 OR 3 DEPENDING ON THE FINAL SELECTED MATERIAL
 2-FINAL NUMBER OF PANEL WILL DEPEND ON THE FINAL SUBMITTAL AND PANELS SELECTION
 3-CONTRACTOR TO VERIFY THAT THE STRING VOLTAGE FALLS WITHIN THE INVERTER OPERATING VOLTAGE AND MPPT VOLTAGE RANGE TAKING INTO CONSIDERATION SITE MAX AND MIN AMBIENT TEMPERATURE.
 4-CONTRACTOR TO VERIFY THAT THE MPPT TRACKER MAX INPUT CURRENT AND SHORT CIRCUIT CURRENT ARE WITHIN THE INVERTER OPERATING MARGIN

-PV SYSTEM SPECIALIST SUPPLY THE CONTROL CABLE FOR THE FOLLOWING:
 1- CONTROL CABLE UP TO GENERATOR CONTROLLER- CONNECTION AT GENERATOR SIDE BY GENERATOR SPECIALIST- CONNECTION AT PV SYSTEM SIDE IS BY PV SYSTEM SPECIALIST-
 2- SUPPLY AND INSTALL OF THE CURRENT TRANSFORMER IN THE ATS . .
 -COMPLETE COORDINATION TO BE DONE BETWEEN THE ELECTRICAL CONTRACTOR PV SPECIALST AND THE GE SPECIALIST
 -ATS PANEL BY ELECTRICAL CONTRACTOR



FOR CONTINUATION REF TO PV RISER

4 x 6mm2

Cat 6 cable

Cat 6 cable

4 x 6mm2

Cat 6 cable

4 x 6mm2

FOR CONTINUATION REF TO ATS

GENERATOR CONTROLLER

MDB+ATS
 RATED 3P+N+E 60A
 CONNECTED LOAD: 21.64KW
 DEMAND LOAD: 20.05KW
 IP 55
 PROVIDE TERMINALS
 20% SPARE
 ON THE PANEL DOOR A 3 ITEMS OF IP 55 SELECTOR SWITCHES TO BE PROVIDED- REF TO ATS NOTES.
 ALL LEDS INDICATORS TO BE IP 55 TO BE INSTALLED ON THE ATS DOOR



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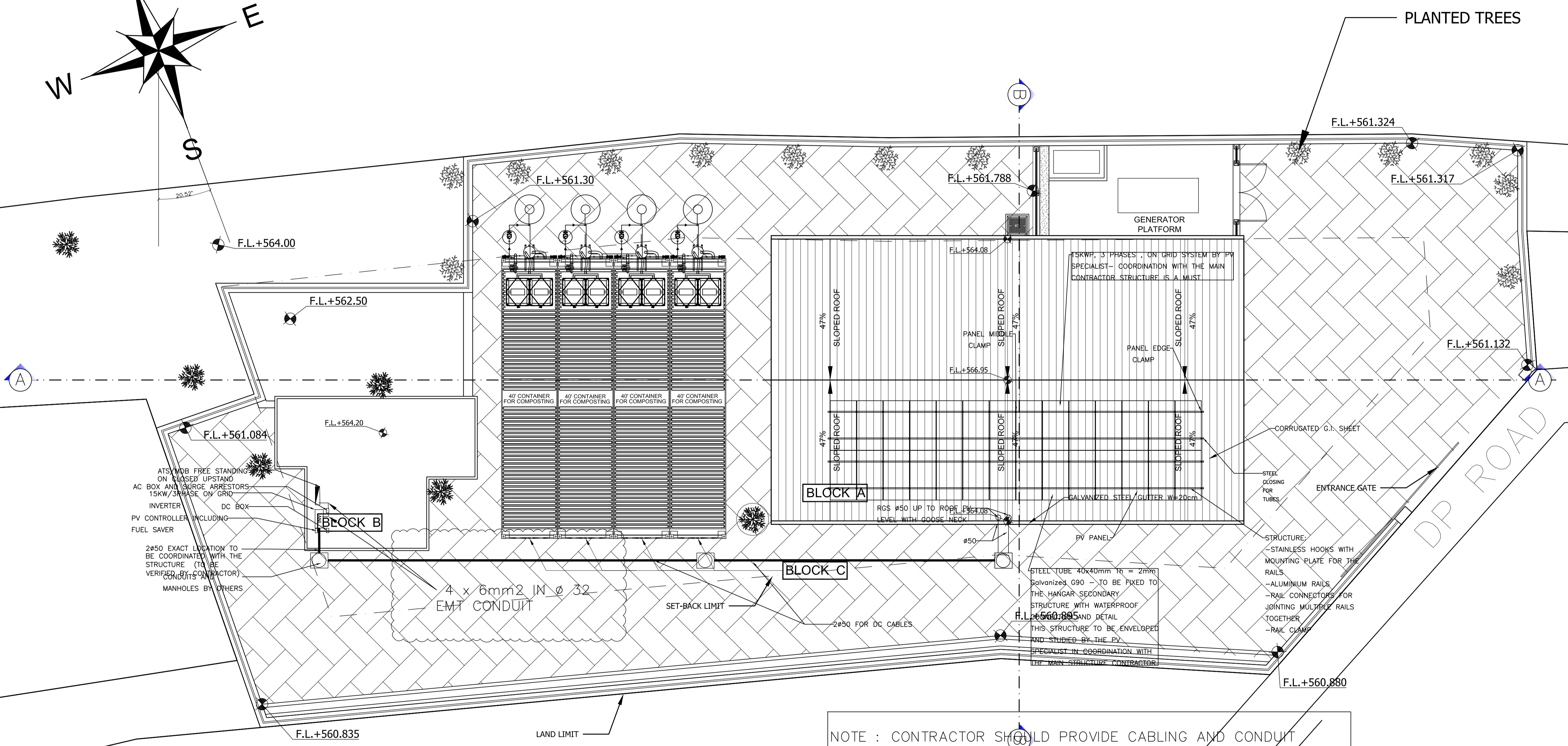
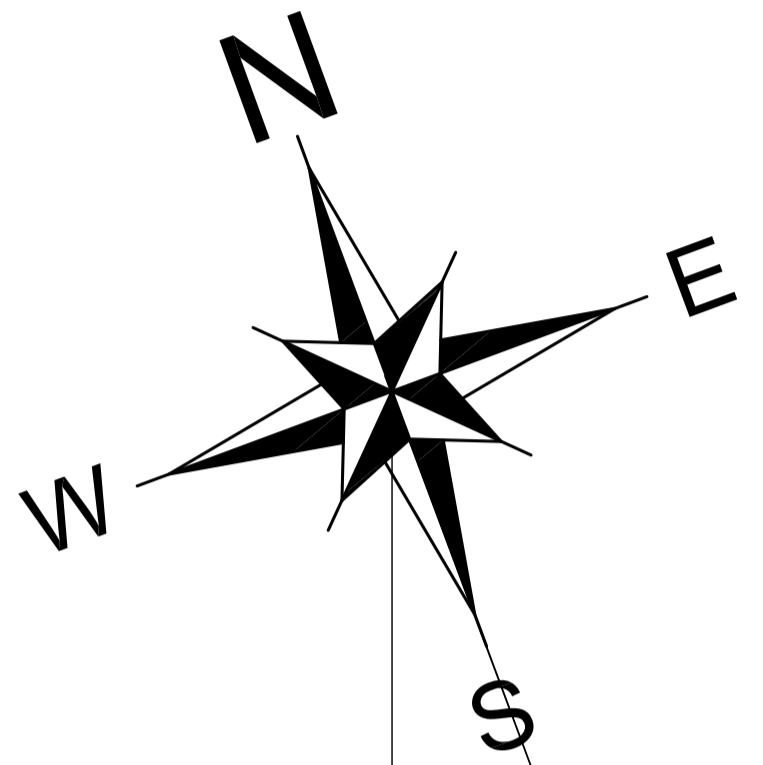
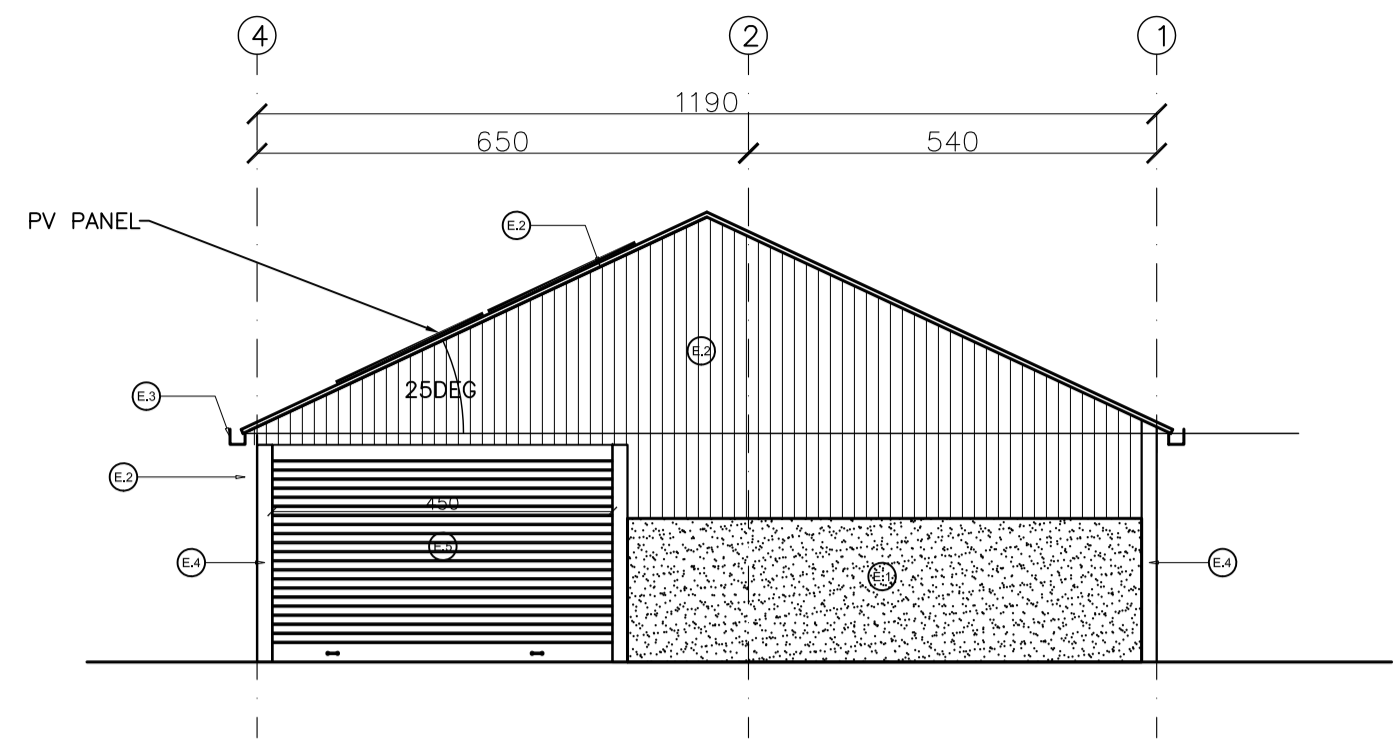
LOT:
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Project Name
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DRAWING TITLE:
 PV RISER
 SYSTEM CONNECTION

DRAWING NUMBER PV-02
 SCALE : NTS DATE : 13/01/2024

NOTES: SAFETY REQUIREMENTS FOR WORK AND MAINTENANCE OF ROOF MOUNTED PV SYSTEM.:
 - ANY TECHNICIAN SHOULD BE EQUIPPED WITH HARNESS ANCHORED TO THE STRUCTURE
 - FACILITY PERSONNEL WILL BE TRAINED OF THE NEED OF SAFETY HARNESSES WHILE MAINTAINING/WORKING ON THIS SYSTEM.
 - SAFETY LINE IN COORDINATION WITH STRUCTURE TO BE PROVIDED BY THE CONTRACTOR



NOTE : CONTRACTOR SHOULD PROVIDE CABLING AND CONDUIT ROUTING ON ROOF. IT SHOULD ALSO INCLUDE LOCATION AND PROTECTION OF CONDUIT AS TRIPPING HAZARD IF RUN ALONG ROOF SURFACE.
 CONTRACTOR SHOULD PROVIDE MOUNTING DETAILS.

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LOT:

RAS EL MATN						
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Project Name
**COMPOSTING STATION
 RAS EL MATN**

DRAWING TITLE:
**LAYOUT/SECTION/
 TYPICAL DETAILS**

DRAWING NUMBER **PV-03**

SCALE : 1/100 DATE : 13/01/2024

PV SYSTEM WORKS

Item	Description	Unit	Quantity	Unit Cost without VAT	Total Cost without VAT (US\$)
A GENERATOR					
A1	supply, install, including crane price and commission the following items as per specifications and as shown on drawings.				
A1.1	PV SYSTEM Supply, Install, Connect, Test And Commission The Following . (Crane Cost Included if needed)				
A1.2	PV Panels as per dwgs and RFQ (15KWP) including secondary structure	Ls	1.0	incl	
A1.3	PV On-Grid inverter as per dwgs and RFQ (15KW)	nbr	1.0	incl	
A1.4	PV controller / Fuel saver, current transformer as per dwgs and RFQ	LS	1.0	incl	
A1.5	AC cabling including conduits ,AC Box IP55 rated box, AC surge arrestors as per dwgs and RFQ	LS	1.0	incl	
A1.6	PV DC cabling including DC, conduits , Box IP65 rated box, DC disconnects, DC fuses and DC surge arrestors as per dwgs and RFQ	LS	1.0	incl	
A1.7	cat6 cable	LS	1.0	incl	
A1.8	irradiation, temperature and wind sensor,	LS	1.0	incl	
A1.9	PV supports and accessories	LS	1.0	incl	
A1.10	equipotential Bonding as per Dwgs and RFP	LS	1.0	incl	
TOTAL A					
B OTHERS					
B1	contractor to quote any item in the dwg not listed in the BOQ (details to be sent)	1	item		
TOTAL C					
pv system works total amount excluding VAT					



USAID
FROM THE AMERICAN PEOPLE



PV ON-GRID SYSTEM SPECIFICATIONS

USAID Diverting Waste by Encouraging Reuse and Recycling (DAWERR) Activity-RAS EL MATN
composting Station

February 2024

USAID DAWERR ACTIVITY:
PV ON GRID SPECIFICATIONS

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USAID DAWERR ACTIVITY:
PV ON GRID SPECIFICATIONS

1. PROJECT DESCRIPTION

The project is a composting facility, with three main entities:

- Composting containers
- Reception area
- Curing area

2. SCOPE OF WORK

This document will cover the general and detailed specification for the PV ON GRID system with fuel saver controller services.

This document should be read in conjunction with the drawings and notes.

3. GENERAL

3.1. DESIGN BRIEF

The project consists of install and connect the following systems:

Pv system-on-grid 15kwp include structure, panels, inverter including monitoring screen, fuel saving controller system DC cables. Ac cable from inverter to ATS panel, current transformer in ATS equipotential bonding, structure works, control cables in coordination with the generator control panel, monitoring, weather sensors and monitoring software (free), manholes and conduits with the PV system zone-

3.2. ENVIRONMENTAL CONDITIONS:

The Pv system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

- Ambient Temperature: -10 °C to 45 °C.
- Relative Humidity: 0 to 95 percent.
- Altitude: 940 m.
- Wind pressure is calculated at 136.8 km/hr (38 m/s) according to LIBNOR Norms NL 137 Second Edition 2013 – 3.1

3.3. SITE COORDINATE POINTS:

- to be used to download in the PVsys software the climatic conditions of RAS EL MATN / Lebanon

3.4. GENERAL SPECIFICATIONS:

- All system's components should be manufactured according to International Quality and Environment Management System Standards ISO 9001 and ISO 14001 respectively.
- Any intervention on the inverters must be possible in full electrical safety. The necessary external protection devices need to be added in the immediate proximity of the inverter.

- Complete installation following recommendations by the manufacturer (minimum spacing, outdoor installation under PV panels metallic structures, etc.)
- Ground connection of the inverter to the equipotential bonding conductor and to the protective conductor of the AC part
- The main cables connected to a single inverter, or to each input of an inverter with its own MPPT (maximum power point tracker), should be coming from parallel strings of same power and from photovoltaic modules in the same plan (tilt/orientation).
- Note: the maximum string open-circuit voltage shall not exceed the inverter maximum MPPT operating voltage
- The electrical installation should be designed according to the IEC and national standards. All cables and wires shall have an adequate cross section that takes into account the maximum current, total distance and voltage drop less than 5%.
- All system's components datasheets and certificates shall be submitted.
- All certifications have to be issued by an internationally recognized laboratory.
- The PV modules of the entire plant shall be procured from the same manufacturer and shall be of the same model number with identical specifications in terms of nominal power rating, nominal characteristics and coefficients.
- No procurement can be done from foreign Policy Restricted countries, as per USAID rules and regulation.
- The following inverters brands are not accepted:
 1. Huawei Technologies Company.
 2. ZTE Corporation.
 3. Hytera Communications Corporation.
 4. Hangzhou Hikvision Digital Technology Company.
 5. Dahua Technology Company.
 6. Or any subsidiary or affiliate of such entities.

- The following panels brands are not accepted:
 1. Hoshine Silicon Industry (metallurgical grade silicon and silicon products) -
 2. Xinjiang Daqo New Energy (polysilicon, wafers)
 3. Xinjiang East Hope Nonferrous Metals (polysilicon, ingots, wafers)
 4. Xinjiang GCL-New Energy Material (polysilicon, ingots, wafers, cells, modules)
 5. Xinjiang Production and Construction Corps

- Measures against Potential Induced Degradation on PV side and/or Inverter side

4. SPECIFICATIONS

A. Solar Photovoltaic (PV) Modules minimum criteria:

PV PANEL SPECS	
Power Tolerance	+5/-0 Avg. %
Nominal Power (Pnom)	550 Wp
Panel Efficiency	Should not be less than 21%
Rated Voltage (Vmpp)	41.9 V
Rated Current (Impp)	13.1 A
Open-Circuit Voltage (Voc)	64.8V
System Voltage IEC	1000 V
Power Temp Coef	-0.35 % / ° C
Voltage Temp Coef.	-176.6 mV / ° C
Current Temp Coef.	2.6 m A / ° C
Standard Tests	IEC 61215, IEC 61730
Quality Certs	ISO 9001:2008, ISO 14001:2004
EHS Compliance	RoHS, OHSAS 18001:2007, lead free, REACH SVHC-163,
Ammonia Test	IEC 62716
Desert Test	10.1109/PVSC.2013.6744437
Salt Spray Test	IEC 61701 (maximum severity)
PID Test	IEC 62804-Potential-Induced Degradation free: 1000 V
Temperature	-40° C to +85° C
Impact Resistance	1 inch (25 mm) diameter hail at 52 mph (23 m/s)
Appearance	Class A Solar Cells Monocrystalline
Tempered Glass	High-transmission tempered anti-reflective
Junction	MC4
front Frame	Class 1 anodized

B. PV DC Cabling:

PV DC cabling and associated components are exposed to UV, wind, water, salt and other environmental conditions. Wiring and components should be fit for this purpose and built in such a way as to minimize exposure to detrimental environmental effects. Particular attention is drawn to the need for prevention of water accumulation in cable/module support systems.

DC CABLE SPECS	
Voltage Level	1500 VDC
Composition	Single Core
Conductor	Tin Coated Copper, Class 5 to IEC 60228

USAID DAWERR ACTIVITY:
PV ON GRID SPECIFICATIONS

Standard Compliant	EN 50618
Insulation Compound	Halogen Free Thermosetting
Outer Sheath Color	Red(positive) and Black(negative)
armored	NO
Method of Installation:	Inside RGS CONDUITS
Fire Performance	Flame Retardant
Cable section:	As per contractor calculation Note

C. ON-GRID Inverter specification:

ON GRID INVERTER SPECS	
Rated Power:	15kw
Minimum Number of MPPT Trackers per inverter:	2 MIN
Minimum Protection Class	IP65
Output AC voltage:	adjustable: 3 / N / PE 230, 400 V (adjustable)
Output AC frequency:	50 Hz
Maximum THD:	4%
Maximum Consumption at night:	3 W
Minimum efficiency (Greater or equal to):	98%
Standards:	Harmonic Current (IEC61000-3-2 and/or IEC61000-3-4), IEC62109-1/2
Anti -islanding protection:	VDE 0126-1-1 or similar
Communication:	MODBUS/RS485, reading/writing on the inverter
Possibility to control output power of Inverters	YES
Measures against Potential Induced Degradation	YES
Proper external protection measures on AC and DC sides	including surge protection.
Outdoor use IP65 - (encased for protection against falling dirt, rain, sleet, snow, windblown dust, splashing water, hose-directed water, and corrosion)	YES
DC-side disconnection device	YES
Ground fault monitoring	YES

USAID DAWERR ACTIVITY:
PV ON GRID SPECIFICATIONS

DC reverse polarity protection	YES
AC short-circuit current capability	YES
All-pole sensitive residual-current monitoring unit	YES
Surge arrester & Overvoltage category (according to IEC 62109-1) I / AC: III; DC: I	YES
Monitoring	1-Integrated screen 2- application free
BRAND OR EQUIVALENT	SMA

D. Controller and Fuel Controller:

CONTROLLER	
Automatic Sustainable Controller	controller to integrate photovoltaic in an application with other power sources.
PV diesel hybrid system	coupling PV and diesel generators
monitoring	includes a display unit
	PV inverter communication support
	generator controller communication support
	Mains voltage and current measurement
Display unit	Easy and user-friendly display : has a screen with four lines. Each line has 20 characters. It includes a number of button and LED functions
	Up to 500 alarms and 500 events logging
	Support of CANbus based I/Os
password	multilevel
ports	CAN bus , Modbus RTU or TCP/IP communication.
Energy management system	programmable
	Inverter Controller should be able to detect blackout and EDL/Generator Operation.
	controls PV output power from inverter during Generator and EDL Operation. (it should be modulated output)
	This controller should be able to read actual power available from PV and actual load, and modulate PV output power from inverters in order not to have return power in the EDL and generator meters, unless a net metering meter is installed
	Displaying on site and data logging Values of interest (voltage, Current, solar radiation...etc.) (sensors should be included)-

USAID DAWERR ACTIVITY:
PV ON GRID SPECIFICATIONS

	Free application is Required-Monitoring on Any PC or cel Phone
	Includes Monitoring system (free), and free mobile application
	Located in IP65 Box.
	Eliminate the risk of reverse power caused by low load
	Minimum genset load
BRAND OR EQUIVALENT: DEIF	

E. Surge arrestors:

on DC and On AC (class B and C)

F. AC CABLES:

Specifications:

Cu/PVC/PVC (black)

600V/1000V

Follow the Lebanese color coding:

- Neutral: Grey
- Phases: Red, Yellow, Blue
- Earthing: Yellow Green.

Brand: "Cable du Liban » or equivalent

Installation:

In conduits

G. CONDUITS/ CABLE TRAYS:

Conduits Specs:

EMT conduits or schedule 40 conduits including accessories and **EMT boxes IP65 should be used**

RGS conduits where mechanical protection is needed.

polyethylene conduits can be used recessed

UPVC heavy impact resistant, can be used where none mechanical protection is Needed- It can be used also in trenches

PVC conduit should not be used for outdoor, exposed environments.

All conduits, fittings and boxes should be rated for the area they will be installed.

Provide liquid tight, flexible conduit at all motor connections.

Do not use PVC for conduit exposed on walls. PVC may be exposed to damage. **Use RGS conduit.**

Cable trays specs: will be hot dip galvanized installed horizontally and vertically, 1.5mm thickness.

Cable trays should be used where more than a cable are running on the same direction.

USAID DAWERR ACTIVITY:
PV ON GRID SPECIFICATIONS

Cable tray will include support and cover (will not be laid directly on the floor).

All cable trays, cable ladder, EMT, RGS conduits will be with equipotential bonding.
All accessories and supports to be provided from same brand.

Cable trays shall be installed as a complete system. Cable tray shall be secured and supported per the cable tray system and all cables shall be fastened to the tray per manufacturer's recommendations.

Cable tray is not recommended for outdoor applications.

H. CONCRETE TYPE

Not applicable

H.2 FERROUS METALS

- 1- Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- 2- Steel Plates, Shapes, and Bars: [ref to structure document](#)
- 3- Rolled Steel Floor Plates: [ref to structure document](#)

5. SEQUENCE OF OPERATION:

	EDL CONTACTOR	GENERATOR CONTACTOR	INVERTER	INVERTER CONTACTOR	0 A< LOAD < load max
EDL PRESENCE	CLOSED	OPEN	DELIVER POWER AS NEEDED BY LOAD	NORMALLY CLOSED	0 <INVERTER OUTPUT < MAX*
GENERATOR PRESENCE	OPEN	CLOSED	1-DELIVER POWER AS NEEDED BY LOAD MINUS THE MIN GENERATOR SET OUTOUT POWER 2- CONTROLLER TO CHECK THE GENERATOR OUTPUT FOR BEST ENERGY SAVING AND KEEP A MIN OUTPUT POWER	NORMALLY CLOSED	0 <INVERTER OUTPUT < (MAX*- GENERATOR MIN SET OUTPUT)
NO ELECTRICITY	CLOSED (NORMALLY CLOSED EDL SIDE)	OPEN	DO NOT DELIVER POWER (ON GRID)	NORMALLY CLOSED	NA
INVERTER OUTPUT ERROR	NO CHANGE IS STATUS	NO CHANGE IN STATUS	TURNED OFF	OPEN	NA
MAX*: DEPENDS ON SUNSHINE, AND LOAD					

6. LABELING

USAID DAWERR ACTIVITY:
PV ON GRID SPECIFICATIONS

Each item of equipment must have nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place.

Tags for each power cable or wire located in manholes, hand holes, and vaults shall be provided.

Provide signage at all disconnecting means including switches and circuit breakers in accordance with local Code.

Warning labels or signs shall be provided and affixed in a conspicuous place on the technical room and shall provide warning about safety hazards, e.g. smoking, water contact, etc. as well as emergency shutdown procedures.

All labeling material shall be weather-resistant.

A. EXECUTION:

- Calculation: following the submitted material the contractor should prepare the calculation note on PVsys or equivalent and submitted for approval

Shopdrawings should be submitted for approval

Shop drawings detailing fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections.

Samples representative of materials and finished products as may be requested by Engineer.

Structural calculation notes to be submitted for Engineer's approval. Submittals shall indicate clearly all the data base taken into considerations, the adopted factors, the codes and standards and the interpretation of the results in a technical Report

- Examination:

Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting the system performance.

Examine roughing-in of piping systems and electrical connections. Verify actual locations Proceed with installation only after unsatisfactory conditions have been corrected.

- Installation:

Installation works shall follow best international practices, ensuring proper system operation and safe installation methods. Proper connections and reliable integration with existing network are the responsibility of the Contractor

Comply with controller/inverter/Pv panel set manufacturers' written installation and alignment instructions

Install Panels, Inverter /controller to provide access, without removing connections or accessories, for periodic maintenance. (min clear space 1.2m)

USAID DAWERR ACTIVITY:
PV ON GRID SPECIFICATIONS

.The PV modules will be physically checked for: (a) any cracks; (b) broken glass; (c) broken, damaged, or discolored module cells; (d) signs of delaminating or water infiltration on modules; and (e) check each PV module for correct voltage and current output against manufacturer specifications. Consultant will reject any PV modules that has any of the signs listed above and the Contractor has to replace the defective PV modules before installation starts.

The tilt angle and azimuth of the modules is as per dwg. It has been established to optimize the production in relation to the needs. The structure should be min at 1m from the finished floor due to Snow.

The Contractor should consider in his design the walk space for cleaning and maintenance of the PV panels. Cleaning and maintenance persons should have a safe access to the PV panels. Safety requirements for work and maintenance of roof mounted pv system.:

- any technician should be equipped with harness anchored to the structure
- facility personnel will be trained of the need of safety harnesses while maintaining/working on this system.

Shadowing of the PV modules from trees, buildings or any other obstacles should be minimized over the whole day and there shall be no shadows.

The maximum string open-circuit voltage shall not exceed the inverter maximum MPPT operating voltage.

The surface for fitting photovoltaic modules to structures shall be perfectly flat in order not to induce mechanical stresses on securing the modules.

Ensure that concrete bases and foundations provided for installation of equipment are constructed in accordance with approved shop and construction drawings and manufacturers' equipment drawings and that holes for fixing bolts and provisions for passage of cables etc. are provided as required.

Ensure that equipment supports, fixings and the like, and sleeves for passage of feeders and cables which are to be built into concrete foundations, bases or building structure are provided as and when required and that they are properly installed.

Use only tools recommended by equipment manufacturers for installations, particularly in making connections and adjustments.

USAID DAWERR ACTIVITY:
PV ON GRID SPECIFICATIONS

Carry out equipment installation under the direct supervision of a qualified technician, licensed by and trained at the factory. Final adjustments and putting into satisfactory operation are to be made by a specialist delegated by the factory.

DC cables cross section between the PV modules and the inverters have to be sized to limit the total voltage drop in the DC circuit to a value $\leq 2\%$.

DC cables should be equipped with plug-in MC4 connectors.

DC cables should be stretched and fixed at regular intervals (max. 2 m) underneath the PV modules.

DC cables should be labeled

Warning sign to be installed on all panelboards.

DC cables have to be installed in covered UV resistant conduits, or trenches to the junction boxes and inverters.

Flexible pipes with glands shall be used where needed

All accessories required for the for the installation and fixing (conduits and cables glands) shall be supplied and installed by the Bidder.

AC cables must be installed inside embedded conduits

The cable ties shall be UV resistance

All cables laying in trenches must be separated by cable spacers

All cables shall be marked properly by means of good quality labels or by other means so that cables can be easily identified

Equipotential Bonding as per dwgs to be provided

Signage is to be provided at all disconnecting means including switches and circuit breakers in accordance with Code.

Working clearances in front of electrical equipment shall be minimum 1.2m and meet all local codes.

Install electrical devices as required, including but not limited to control. DC and AC Cables, conduits,protections.....

7. TESTING AND COMMISSIONING:

After completing the installation, certain verification and acceptance tests shall be performed before the system enters into operation. The Contractor shall be requested to submit testing procedures to the Employer's representative for review and approval. Should be done by the contractor, internally with the consultant presence

A complete functional test to be performed on the system and compared against the design specifications.

USAID DAWERR ACTIVITY:
PV ON GRID SPECIFICATIONS

7.1. PV SYSTEM CHECKLIST

The contractor shall establish a test program to ensure that all required testing is properly identified, planned, documented and performed under controlled and suitable environmental conditions, including cleanliness

Test procedures shall incorporate or reference the requirements as contained in the contract technical specifications, codes, and industry standards

The contractor shall submit the test procedures to the Consultant team for review and acceptance prior to their implementation

The contractor shall be responsible for establishing a system of weekly test reports that will record all quality test results

Test reports, when completed, are attached to a Contractor’s Quality Control Report and send to the consultant

Note: Startup tests shall comply with IEC 62446-1 Category (1) test requirements and manufacturer's testing procedures.

Verify that the system output is within 5% of calculated array power, irradiance, mismatch and dust factor, array temperature, wiring efficiency factor, inverter efficiency, and inverter output power.

The required tests to be performed are the following:

PV Array Test	Visual Inspection
	Open Circuit Voltage Testing – Isc & Voc – Irradiance measurement
	"PHYSICAL CHECKOUT OF PV MODULES" including: Check for cracked or broken glass on the modules. Check for signs of delaminating or water infiltration on modules. Check for broken damaged or discolored module cells. Check each PV module for correct voltage and current output against manufacturer specifications.
All Electrical System Wiring Test	Continuity Test
	Insulation Resistance Test
	Polarity Test

USAID DAWERR ACTIVITY:
PV ON GRID SPECIFICATIONS

Distribution Board Tests	Infrared Visual Overheating Testing for the Panel Boards (FLIR technology or approved equivalent)
Functional Tests	Verifying the proper operation of the ON-GRID system: controller/inverter output, generator min output, zero return on Grid
	Verifying the proper operation of disconnecting means and component connection and disconnection sequences
	Verify that interactive inverters and ac modules de-energize their output to utility grid upon loss of grid voltage
	Verify that interactive inverters automatically reconnect to their output to the grid once the voltage has been restored for at least 5 minutes
	Verify the proper grid voltage and frequency to operate inverters, including evaluating voltage drop between the inverter ac output and point of connection to the grid.
PV Inverter functional and electrical tests Performance Ratio Tests	Inverters tests shall be performed in accordance with the Company Standards
	Verify system grounding integrity by performing grounding resistance test
Monitoring and Communication Systems	Signal integrity test
	Wireless/Wireline Data communication bandwidth test
	Quality of service on data bandwidth and data rate test.
	Communication equipment functional test.
	Check validity of all data recording and readings; including export, download and data transfer
	System alarm conditions and loss of communication tests
	Portal data download, printing and data historian search test
Mechanical Systems & Civil Works	Verification on all connections (tight and secure within manufacturer's recommended torque limits)
	All compression lug connections verification (tight and secure)
	PV module clamps tightness verification (within manufacturer's recommended torque limits)
	Verification on all communication cable terminations and connections
	Verification all mechanical system integrity of PV mounting and all electrical equipment mounting

7.2. LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLE CHECKLIST

USAID DAWERR ACTIVITY:
PV ON GRID SPECIFICATIONS

INSTALLATION OF CONDUCTORS AND CABLES – VERIFY THE FOLLOWING	
<input type="checkbox"/>	Equipment grounding (earthing) conductor installed in raceways.
<input type="checkbox"/>	Conductors and cables color-coded at each end (per design documents and/or applicable codes).
<input type="checkbox"/>	Conductors and cables labeled at each end including power panels, control panels, manholes, etc.
<input type="checkbox"/>	Terminal blocks identified.
<input type="checkbox"/>	Electrical connectors and terminals tightened per manufacturer's torque-tightening values.
<input type="checkbox"/>	Cables and pathways used for fire-alarm circuits and equipment control wiring associated with fire-alarm system do not contain any other wire or cable.
<input type="checkbox"/>	Exposed sections of conductor and cable show no physical damage.
<input type="checkbox"/>	Exposed sections of conductor and cable connected in accordance with the single-line diagram.
TESTING	
<input type="checkbox"/>	Test bolted connections for high resistance using one of the following: <ul style="list-style-type: none"> ▪ Low-resistance ohmmeter ▪ Calibrated torque wrench ▪ Thermal
<input type="checkbox"/>	Perform insulation-resistance test (per NETA ATS or equivalent IEC standard) on each conductor for ground and adjacent conductors. <ul style="list-style-type: none"> ▪ Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration. ▪ If cables do not pass the test, they will be considered defective.
<input type="checkbox"/>	Prepare test and inspection reports.
CLOSE-OUT DOCUMENTATION	
<input type="checkbox"/>	Warranty provided.

8. Warranty

The awarded party referred to hereon as Contractor shall guarantee all his works :

PV modules : 10 year warranty on material and manufacturing

Solar inverter/fuel controller: 5 years warranty on material and manufacturing

Electrical works : 1 year

Structure : shall be covered by a liability period of five years' guarantee

Warranty shall start after the completion date, inspection and approval by the consultant of all the works specified herein, and warranty start date shall be clearly mentioned on the warranty letter. The

USAID DAWERR ACTIVITY:
PV ON GRID SPECIFICATIONS

warranty shall cover all works, manpower, spare parts, replacements, resulting from failure of equipment, systems and accessories supplied by the Contractor, except when said failures are due to the Client's fault.

All components of the system mentioned above shall also be covered by their individual warranties of defects in materials and workmanship and an operation and performance guarantee backed by the manufacturers for the periods mentioned in the technical specifications.

Individual warranty to be indicated for all components in addition to the power output warranty for the PV modules which should ensure that the first year degradation in modules power doesn't exceed 2.5% with linear annual degradation afterwards such that the power output after 25 years is 80% as a minimum.

Rectification of all the defects during Warrantee, Operation and Maintenance period shall have to be done by the contractor promptly, at most within 7 days from the date of receipt of the complaint.

It is understood that any alteration made to the product without the prior written approval of the Contractor will automatically cancel the remaining warranty period on the affected part.

Just after the completion date of all the works, the supplied installations shall be tested, commissioned and handed over complete and in perfect operating condition.

The Contractor must remain at the disposal of the Cooperative for at least three months after hand over of the systems in order to answer any technical or non-technical questions, and in order to be present on site when the client/beneficiary will perform his own functional tests to check that all technical requirements have been fulfilled.

The Contractor must be available to answer any request that comes from the Cooperative. The reply delay of the Contractor should be within one week.

9. Safety requirements

Safety requirements maintenance of roof mounted PV system.:

- any technician should be equipped with harness anchored to the structure
- facility personnel will be trained of the need of safety harnesses while maintaining/working on this system.

GENERATOR WORKS

Item	Description	Unit	Quantity	Unit Cost without VAT	Total Cost without VAT (US\$)
A GENERATOR					
A1	supply, install, and program including crane price and testing and commission as per RFP the following items as per specifications and as shown on drawings.-Price will include testing and shopdrawing				
A1.1	30 Kva Prime Generator With Canopy 68 dB @1m , sylomer Muffler ,Water Fuel Seperator, Heater, Strainer,Control Panel(Deep sea as per RFP or equivalent), neutral grounding, equipotential bonding,emergency stop, CRANE, BOBCAT.....	1	No.		
A1.2	2000 L Fuel Tank , digital fuel level indicator, buzzer,ladder as per dwgs	1	item		
A1.3	Catalytic Filter	1	item		
A1.4	Fuel Pipes And Valves, filling line	1	item		
A1.5	Control Cables between Ats and generator, between fuel tank and generator, between fuel levels and ATS	1	item		
A1.6	Heater Power cable 3x2,5mm ² (0.6 / 1 KV Conforming to IEC 60502-1 /)	20	lm		
A1.7	Charger Power cable 3x2,5mm ² (0.6 / 1 KV Conforming to IEC 60502-1 /)	20	lm		
A1.8	Oil and Fuel SPILL KIT: kit sizes 240L bin , 60L drums spill kit and 50L and 25L carry bag spill kits. The contents in these diesel spill kits include floor sweep, absorbent booms, absorbent pillows, absorbent pads, wipes, gloves and waste disposal bags.	1	item		
A1.9	IP55 emergency stop in red metal box, including all control cables	1	item		
A1.10	25 Kg wheeled ABC fire extinguisher.	1	item		

GENERATOR WORKS

A2	Power cables: Supply, install, connect , test and commission the following items as per specifications and as shown on drawings.				
A2.1	4C x16mm ² Cable Cu./PVC/PVC 0.6/1.0 Kv	35	lm		
A2.2	1 x16mm ² PVC/Cu Y/G AS ECC, earth cables (to IEC 227)	35	lm		
A2.3	neutral grounding connection	1	item		
A3	Conduits: Excavate , supply, install, and commission the following items as per specifications and as shown on drawings.				
A3.1	Conduiting for control and power up to the nearest manhole, and between the fuel tank and the generator, for the present and future GE	1	item		
TOTAL A					
B OTHERS					
B1	contractor to quote any item in the dwg not listed in the BOQ (details to be sent)	1	item		
TOTAL B					
GENERATOR works total amount excluding VAT					

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GENERAL NOTES: IS NOT TO BE SCALE, ONLY WIDTH EMPLOYED AND TO BE FOLLOWED.
2-ALL DIMENSIONS ARE IN CENTIMETERS UNLESS OTHERWISE INDICATED.
3-ALL LEVELS ARE IN METERS.

REVISION:

NO.	DATE	DESCRIPTION	BY	CHECKED	APPROVED
2	06/12/2023	DESIGN	RS	MM	RH
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0	30/09/2023	DESIGN	RS	MM	RH

LOT:

RAS EL MATN

Project Name

COMPOSTING STATION
RAS EL MATN

DRAWING TITLE:

**LIST OF DRAWINGS &
GENERAL NOTES**

DRAWING NUMBER

GE-01

SCALE : 1/100

DATE : 06/12/2023

LIST OF DRAWINGS

GE-01 LIST OF DRAWINGS & GENERAL NOTES
GE-02 GENERATOR GENERAL LAYOUT
GE-03 GENERATOR AND FUEL TANK DETAILS & GENERAL NOTES
GE-04 POWER RISER GENERATOR CONTROL

GENERAL NOTES

NOTE 1 : ALL SURFACE MOUNTED CONDUITS WILL BE EXT OR RGS CONDUITS TYPE.
NOTE2: ALL WIRES AND CABLES ARE COPPER TYPE-UNLESS OTHERWISE SPECIFIED
NOTE 3: FOR ATIS CONTROL REF TO ATIS NOTES AND DWG5- FOR INFO AND ACTION WHERE NEEDED
NOTE 4: WHERE CONDUITS CANNOT BE PROTECTED, EXT OR RGS CONDUITS CONDUITS TO BE USED
NOTE 5: ALL SURFACE MOUNTED MATERIAL TO BE AUTO EXTINGUISHABLE AND HIGH IMPACT PROTECTED TYPE
NOTE 6: IN TECHNICAL AREAS ALL CONDUITS AND BOXES MUST BE WATERPROOF AND IK-10 PROTECTED
NOTE 7:ALL RECESSED CONDUITS TO BE POLYETHYLENE HIGH IMPACT PROTECTED TYPE
NOTE 8: MIN CONDUIT FOR POWER IS ø 20, AND ø 20 FOR LOW CURRENT
NOTE 9: FOR FUEL SYSTEM REF TO SPECS AND DWG5 DETAILS

NOTE 10:THE LAYOUT DRAWINGS ARE DESIGN DRAWINGS, AND DOESN'T COVER ALL THE NECESSARY DETAILS NEEDED FOR CONSTRUCTION PURPOSES, HENCE THE CONTRACTOR IS ASKED TO SUBMIT SHOP DRAWINGS PRIOR THE START OF CONSTRUCTION WORKS SHOWING ALL PIPING LEVELS AND EXACT ROUTING.
IN ADDITION THE CONTRACTOR IS TO SUBMIT A FULL SET OF AS BUILT DRAWING SHOWING ALL THE DETAILS EXACTLY AS EXECUTED ON SITE

NOTE 11: CHINESE PRODUCTS/BRANDS/MATERIAL ARE NOT APPROVED
THE LIST OF MANUFACTURERS SHOULD FOLLOW USAD'S RULES AND REGULATION FOR FOREIGN POLICY RESTRICTED COUNTRIES.

NOTE 12:
-ALL CONDUIT AND CABLE TRAY SHALL NOT BE USED FOR OUTDOOR EXPOSED ENVIRONMENTS.
-ALL CONDUITS, FITTINGS AND BOXES SHALL BE RATED FOR THE AREA THEY WILL BE INSTALLED IN.
-PROVIDE LIQUID TIGHT FLEXIBLE CONDUIT AT ALL MOTOR CONNECTIONS.
-DO NOT USE PVC FOR CONDUIT EXPOSED ON WALLS. PVC MAY BE EXPOSED TO DAMAGE. USE EXT OR RGS CONDUIT.
-RGS CONDUIT SHALL BE USED FOR OUTDOOR EXPOSED ENVIRONMENTS.
-ALL RACEWAYS, CONDUITS, DUCTS AND MULTI-CONDUCTOR CABLES SHOULD CONTAIN EQUIPMENT EARTHING CONDUCTORS SIZED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE OR EQUIVALENT EUROPEAN STANDARD. MINIMUM SIZES SHALL BE 2.5 MM².

PROJECT ELECTRICAL SCOPE BRIEF

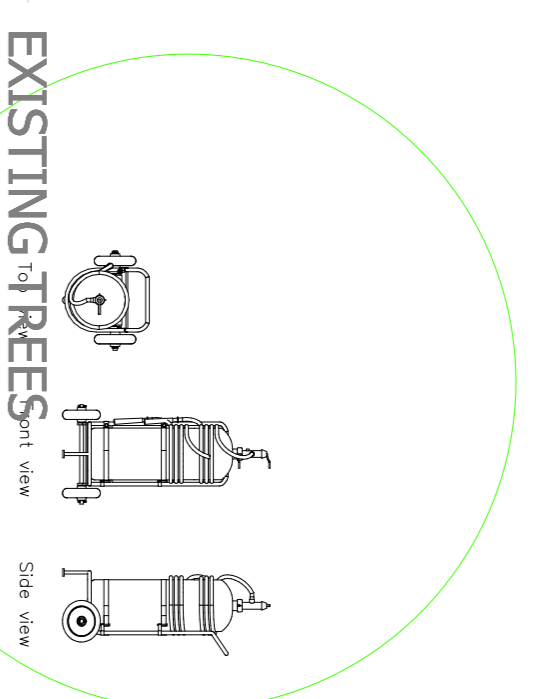
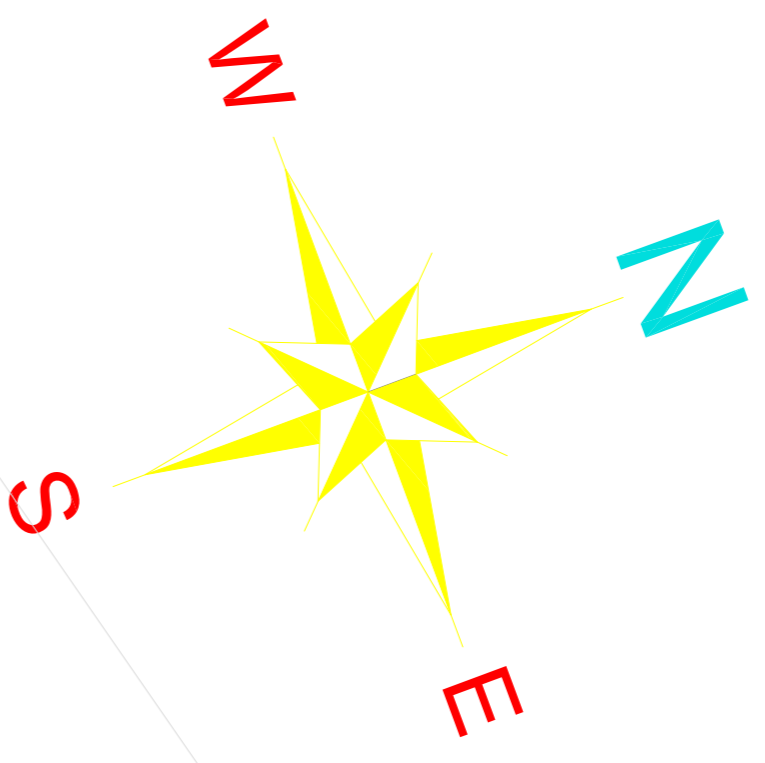
THE PROJECT CONSIST OF INSTALL AND CONNECT THE FOLLOWING SYSTEMS :

A. BY GENERATOR CONTRACTOR:
POWER AND CONTROL CABLES FROM UP TO ATIS/ INVERTER GENERATOR . FUEL TANK, FUEL SYSTEM, EMERGENCY STOP, ANTI-SPILL KIT, EQUIPOTENTIAL BONDING, NOISE TREATMENT, VIBRATION TREATMENT, SMOKE EXHAUST, VENTILATION, REF TO STRUCTURE DOCUMENTS FOR STRUCTURE WORKS, CONDUITS WITHIN THE GENERATOR SLAB

B. BY OTHERS:
MANHOLES, CONDUITS UP TO ATIS . CONNECTION ATIS SIDE, ATIS, INVERTER
C. FUTURE INSTALLATION WILL BE ELECTRICALLY INDEPENDENT FROM FUTURE INSTALLATION

GENERAL SPECIFICATIONS

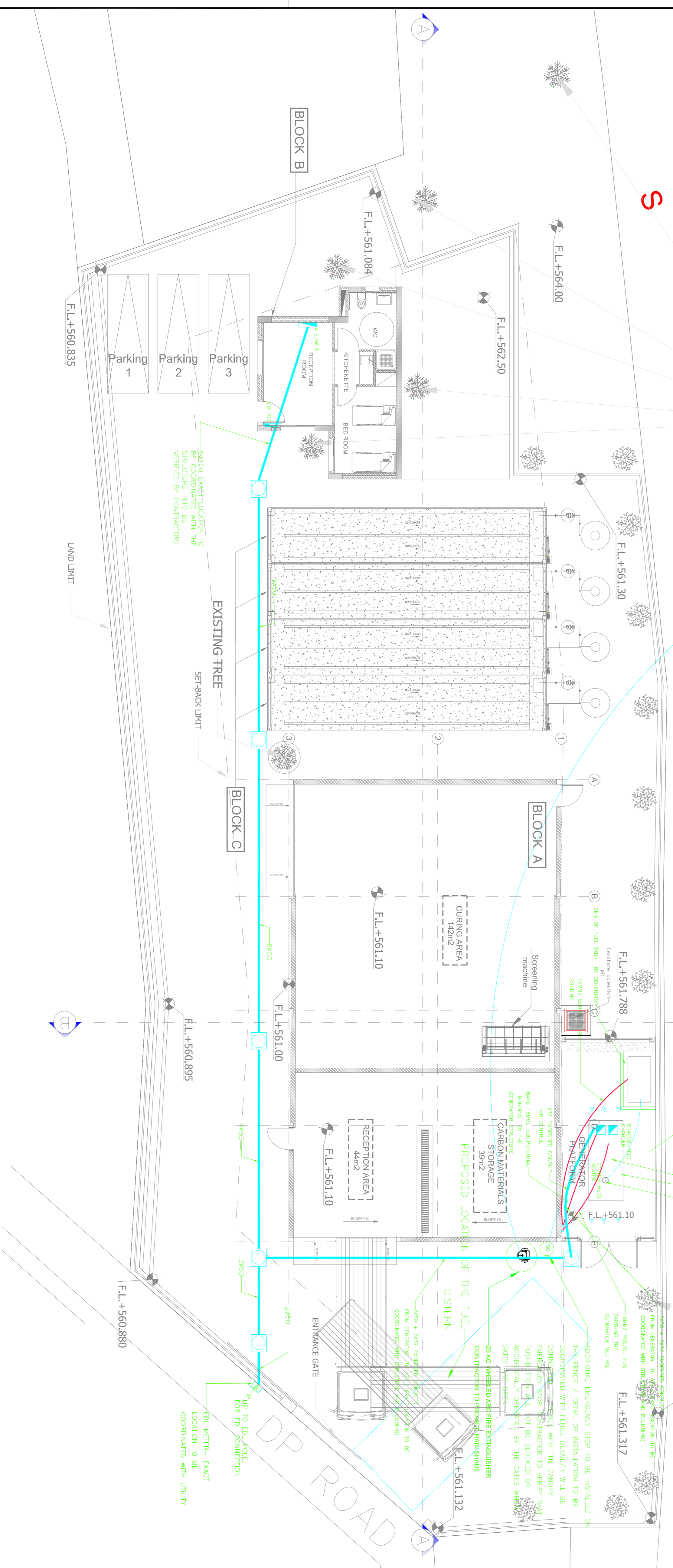
- THE CONTRACTOR SHALL COMPLY WITH THE MOST RECENT VERSION OF DESIGN AND STANDARDS FOR ALL WORK, EQUIPMENT AND MATERIALS. THE FOLLOWING LIST OF STANDARDS IS PROVIDED AS A GUIDELINE: INTERNATIONAL ELECTRO TECHNICAL COMMISSION (IEC), EC STANDARDS, AND NL STANDARDS. THE CONTRACTOR WILL COMPLY WITH ALL APPLICABLE LEBANESE LAWS AND REGULATIONS, AND FUTURE AMENDMENTS.
- THE CONTRACTOR SHALL PROVIDE ALL LABORS, MATERIALS, TOOLS, EQUIPMENTS, AND TRANSPORTATION: INSURANCE, ETC. FOR ALL WORK HEREIN SPECIFIED AND OR REQUIRED TO COMPLETE THE PROJECT.
- THE SYSTEM SHOULD BE FULLY OPERATIONAL IN THE FOLLOWING CONDITIONS:
 - a. RELATIVE HUMIDITY UP TO 95%
 - b. AMBIENT TEMPERATURE FROM -10°C TO 45°C.
 - c. RURAL ENVIRONMENT WITH PRESENCE OF DUST, INSECTS,...
 - d. SALTY ENVIRONMENT
- A WARRANTY OF ONE YEAR ON THE INSTALLED PRODUCTS SHALL BE PROVIDED.
- THE CONTRACTOR SHOULD DO ALL THE NEEDED COORDINATION BETWEEN TRADES .



PART OF GENERATOR SPECIALIST WORK:
 - SHOULD BE DEVELOPED BY SPECIALIST
 - REF TO A15 DWG FOR CONTROL COORDINATION
 - ALL CONDUITS WITHIN THE GENERATOR SLAB IS PART OF THE GENERATOR SPECIALIST
 - ALL WIRES AND CABLES RELATED TO THE GENERATOR POWER AND CONTROL ARE PART OF THE GENERATOR SPECIALIST WORKS
 - MAIN EARTH BAR WILL BE PROVIDED BY THE ELECTRICAL CONTRACTOR - THE GENERATOR AND NEUTRAL EARTHING
 - PROVIDE EMPTY CONDUIT UP TO INVERTER FOR PV/GE SYNCHRO AND CONTROL
 - CONTROL AND SIGNAL CIRCUITS SHALL BE RUN IN A SEPARATE RACEWAY

GENERATOR AND FUEL TANK EQUIPOTENTIAL BONDING AND NEUTRAL GROUNDING BY GENERATOR CONTRACTOR

PLANTED TREES



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GENERAL NOTES: 1- NOT TO BE SCALE. 2- ALL DIMENSIONS ARE TO BE EXCEPTED. 3- ALL DIMENSIONS ARE IN METERS. 4- ALL LEVELS ARE IN METERS.

REV.	DATE	DESCRIPTION	BY	CHKD	APPD
2	06/12/2023	DESIGN	RS	MM	RH
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LOT: RAS EL MATN

Project Name: COMPOSTING STATION
 RAS EL MATN

DRAWING TITLE: GENERATOR GENERAL LAYOUT

DRAWING NUMBER: GE-02

SCALE: 1/100 DATE: 06/12/2023

ACTIVITY:

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LOT:

RAS EL MATN

Project Name

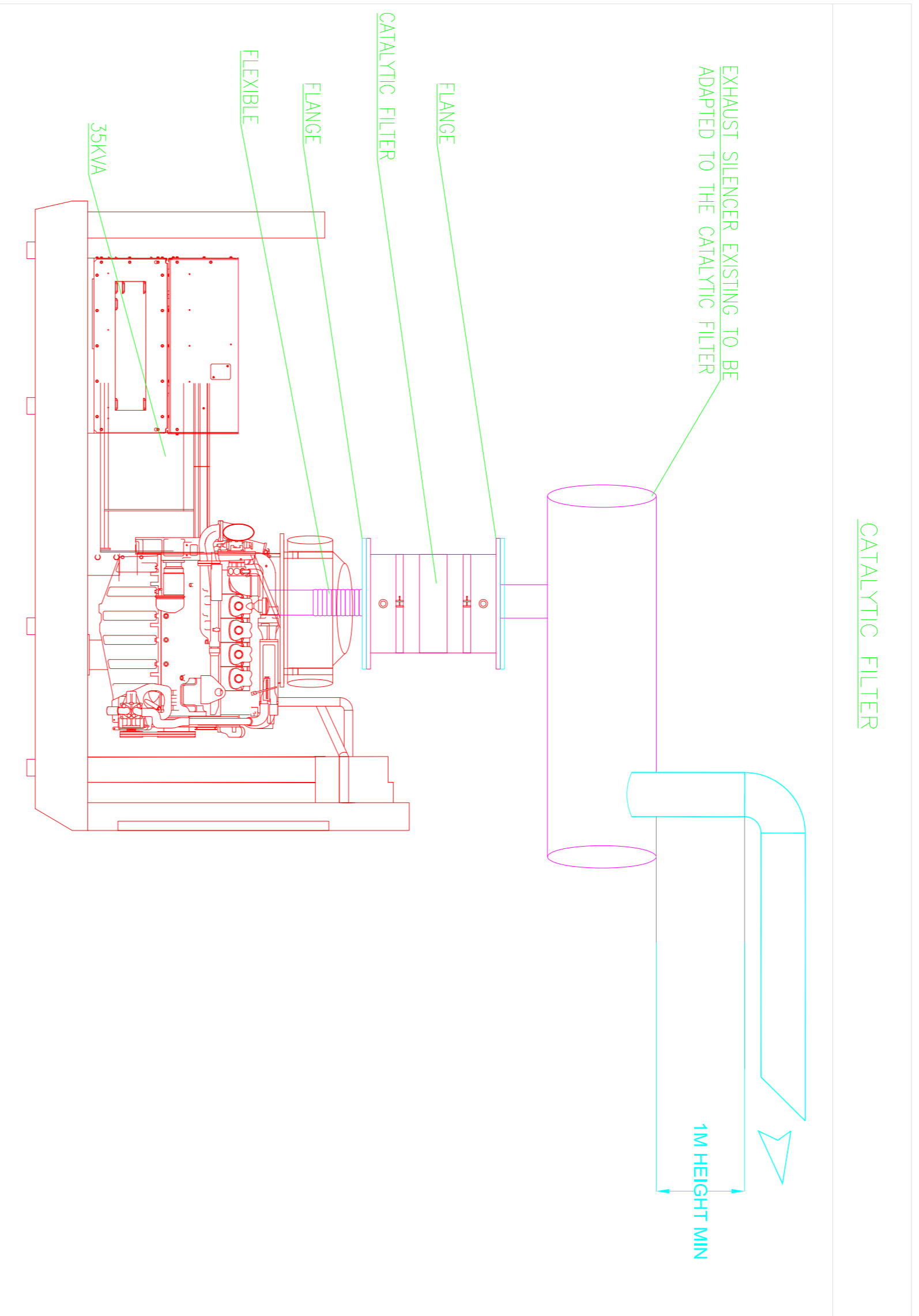
COMPOSTING STATION
RAS EL MATN

DRAWING TITLE:

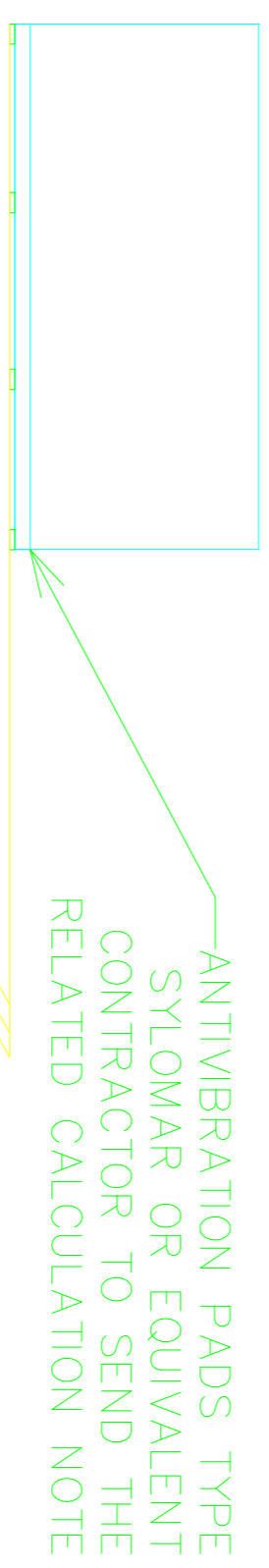
GENERATOR AND FUEL
TANK DETAILS &
GENERAL NOTES

DRAWING NUMBER GE-03

SCALE : 1/100 DATE : 06/12/2023



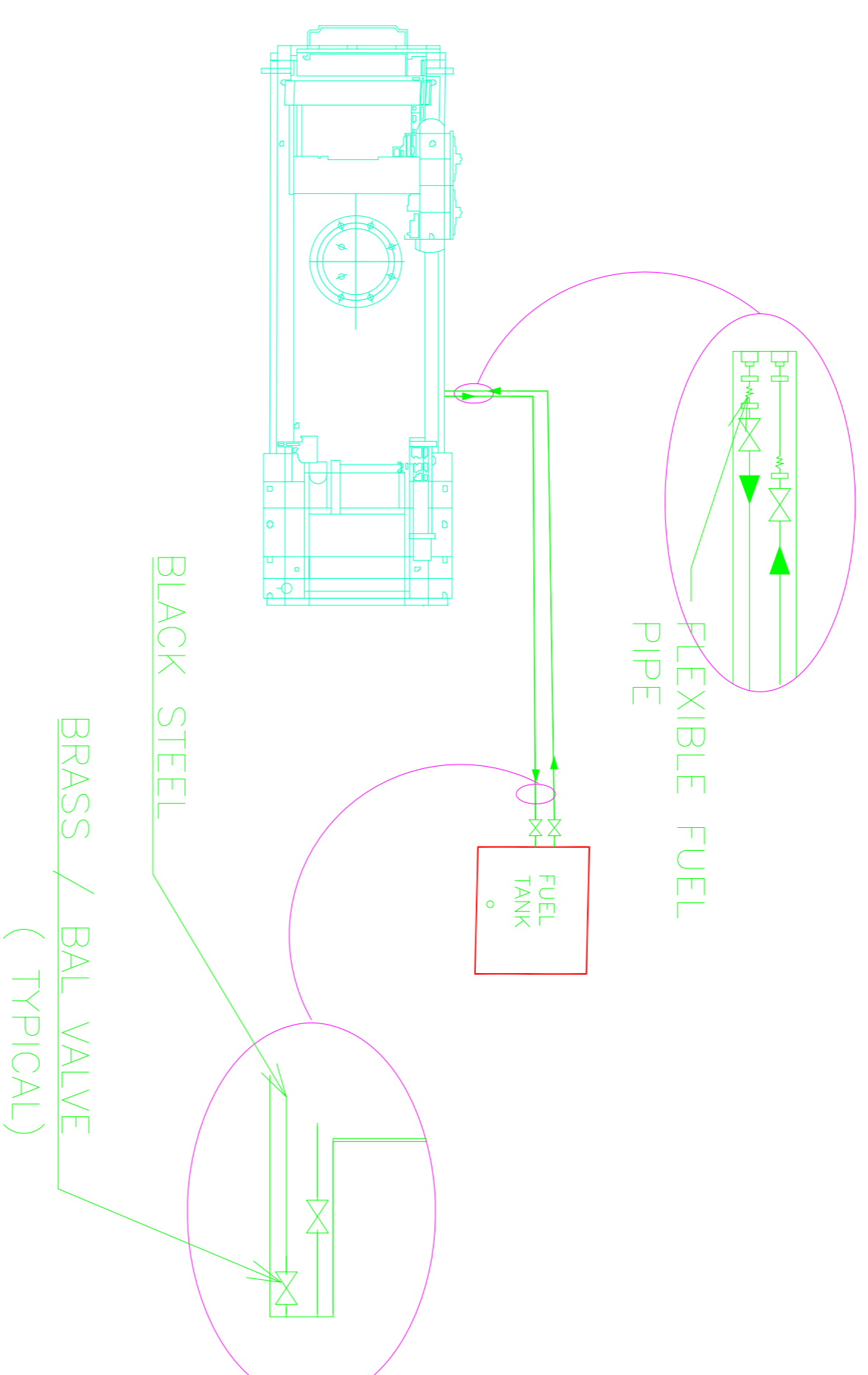
ANTIVIBRATION PADS



BASIS OF CALCULATION:

1. THE CALCULATIONS BASE ON THE PHYSICAL MODEL OF A HARMONIC OSCILLATOR WITH A MASSLESS SPRING ON A RIGID AND PLANE SUBSOIL.
2. USE A CALCULATION PROGRAM FRECOALC THAT MAKES CALCULATIONS BASED ON THE ASSUMPTION OF A RIGID MASS IN THE CENTRE OF GRAVITY.
3. THE CALCULATED VALUES SHOULD TAKE INTO CONSIDERATION THE NON-LINEAR BEHAVIOUR OF THE MATERIAL.
4. THE MATERIAL DATA SHOULD TAKE INTO ACCOUNT : SHAPE-FACTOR-DEPENDENCY
5. ALL INFORMATION AND DATA SHOULD CORRESPOND TO THE MATERIAL DATA SHEETS VALUES , MATERIAL AND TOLERANCES

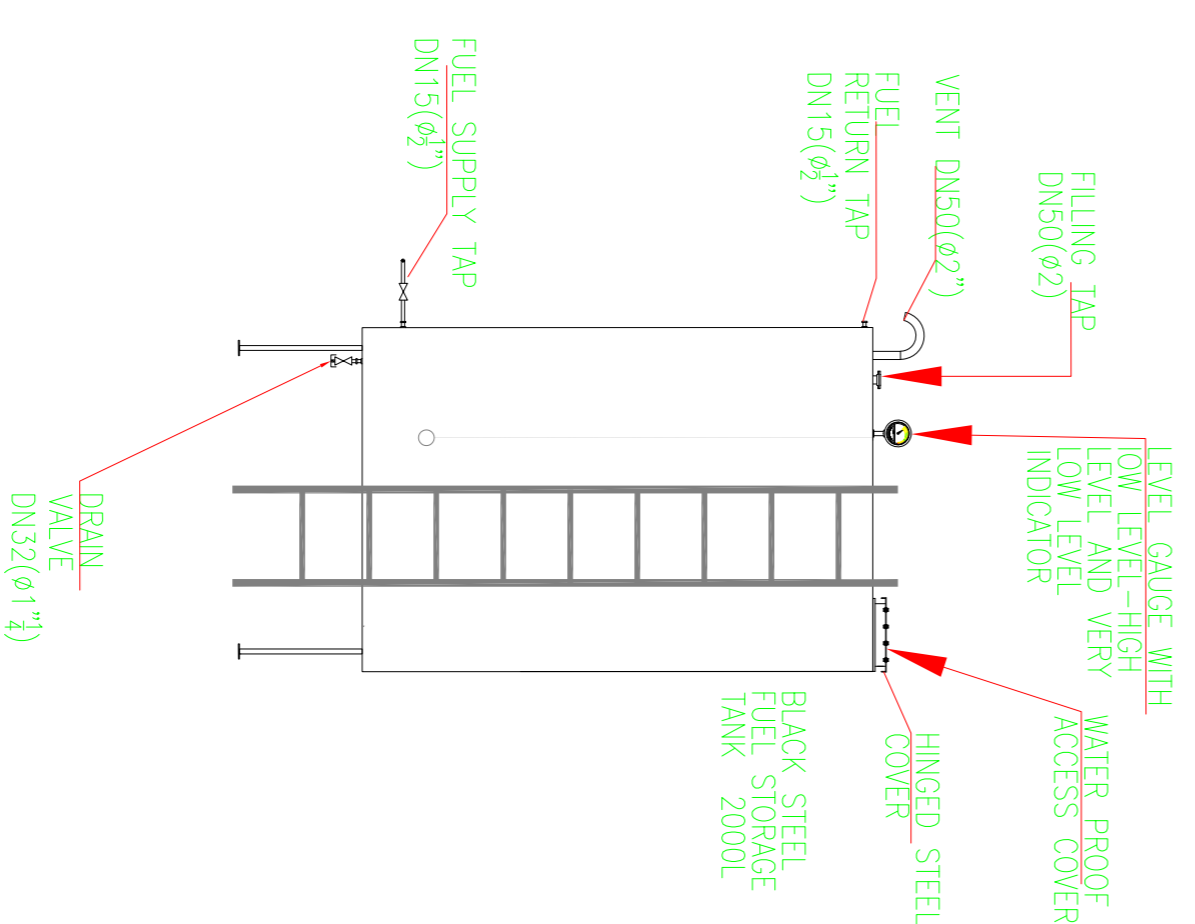
FUEL CONNECTION – TYPICAL



TANKS SPECS:

1. 2,000 LITERS FUEL OIL TANKS CONSTRUCTED OF MIN 3MM THICK PAINTED BLACK STEEL.
2. INTERCONNECTION BETWEEN TANKS WILL INCLUDE PIPES , VALVES AND ACCESSORIES REQUIRED FOR A SMOOTH AND PERFECT OPERATION REGARDLESS OF ANY FAILURE IN ANY ONE OF THEM
3. THE FUEL TANK MUST BE EQUIPPED WITH A FIXATION AND MOUNTING STRUCTURE AND WITH A CONTENTS GAUGE GRADUATED
4. THE BIDDER SHOULD SUPPLY RELEVANT DATAS HEETS OR A PROOF OF STRUCTURAL STABILITY OF THE FUEL TANK.
5. THE BIDDER MUST PROVIDE THE RESULTS OF THE HYDRAULIC TEST
6. REF TO TANK SCHEMATIC DETAIL
7. HIGH LEVEL WILL BE CONNECTED TO AN ALARM BELL WITH SILENT PUSH BUTTON LOCATED NEXT TO THE FILLING POINT
8. LOW LEVEL SHOULD BE INDICATED ON THE ATS PANEL AS PRE-ALARM
9. VERY LOW LEVEL SHOULD BE INDICATED ON THE ATS PANE AND WILL SHUT-DOWN THE GENSET
10. HIGH-LOW AND VERY LOW LEVELS SHOULD BE PROGRAMMABLE, OR WITH DIP-SWITCH
11. LADDER TO BE PROVIDED

FUEL TANK SCHEMATIC DETAIL



ACTING: **DAWERR**

ENJOINT: **RAS EL MATN MUNICIPALITY**

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Mail: tecpromo@gmail.com

GENERAL NOTES: IS NOT TO BE SCALE. ONLY WIDTH EMPLOYED ARE TO BE FOLLOWED.
2-ALL DIMENSIONS ARE IN CENTIMETERS UNLESS OTHERWISE INDICATED.
3-ALL LEVELS ARE IN METERS.

REVISIONS:

NO.	DATE	DESCRIPTION	BY	CHKD	APP'D
2	06/12/2023	DESIGN	RS	MM	RH
1	18/10/2023	DESIGN	RS	RS	RH
0	30/09/2023	DESIGN	RS	MM	RH

DATE: 06/12/2023

APPROVED: (Signature)

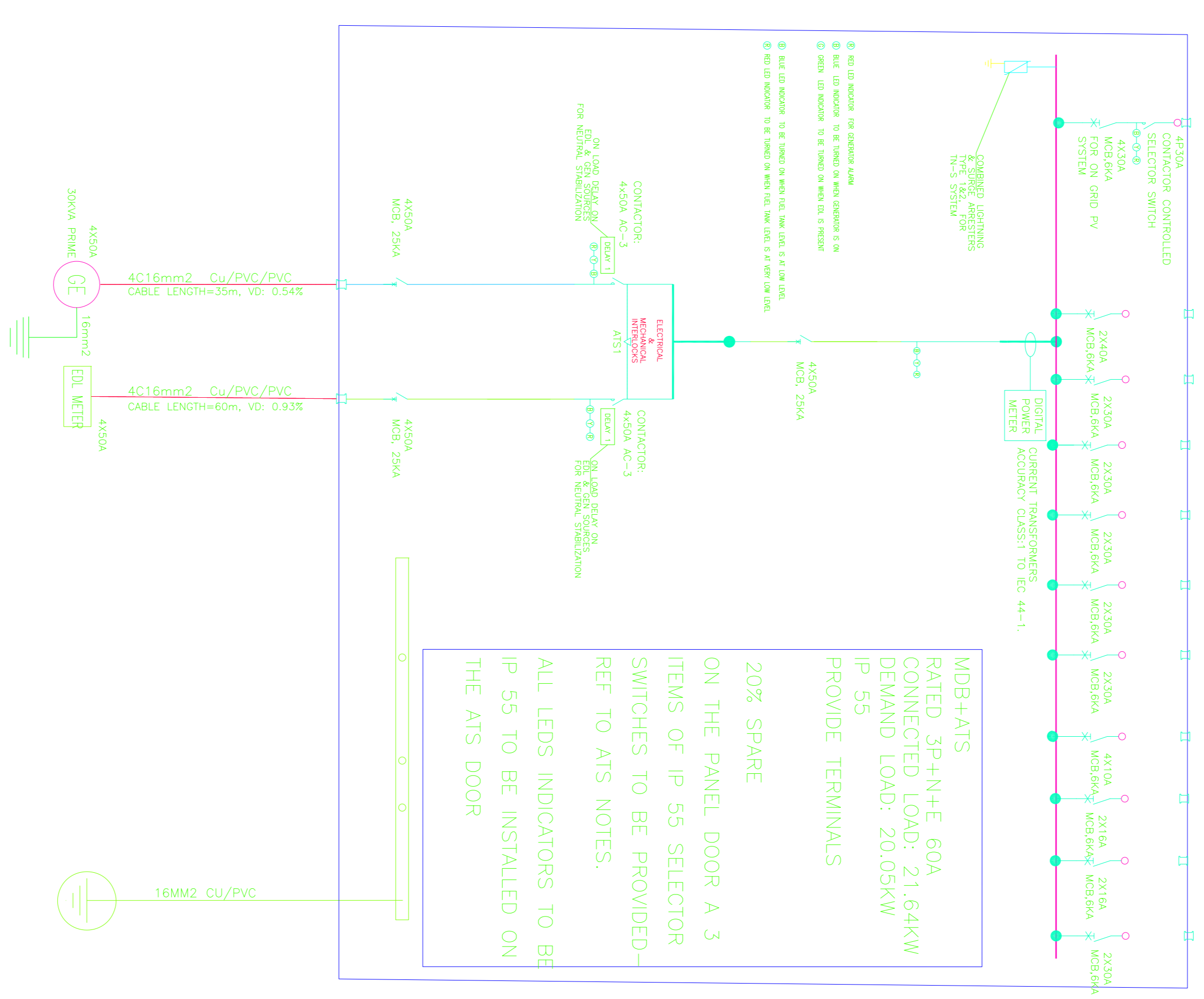
LOT: **RAS EL MATN**

Project Name: **COMPOSTING STATION**
RAS EL MATN

DRAWING TITLE: **POWER RISER**
GENERATOR CONTROL

DRAWING NUMBER: **GE-04**
SCALE: 1/100 DATE: 06/12/2023

- AT5 CONTROL – GENERATOR SPECIALIST SUPPLY THE CONTROL CABLE FOR THE FOLLOWING– CONNECTION AT AT5 SIDE IS BY ELECTRICAL CONTRACTOR– CONNECTION AT GENERATOR SIDE IS BY GENERATOR SPECIALIST– SUPPLY AND INSTALL OF THE AT5 , SELECTORS, LEDS BY ELECTRICAL CONTRACTOR SPECIALIST:
- I– ON THE AT5 PANEL DOOR AN IP 55 SELECTOR SWITCH:
- 1– AUTO/MANUAL SELECTORS SWITCH WILL CONTROL THE AT5. ON AUTO MODE THE PRIORITY IS FOR EDL, AND WILL TRANSFER TO THE GE SIDE WHE THERE IS NO EDL AND GE IS ON AUTOMATICALLY .
- 2–A SELECTOR SWITCH EDL/GE WILL FORCE ONE OF THE INCOMERS TO BE THE PRIORITY ON AT5– NOTE THAT THIS SWITCH IS OPERATIONAL IN CASE SWITCH (1) IS ON MANUAL MODE ONLY
- 3–A SELECTOR SWITCH ON/OFF WILL FORCE THE GENERATOR TO TURN ON OR OFF– NOTE THAT THIS SWITCH IS OPERATIONAL IN CASE SWITCH (1) IS ON MANUAL MODE ONLY
- II– A SPECIAL SECTION WITHIN THE PANEL TO BE PROVIDED FOR THE CONTROL
- III–ALL CONNECTIONS (CABLE ENTRY) TO BE PROVIDED ON THE LOWER SIDE OF THE PANEL
- IV–CABLE GLANDS SIZED AS PER CABLE REQUIREMENT TO BE PROVIDED FOR ALL CABLES
- V–THE BUS BAR SIZE TO BE 20% MORE THAN THE CB SIZE
- VI–NEUTRAL BUSBAR SAME SIZE AS THE PHASE BUS BAR
- VII–ALL BUSBARS SHOULD BE COPPER AND TREATED ANTI OXIDATION, AND ENVELOPED IN NONE FLAMMABLE SLEEVE FOR COLOR CODING
- VIII–POLY–CARBONATE COVER WITH " DANGER " SIGN SHOULD COVER ALL LIVE PARTS
- IX–ISOLATION AND SUPPORTS DATA SHEET AND CALCULATION TO BE PROVIDED TO SUPPORT THE ICC
- X–THE PANEL, SHOULD HAVE ALL SIDES COVERED, 1 HINGED DOOR, PASSAGE OF CABLE SHOULD BE OPENED BY SPECIAL TOOL AS PER CABLE GLAND SIZE, AND INTERNAL REMOVABLE PLASTRON– REF TO SPECS FOR MORE DETAILS
- XI–A MIN 30 CM COVERED UPSTAND TO BE PROVIDED FOR LAY–ON FREE STANDING PANEL – IN ADDITION THE PANEL SHOULD BE FIXED TO THE WALL
- X–A SELECTOR SWITCH ON/OFF WILL FORCE TO DISCONNECT THE SOLAR ON–GRID FROM THE BUSBAR GENERATOR POWER CABLE TO BE SUPPLIED AND INSTALLED BY THE GENERATOR SPECIALIST– CONNECTED X–AT THE AT5 SIDE BY THE ELECTRICAL CONTRACTOR
- XII–COMPLETE COORDINATION TO BE DONE BETWEEN THE ELECTRICAL CONTRACTOR AND THE GE SPECIALIST



MDB+ATS
RATED: 3P+N+E 60A
CONNECTED LOAD: 21.64KW
DEMAND LOAD: 20.05KW
IP 55
PROVIDE TERMINALS
20% SPARE
ON THE PANEL DOOR A 3
ITEMS OF IP 55 SELECTOR
SWITCHES TO BE PROVIDED–
REF TO AT5 NOTES.
ALL LEDES INDICATORS TO BE
IP 55 TO BE INSTALLED ON
THE AT5 DOOR



USAID
FROM THE AMERICAN PEOPLE



GENERATOR SPECIFICATIONS

USAID Diverting Waste by Encouraging Reuse and Recycling (DAWERR) Activity- RAS EL MATN
composting Station

FEBRUARY 2024

USAID DAWERR ACTIVITY:
GENERATOR SPECIFICATIONS

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USAID DAWERR ACTIVITY:
GENERATOR SPECIFICATIONS

1. PROJECT DESCRIPTION

The project is a composting facility, with three main entities:

- Composting containers
- Reception area
- Curing area

2. SCOPE OF WORK

This document will cover the general and detailed specification for the Generator services.

This document should be read in conjunction with the drawings and notes.

3. ELECTRICAL WORKS

3.1. DESIGN BRIEF

The system includes the supply, installation and connection of a GENERATOR, including fuel system, control and earthing, and all reservations as stated in the dwgs.

3.2. SPECIFICATIONS

A. GENERATOR:

- **APPROVED MANUFACTURER:**
 - Cummins/Perkins
 - approved equal
- **ENGINE-GENERATOR** sets for emergency power supply with the following features:
 - Diesel engine with Alternator.
 - Unit-mounted cooling system.
 - Unit-mounted control and monitoring.
- **ENVIRONMENTAL CONDITIONS:**

Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

 - Ambient Temperature: -10 °C to 45 °C.
 - Relative Humidity: 0 to 95 percent.
 - Altitude: 940 m.
 - Wind pressure is calculated at 136.8 km/hr (38 m/s) according to LIBNOR Norms NL 137 Second Edition 2013 – 3.1
- **ENGINE GENERATOR SET:**

Factory-assembled and tested, engine generator set.

Mounting Frame: maintain alignment of mounted components without depending on concrete foundation and have lifting attachments.

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GENERATOR SPECIFICATIONS

Power Output Ratings:30KVA (prime rating).

adapted for solar synchro

electronic governor

electronic pump

PGM

Output Connections: three-phase, four wire.

Nameplates: for each major system component to identify manufacturer's name and address, and model and serial number of component.

Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.

Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.

Steady-State Frequency Operation Bandwidth: 0.5 percent of rated frequency from no load to full load.

Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

- **AC GENERATOR:**

The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc.

All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall not exceed 125 degrees Centigrade.

The generator shall be capable of delivering rated output (KVA) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.

A Permanent Magnet Generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds.

Any other exaltation method different from PMG shall be rejected.

- **GENERATOR, EXCITER, AND VOLTAGE REGULATOR:**

Subtransient Reactance: 12 percent, maximum.

BDrive: generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

Electrical Insulation: class H or class F.

Construction shall prevent mechanical, electrical and thermal damage due to vibration, over speed up to 125percent of rating, and heat during operation at 110 percent of rated capacity.

Enclosure: drip proof.

Instrument Transformers: mounted within generator enclosure.

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Voltage Regulator: solid-state type, separate from exciter, providing performance as specified. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

Strip Heater: thermostatically controlled unit arranged to maintain stator windings above dew point.

Windings: two-thirds pitch stator winding and fully linked amortisseur winding.

- **ENGINE-GENERATOR SET CONTROL:**

Equipped with deep-sea DSE8610 MKII with synchro, monitoring and control features includes ON/OFF/Run control, and Alarm Silence Push Button all alarms and log file can be monitored date/time

Red "mushroom-head" push-button EMERGENCY STOP switch., housed in an IP65 mount enclosure, installed on the canopy from outside permanently labeled as "Generator Emergency Stop

Emergency stop shall over-ride all other controls to immediately shut off the fuel supply and stop the engine. Controls to accept operation of a remote contact to provide for remote emergency stop

- **GENERATOR OVER CURRENT AND FAULT PROTECTION:**

- a. Generator Circuit Breaker: 4 poles molded-case, with adjustable trip unit complying with UL489.

Tripping characteristics: adjustable long-time and short-time delay and instantaneous.

Trip settings: selected to coordinate with generator thermal damage curve.

Shunt Trip: connected to trip breaker when generator set is shut down by other protective devices.

Mounting: adjacent to or integrated with control and monitoring panel.

- b. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits.

Protector shall perform the following functions:

- Initiates a generator overload alarm when generator has operated at on overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
- Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
- As over current heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
- Senses clearing of a fault by other over current devices and controls recovery of rated voltage to avoid overshoot.

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GENERATOR SPECIFICATIONS

- c. Ground-Fault Indication: Integrate ground-fault alarm indication with other generator-set alarm indications.

• **GENERATOR SET AC OUTPUT METERING:**

The generator set shall be provided with a metering set with the following features and functions: digital metering set, 0.5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three phase voltages (line to neutral or line to line) simultaneously.

• **GENERATOR SET ALARM AND STATUS MESSAGE DISPLAY:**

THE CONTROL PANEL SHALL INCLUDE AN AUDIBLE ALARM TO SIGNAL ANY OF THE ALARM SHUT DOWN OR PRE-ALARM CONDITIONS. ALARMS SHALL NOT RESET AND THE AUDIBLE ALARM SHALL NOT SHUT OFF UNTIL MANUALLY ACKNOWLEDGED. FAULT LIGHTS SHALL NOT RESET UNTIL THE FAULT IS RESOLVED. PROVIDE LAMP TEST PUSHBUTTON AND ALARM ACKNOWLEDGE PUSHBUTTON."

The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing alarm and shutdown conditions. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on a digital display panel:

- Low oil pressure (alarm)
- Low oil pressure (shutdown)
- Oil pressure sender failure (alarm)
- Low coolant temperature (alarm)
- High coolant temperature (alarm)
- High coolant temperature (shutdown)
- Engine temperature sender failure (alarm)
- Low coolant level (alarm or shutdown-selectable)
- Fail to crank (shutdown)
- Overcrank (shutdown)
- Overspeed (shutdown)
- Low DC voltage (alarm)
- High DC voltage (alarm)
- Weak battery (alarm)
- Low fuel-day tank (alarm)
- high AC voltage (shutdown)
- Low AC voltage (shutdown)
- Under/over frequency (shutdown)
- Over current (warning)
- Over current (shutdown)
- Short circuit (shutdown)
- Ground fault (alarm)
- Over load (alarm)
- Emergency stop (shutdown)

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- Switch not in AUTO position(alarm)
- Generator circuit breaker tripped(alarm)

- **ENGINE STATUS MONITORING:**

The following information shall be available from a digital status panel on the generator set control:

- Engine oil pressure (psi or kPA)
- Engine coolant temperature (degrees F or C; both left and right bank temperature shall be indicated on V-block engines)
- Engine oil temperature (degrees F or C)
- Engine speed (rpm)
- Number of hours of operation (hours)
- Number of start attempts
- Battery voltage (DC volts)

- **CRANKING AND GOVERNOR:**

The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and No. of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15 second rest period between cranking periods.

- **ALTERNATOR CONTROL AND VOLTAGE REGULATION FUNCTIONS:**

The voltage regulation system shall include provisions for reactive load sharing and electronic voltage matching for paralleling applications. Motorized voltage adjust pot is not acceptable for voltage matching.

Controls shall be provided to monitor the output current of the generator set and initiate an alarm when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator.

Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition when total load on the generator set exceeds the generator set rating for in excess of 5 seconds.

Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.

An AC over/under voltage monitoring system which responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 25VDC or more than 32 VDC. During engine starting, the low voltage limit shall be disabled, and if DC voltage drops to less than 14.4 volts for more than two seconds a "weak battery" alarm shall be initiated.

The control system shall include a ground fault monitoring relay.

- **BASE:**

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The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.

- **BATTERIES AND CHARGERS:**

Starting and Control Batteries: starting battery bank, lead calcium type, 24-volt DC, sized as recommended by the generator set manufacturer, shall be supplied for each generator set with battery cables and connectors.

Battery Charger (if any): a UL listed/CSA certified 10-amp voltage regulated battery charger shall be provided for each engine-generator set. The charger may be located in an automatic transfer switch, or may be wall mounted, at the discretion of the installer. Input AC voltage and DC output voltage shall be as required. Chargers shall be equipped with float, taper and equalize charge settings. Operational monitors shall provide visual output:

- Loss of AC power - red light
- Low battery voltage - red light
- High battery voltage - red light
- Power ON - green light (no relay contact)

Analog DC voltmeter and ammeter, 12 hour equalize charge timer, AC and DC fuses shall also be provided on the charger.

- **BATTERIES TECHNICAL CHARACTERISTICS:**

Components: sized so they will not be damaged during a full-cranking cycle with ambient temperature at maximum specified.

Cranking Motor: heavy-duty unit that automatically engages and releases from engine flywheel without binding.

Battery: adequate capacity within ambient temperature range to provide specified cranking cycle at least three times without recharging.

Battery Cable: size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.

Battery-Charging Alternator: factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.

- **CHARGER TECHNICAL CHARACTERISTICS:**

Battery Charger: current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL1236 and include the following features:

- Operation: equalizing-charging rate of 10A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
- Automatic Temperature Compensation: adjust float and equalize voltages for variations in ambient temperature from minus 40-degree C to plus 50 degree C to prevent overcharging at high temperatures and undercharging at low temperatures.
- Automatic Voltage Regulation: maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.

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- Ammeter and Voltmeter: flush mounted in door. Meters shall indicate charging rates.
- Safety Functions: sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.

- **COUPLING SYSTEM:**

The coupling system shall be of unit construction which forms the engine and generator into one unit of exceptional strength and ensures perfect alignment.

The alternator end shield and the engine flywheel housing faces shall be fully machined with spigots concentric to their shafts. The machined flanges mounted on the alternator shall be connected to the flywheel housing flange by steel bolts.

A flexible rubber block coupling shall be fitted between the engine and alternator to provide the drive and absorb the transmission of shock loads. The torsional flexibility shall be designed to match the torsional characteristics of the system to prevent resonant conditions.

- **SMOKE EXHAUST:**

The installation of the exhaust pipe must comply with relevant regulations, standards and other requirements. During installation, the contractor shall ensure that the exhaust pipe is far away from Burning substances.

A rain cover should be added to prevent rain and snow from entering the exhaust system.

Flange to be provided to connect the pipe to the Muffler.

Black steel pipe to be 3mm min.

The mufflers shall be critical grade.

Exhaust system shall be installed according to the generator set manufacturers recommendations and applicable codes and standards. Exhaust pipe shall have sufficient size to ensure that exhaust back pressure does not exceed the maximum limitations set by supplier. The insulation shall be installed so that it does not interface with the functioning of flexible exhaust fitting.

Flexible gastight connection pieces shall be provided in the exhaust pipe line to allow for thermal expansion and to prevent vibration being transmitted to the engine.

B. FUEL TANKS, VALVES AND PIPES

Pipes: Will be seamless black steel schedule 40.

Valves: will be brass with well-known brand- ball type is recommended

Tank:

- Will be 1x 2000 L storage
- Shall be constructed of min 3mm thick black steel.
- The fuel tank must be equipped with a fixation and mounting structure and a contents gauge graduated.
- includes ladder

C. CANOPY

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Critical muffler with minimum sound reduction to achieve 68 Dba at 1m
Exhaust pipe to be equipped with a rain cap
Sylomer pads for vibration reduction to be installed between the enclosure and the concrete pad design and dimensions according to the site's limitations.(calculation note by specialist to be sent)
All unneeded openings should be closed
Should be waterproof
No rust on the paintings, anti-corrosive
Ventilation Openings should be wire mesh for protection from rats
User-friendly
Easy maintenance - doors provided at all sides
Easy handling and easy transportation
Durable industrial locking system for doors
Canopy to be painted and powder coating
Forced ventilation systems to provide sufficient air flow
The canopy meets noise 68 DB at one-meter distance
The enclosure to be 1.6 mm thick CRC sheet
Sound proofing of the enclosure with sound proof acoustic rock wool 96 / m 3 density and thickness 100 mm

D. THE CATALYTIC CONVERTER

The catalytic converter must be installed with the following expected exhaust emission reduction at full load conditions:

- CO – 90%
- HC & Odor – 80%
- CH₂O – 80%
- DPM (Diesel Particulate Matter) – 30%
- Should be connected before the muffler
- Connection should be by Flange

E. EARTHING AND GROUNDING:

The grounding will be provided next to the generator by others.

For the generator neutral grounding it will include a min 10mm² Yellow/Green PVC cable up to the earth bar.

Earthing to include (in addition to indicated neutral grounding) the grounding of frame, extraneous conductive parts, etc.

F. OPERATION/ ATS control (Note ATS by others):

The contractor should fully coordinate with the ATS manufacturer to achieve the following:

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- A. when voltage and/or frequency of any phase drops below an adjustable setting (85-100%) of normal supply for an adjustable period of 1-300 seconds, power failure relay is to actuate engine starting control, whilst normal mains contactor or breaker is to open. After an adjustable period of 0-10 seconds from sensing stabilized rated voltage and frequency of generators at the ATS, voltage pick-up adjustable from 85% to 100% nominal, frequency pick-up adjustable 90% to 100% nominal, the emergency contactor is to close.
- B. Upon restoration of normal mains supply to above the present limits, adjustable between 90% and 100% of rated voltage and/ or frequency contactor is to open and after a presentable pause 0.5 to 30 seconds minimum, normal mains contactor is to close, time delay is to be effective in both directions.
- C. ENGINE SHUTDOWN: is to be initiated of the load normal source
- D. Transfer mechanism is to be powered from the source to which the load is being transferred.
- E. SELECTOR SWITCHES: are to be provided as follows noted on dwgs
- G. PILOT LIGHTS: ref to dwgs
- H. Timer 24 hours : The generator should include a 24 Hours Timer with different outputs – the starting of generator will depend on the timer and the lost of utility power (programmable)

G. EXECUTION:

- Examination:
Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting package engine-generator performance.
Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
Proceed with installation only after unsatisfactory conditions have been corrected.
- Installation:
Comply with packaged engine-generator set manufacturers' written installation and alignment instructions
Install engine generator to provide access, without removing connections or accessories, for periodic maintenance.
Install engine generator set with restrained spring isolators having a minimum deflection of 25mm on 100mm high concrete base. Secure sets to anchor bolts installed in concrete bases.

EQUIPMENT BASES: ensure that concrete bases and foundations provided for installation of equipment are constructed in accordance with approved shop and construction drawings and

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manufacturers' equipment drawings and that holes for fixing bolts and provisions for passage of cables etc. are provided as required.

BUILT-IN ITEMS: ensure that equipment supports, fixings and the like, and sleeves for passage of feeders and cables which are to be built into concrete foundations, bases or building structure are provided as and when required and that they are properly installed.

TOOLS: use only tools recommended by equipment manufacturers for installations, particularly in making connections and adjustments.

SUPERVISION: carry out equipment installation under the direct supervision of a qualified technician, licensed by and trained at the factory. Final adjustments and putting into satisfactory operation are to be made by a specialist delegated by the factory.

GENERATING SET: install to maintain alignment and minimize engine and generator stresses. Protect instrumentation and control equipment including engine mounted instruments from machine vibration. Mountings and method of mounting are to be as recommended by the manufacturer and approved by the Engineer.

ENGINE EXHAUST PIPING is to be slightly sloped away from engine to avoid condensation returning to engine and is to have drain plugs or clean-out at lower end as required.

ENGINE HOT-AIR EXHAUST DUCT: install approved canvas duct with metal frames between radiator and louvered opening in wall for radiator exhaust air.

TANK VENT PIPE: extend to at least 2 m above ground level with end at least 1 m away from any building opening. Slope vent pipe back to tank without traps and support securely. Provide replaceable dust filter and gooseneck bend or approved weatherproof vent cap at top of pipe.

PIPE HANGERS AND SUPPORTS: fasten securely to building structure with approved masonry expansion bolts, minimum 20 mm diameter and install in accordance with manufacturers' instructions.

EARTHING

Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet.

ELECTRICAL WIRING: Install electrical devices as required, including but not limited to control

Install Anti-vibration Pads

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- Connection:

Connect fuel, cooling-system, and exhaust-system piping adjacent to engine generator to allow service and maintenance.

Connect engine exhaust pipe and catalytic filter to engine with flexible connector,.

Connector fuel piping to engines with a gate valve and union and flexible connector.

Ground equipment

Connect wiring.

- Identification:

Identify all system components

H. CABLES:

Specifications:

Cu/PVC/PVC (black)

600V/1000V

Follow the Lebanese color coding:

- Neutral: Grey
- Phases: Red, Yellow, Blue
- Earthing: Yellow Green.

Brand: "Cable du Liban » or equivalent

Installation:

in conduit

I. CONDUITS/ CABLE TRAYS:

Conduits Specs:

EMT conduits or schedule 40 conduits including accessories and EMT boxes IP55 should be used

If using EMT outdoors, then provide corrosion-resistant support hardware and rain tight couplings and connectors per NEC Article 358.

RGS conduits where mechanical protection is needed.

polyethylene conduits can be used recessed

UPVC heavy impact resistant, can be used where none mechanical protection is Needed- It can be used also in trenches

PVC conduit should not be used for outdoor, exposed environments.

All conduits, fittings and boxes should be rated for the area they will be installed.

Provide liquid tight, flexible conduit at all motor connections.

Do not use PVC for conduit exposed on walls. PVC may be exposed to damage. Use EMT or RGS conduit.

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Cable trays specs: will be hot dip galvanized installed horizontally and vertically, 1.5mm thickness. Cable trays should be used where more than a cable are running on the same direction. Cable tray will include support and cover (will not be laid directly on the floor).

All cable trays, cable ladder, EMT, RGS conduits will be with equipotential bonding. All accessories and supports to be provided from same brand.

Cable trays shall be installed as a complete system. Cable tray shall be secured and supported per the cable tray system and all cables shall be fastened to the tray per manufacturer's recommendations.

Cable tray is not recommended for outdoor applications.

4. TESTING AND COMMISSIONING:

Should be done by the contractor, internally with the consultant presence

4.1. GENERATOR CHECKLIST

a. Manufacturer Test in the factory

A signed copy of this test should be done and provided for approval specifications Factory Test requirements. Require that a factory test be performed prior to shipment to the include the following:

- Demonstrate proper operation of all safety devices.
- Conduct load tests utilizing resistive load banks as follows:

Load	Hours
-----	-----
1/2	1
3/4	1
Full	4

- At the end of two hours at full load (specified standby kW), the engine-generator shall be block loaded from no load to full load a total of two times over two hours. Record voltage and frequency by a strip chart recorder. Record current, water temperature, and lube oil pressure every 15 minutes. Provide testing in accordance with NFPA 110. Provide a demonstration that all safety devices are operational.

b. On site testing

Field Test requirements to perform inspection and field test of the diesel fuel storage tank and generator unit in accordance with the manufacturer's recommendations. Generator field test shall be under actual operating conditions Test results are to be submitted to the Engineer/Owner for review.

Equipment Start-Up requirements for the supplier's representative to check the installed equipment, operate the unit to demonstrate its ability to operate continuously without vibration, jamming, leakage or overheating and to perform specified functions.

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The following is a list of tests that is not Limited to:

- Generator:
 - The contractor should submit all the internal test done by the manufacturer
 - On site test: using the real load
 - List of tests:
 - **GENERAL :**
 - Engine start and stop control
 - Equipotentiality
 - Control and protection devices
 - Leaks in oil, water and exhaust
 - Excessive vibration
 - Every 15 minutes the following parameters shall be recorded:
Measurements of all engine parameters
oil pressure
temperature
Noise Level @1m
 - **TRANSIENT LOAD SWITCHING:** Resistive load shall be applied and switched "ON" and "OFF" in STEPS, with the diesel generator running at rated speed and generating rated voltage. Transient recordings of maximum, minimum and nominal voltage and frequency levels together with the response times shall be obtained.
 - **FUNCTIONAL TEST:**
The operation of interlocks and interconnections with all external equipment and controls to be connected on site, shall be simulated as part of these tests.
 - The generating set shall be tested on Site for manual and automatic operation, for regulation, for sudden load pick-up
 - Test transfer switch per NETA ATS (or applicable IEC standards) and demonstrate interlocking sequence and operational function at least three times per the following:
 - Simulate power failures of normal source to automatic transfer switch and retransfer from emergency source with normal source available.
 - Simulate loss of phase-to-ground voltage for each phase of normal source.
 - Verify time delay settings.
 - Verify pickup and dropout voltages by data readout or inspection of control settings.
 - Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

4.2. LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLE CHECKLIST

INSTALLATION OF CONDUCTORS AND CABLES – VERIFY THE FOLLOWING	
<input type="checkbox"/>	Equipment grounding (earthing) conductor installed in raceways.

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<input type="checkbox"/>	Conductors and cables color-coded at each end (per design documents and/or applicable codes).
<input type="checkbox"/>	Conductors and cables labeled at each end including power panels, control panels, manholes, etc.
<input type="checkbox"/>	Terminal blocks identified.
<input type="checkbox"/>	Electrical connectors and terminals tightened per manufacturer's torque-tightening values.
<input type="checkbox"/>	Cables and pathways used for fire-alarm circuits and equipment control wiring associated with fire-alarm system do not contain any other wire or cable.
<input type="checkbox"/>	Exposed sections of conductor and cable show no physical damage.
<input type="checkbox"/>	Exposed sections of conductor and cable connected in accordance with the single-line diagram.
TESTING	
<input type="checkbox"/>	<p>Test bolted connections for high resistance using one of the following:</p> <ul style="list-style-type: none"> ▪ Low-resistance ohmmeter ▪ Calibrated torque wrench ▪ Thermal
<input type="checkbox"/>	<p>Perform insulation-resistance test (per NETA ATS or equivalent IEC standard) on each conductor for ground and adjacent conductors.</p> <ul style="list-style-type: none"> ▪ Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration. ▪ If cables do not pass the test, they will be considered defective.
<input type="checkbox"/>	Prepare test and inspection reports.
CLOSE-OUT DOCUMENTATION	
<input type="checkbox"/>	Warranty provided.

4.3. GENERATOR CHECKLIST

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ENGINE GENERATOR SET INSPECTION CHECKLIST							
SECTION A - CUSTOMER DATA							
1. PLANT/BUILDING		2. LOCATION		3. JOB NUMBER			
4. EQUIPMENT		5. CIRCUIT DESIGNATION		6. DATE (YYYYMMDD)			
7. TEST EQUIPMENT TYPE/BRAND AND CALIBRATION DATE				8. TESTED BY			
SECTION B - EQUIPMENT DATA							
9. MANUFACTURER		10. STYLE/S.O.	11. VOLTAGE RATING		12. KW RATING		
13. CIRCUIT BREAKER SIZE/INTERRUPTING RATING			14. WET BULB TEMPERATURE		15. DRY BULB TEMPERATURE		
SECTION C - VISUAL AND ELECTRICAL/MECHANICAL INSPECTION							
16.	CHECK POINT	COND*	NOTES	CHECK POINT	COND*	NOTES	
	EXTERIOR OF EQUIPMENT	<input type="text"/>		EQUIPMENT IDENTIFICATION	<input type="text"/>		
	COMPLETENESS OF ASSEMBLY	<input type="text"/>		BRACING	<input type="text"/>		
	EQUIPMENT ROTATION	<input type="text"/>		PROPER PHASE CONNECTIONS	<input type="text"/>		
	CHECK OIL LEVEL	<input type="text"/>		REFERENCE DRAWINGS	<input type="text"/>		
	CHECK FUEL LEVEL	<input type="text"/>		WORKING CLEARANCE	<input type="text"/>		
	PROPER EQUIPMENT GROUNDING	<input type="text"/>		ANCHORAGE	<input type="text"/>		
	CHECK METER/GAUGES	<input type="text"/>		ALL FILTERS AND VENTS CLEAR	<input type="text"/>		
	TIGHTNESS OF BOLTED CONNECTIONS	<input type="text"/>		CHECK EQUIPMENT ENVIRONMENTAL CLASSIFICATION	<input type="text"/>		
	VERIFY GOVERNOR AND REGULATOR	<input type="text"/>		CHECK FOR PROVISIONS OF SPILL CONTAINER	<input type="text"/>		
	CHECK VIBRATION	<input type="text"/>		CONTROL SYSTEM	<input type="text"/>		
	CHECK BATTERIES	<input type="text"/>		CHECK FUEL FILTER	<input type="text"/>		
	CHECK RADIATOR FLUID	<input type="text"/>		CHECK ALARM INDICATORS: PROPER COLOR FOR EACH FUNCTION	<input type="text"/>		
	PROPER SYSTEM GROUND	<input type="text"/>			<input type="text"/>		
SECTION D - ELECTRICAL TESTS							
17.	INSULATION RESISTANCE	A-GRD	B-GRD	C-GRD	A-B	B-C	C-A
	@ <input type="text"/> V	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	POLARIZATION INDEX	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	RATIO = 10 MINUTE/1 MINUTE	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	DC OVERPOTENTIAL TEST	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	@ <input type="text"/> V	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
18.	NOTES						
	1. PERFORM 5 MEASUREMENTS AT ONE MINUTE INTERVALS.						
	2. DC HIPOT MEASUREMENTS SHOULD BEGIN AT 20% OF MAXIMUM TEST VOLTAGE AND INCREASE IN EQUAL INTERVALS.						
	MAX DC TEST VOLTAGE = R (2 x NAMEPLATE RATING) x 1.6						
	WHERE R = .8 FOR DC TEST ON INSTALLATION						
	WHERE R = .6 FOR DC TEST AFTER SERVICE						
	(TEST MEASUREMENTS SHOULD NOT EXCEED MANUFACTURER'S RECOMMENDATION)						

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SECTION D - ELECTRICAL TESTS (Continued)										
19. MEASUREMENT DESCRIPTION	VOLTAGE AND CURRENT MEASUREMENTS									
	VOLTAGE**					CURRENT**				
	A-N	B-N	C-N	A-B	B-C	C-A	A	B	C	N
20. LOAD TESTS AS A PERCENTAGE OF GENERATOR RATING										
	NO LOAD	25 %	75 %	100 %	110% (PRIME ENGINE ONLY)					
A-N										
B-N										
C-N										
A-B										
B-C										
C-A										
A										
B										
C										
N										
G										
21. NOTES										
<p>1. VOLTAGE MEASUREMENT TO BE MADE AFTER GENERATOR IS STARTED AND CONNECTED TO LOAD (CAN USE LOAD BANK).</p> <p>2. DURING COMMISSIONING OF GENERATOR SETS OR ANY EQUIPMENT, A REPRESENTATIVE OF THE MANUFACTURING COMPANY OR SUPPLIER MUST BE PRESENT TO WITNESS AND/OR PERFORM THE TESTS.</p> <p>3. ENGINE GENERATOR TESTING IS A VERY INTENSIVE PROCESS AND REQUIRES A 10 TO 14 HOUR DAY DEPENDING ON THE EQUIPMENT BEING COMMISSIONED. SUPPLIER/MANUFACTURER NORMALLY SUPPLY GENERATOR TESTING LOAD REQUIREMENTS.</p> <p>4. VERIFY ALL SYSTEM CHECK POINTS DURING LOAD CHANGES AND RECORD PER SPECIFIED REQUIREMENTS AND/OR EQUIPMENT MANUFACTURER.</p> <p>5. PERFORM AND RECORD ENGINE MANUFACTURER'S RECOMMENDED CHECKS AND INSPECTIONS.</p>										
<p>*CONDITION: A=ACCEPTABLE; R=NEEDS REPAIR, REPLACEMENT OR ADJUSTMENT; C=CORRECTED; NA=NOT APPLICABLE **NOTE VALUE AND PHASING</p>										

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5. WARRANTY

The awarded party referred to hereon as Contractor shall guarantee all his works :

Generator /Controller: 1 year warranty on material and manufacturing

Fuel system: 1 years

Electrical works : 1 year

Warranty shall start after the completion date, inspection and approval by the consultant of all the works specified herein, and warranty start date shall be clearly mentioned on the warranty letter. The warranty shall cover all works, manpower, spare parts, replacements, resulting from failure of equipment, systems and accessories supplied by the Contractor, except when said failures are due to the Client's fault.

All components of the system mentioned above shall also be covered by their individual warranties of defects in materials and workmanship and an operation and performance guarantee backed by the manufacturers for the periods mentioned in the technical specifications.

Individual warranty to be indicated for all components

Rectification of all the defects during Warrantee, Operation and Maintenance period shall have to be done by the contractor promptly, at most within 7 days from the date of receipt of the complaint.

It is understood that any alteration made to the product without the prior written approval of the Contractor will automatically cancel the remaining warranty period on the affected part.

Just after the completion date of all the works, the supplied installations shall be tested, commissioned and handed over complete and in perfect operating condition.

The Contractor must remain at the disposal of the client for at least three months after hand over of the systems in order to answer any technical or non-technical questions, and in order to be present on site when the client/beneficiary will perform his own functional tests to check that all technical requirements have been fulfilled.

The Contractor must be available to answer any request that comes from the client. The reply delay of the Contractor should be within one week.