TECHNICAL SPECIFICATIONS FOR A 2.0MW$_{AC}$ HYBRID SOLAR PV PLANT FOR PRESIDENTIAL CONSTITUENCY ENERGY INITIATIVE (PCEI)

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1. TECHNICAL SCHEDULE FOR PLANT CONFIGURATION

S/N	DESCRIPTION	UNIT	REQUIREMENT	TENDERER'S GUARANTEE
1.1	Total Installed AC capacity at 50°C and power factor = 0.95	MW_{AC}	2.0	
1.2	Performance Ratio	%	≥ 85	
1.3	Design lifetime of the Plant	Years	≥ 30	
1.4	Plant availability	%	≥ 25	
1.5	Land area required for the plant	Ha	≥ 3	
		Ha/MWp	≤1.6	
1.6	Modules nominal capacity	Wp	≥580	
1.7	Total Installed PV peak power (STC)	MWp	≥2.3	
1.8	String Inverter Capacity	kW	≤350	
1.9	DC to AC power ratio		≥1.15	
1.10	Tilt angle (Contractor to carry out tilt angle optimisation)	deg	≈14°	
1.11	Auxiliary losses due to self-consumption for entire Plant	%	≤1%.	

2. TECHNICAL SCHEDULE FOR SOLAR PHOTOVOLTAIC (PV) MODULE

S/N	DESCRIPTION	UNIT	REQUIREMENT	TENDERER'S GUARANTEE
2.1	The manufacturer shall have: ISO 9001, ISO 14001, OHSAS 18001 Certificates	-	As Specified	
2.2	Tier-1, Manufacturer's experience in manufacturing PV modules: Minimum 10 years	-	As Specified	
2.3	Peak Power of Individual Module under STC	Watt-peak	≥ 580	
2.4	PV Plant DC Capacity	MWp	≥2.3	
2.5	Solar PV Module Efficiency	%	≥ 22	
2.6	Cell Type	-	Mono Crystalline Silicon	
2.7	Junction Box Protection (according to IEC 60529)	-	IP67 or better	
2.8	PV Module System Voltage	Vdc	Maximum: 1000-1500	
2.9	Module Power Warranty: A letter provided by principal PV module manufacturer in their letterhead stating the warranty period for their PV module. The warranty period for the PV module must be at least 10 years of 90% rated power output and 20 years of min 80% rated power output at STC. Minimum 5 years warranty against manufacturing defects.	-	As Specified	
2.10	International Certification: IEC 61215:2005 2nd edition or latest edition of IEC61215-1:2016, IEC 61215-2:2016, for Terrestrial PV modules - Design qualification and type approval, Part-1: Test requirements and Part-2: Test Procedure. IEC 62804 for detection of Potential Induced Degradation (PID) and IEC 61730 for PV module safety qualification. The test certificates must be provided.	-	As Specified	

S/N	DESCRIPTION	UNIT	REQUIREMENT	TENDERER'S GUARANTEE
2.11	All PV modules offered for the project must be of same type, same model, same power rating and same manufacturer	-	As Specified	
2.12	Bidder must submit the technical datasheet of Solar PV Module	-	As Specified	

3. TECHNICAL SCHEDULE FOR THREE PHASE HYBRID INVERTER

S/N	DESCRIPTION	UNIT	REQUIREMENT	TENDERER'S GUARANTEE
3.1	The manufacturer shall have: ISO 9001, ISO 14001 Certificates	-	As Specified	
3.2	Warranty: Manufacturing warranty of minimum 5 years from inverter manufacturer in their letter head signed and stamped	-	As Specified	
3.3	Inverter Type		Three Phase Hybrid Inverter	
3.4	Nominal AC active power	MW_{AC}	≤ 0.35	
3.5	Output Frequency	Hz	50 Hz ± 2.5%	
3.6	Peak Efficiency	%	> 98%	
3.7	Total Harmonic Distortion (THD)	%	<3%	
3.8	Power Factor	-	-0.95 Lagging to +0.95 Leading	
3.9	Protection Class	-	IP66 or above	
3.10	String-level management At least 10 MPP Trackers	-	As Specified	
3.11	MPPT Operating Voltage Range: 200 V ~ 1,000 V	-	As Specified	
3.12	Nominal Output Voltage: 380V/400V/480V, 3W+(N)+P	-	As Specified	
3.13	The matching array controller must have the anti-PID module The inverter should have Anti-islanding Protection, with the Input-side Disconnection Device, AC Overcurrent Protection, DC Reverse-polarity Protection, PV-array String Fault Monitoring, DC Insulation Resistance Detection, Residual Current Monitoring Unit, Arc Fault Protection, Smart String Level Disconnector Display: LED indicators, WLAN adaptor + APP	-	As Specified	

S/N	DESCRIPTION	UNIT	REQUIREMENT	TENDERER'S GUARANTEE
3.14	Certificate: EN 62109-1/-2, IEC 62109-1/-2, EN 50530, IEC 62116, IEC 61727, IEC 60068, IEC 61683 Grid Connection Standards: VDE-AR-N4105, EN 50549-1, EN 50549-2, RD 661, RD 1699, C10/11	-	As Specified	
3.15	Three Phase Hybrid Inverter – with Capability to Work off the grid.	-	As Specified	

4. TECHNICAL SCHEDULE FOR SYSTEM MONITORING UNIT

S/N	DESCRIPTION	UNIT	REQUIREMENT	TENDERER'S GUARANTEE
4.1	RS485 or Modbus communication port for receiving data from inverters, charge controller, PV monitoring unit or power meter etc	-	As Specified	
4.2	RS232 or LAN port or Modbus for local monitoring or network monitoring	-	As Specified	
4.3	Internet connection via GSM modem, CDMA, GPRS, 3G, ADSL, VSAT	-	As Specified	
4.4	Automatic store data into SD card when communication has failed	-	As Specified	
4.5	The bidder must submit the technical datasheet for Monitoring System.	-	As Specified	

5. TECHNICAL SCHEDULE FOR SUPPORT STRUCTURE FOR PV MODULES

S/N	DESCRIPTION	UNIT	REQUIREMENT	TENDERER'S GUARANTEE
5.1	Tilt angle and orientation: Optimum PV production angle at given latitude/ longitude of the site.	-	As Specified	
5.2	Mounting structure design and foundation arrangements shall consider all static and dynamic loads suitable for proposed site. Support structure design and foundation or fixation mounting arrangements should withstand a minimum basic wind speed of 40m/s.	-	As Specified	
5.3	Mounting structure shall be installed in such a way that PV array shading is minimized as much as possible considering site condition	-	As Specified	
5.4	Stainless Steel (SS 304) nuts & bolts should be used for fixing modules with the structure. Stainless Steel (SS 304) or Galvanized bolts, nuts, fasteners, washer, mounting clamps should be used for fixing structure and compatible with materials which it is being fixed. In case of welding structure, the galvanization should be done after the fabrication work.	-	As Specified	
5.5	The foundation of PV structure shall be minimum 0.8 meter deep with concrete reinforcement	-	As Specified	

6. TECHNICAL SCHEDULE FOR DC CABLES AND ACCESSORIES

S/N	DESCRIPTION	UNIT	REQUIREMENT	TENDERER'S GUARANTEE
6.1	Cables shall be selected with an insulation voltage level applicable to the system voltage for which they are used and capacity suitable for the load being served	-	As Specified	
6.2	Cables shall be multi-strand, PVC insulated cables and UV resistant, suitable for outdoor installations	-	As Specified	
6.3	All DC cables must be copper.	-	As Specified	
6.4	Outdoor cables from PV plant to Powerhouse should be armored. The cable must be underground at a depth of 0.5 meter with sand and soil filling. Any underground cable interconnections must be water-tight corrosion resistant types.	-	As Specified	
6.5	All external wiring, cabling, insulation material and junction boxes must be UV-resistant, and terminals protected against dust and moisture.	-	As Specified	
6.6	String junction boxes/string combiner boxes/main combiner boxes/grid connected AC combiner box must be minimum IP65 according to IEC 60529.	-	As Specified	

7. TECHNICAL SCHEDULE FOR POWER GENERATION SYSTEM EARTHING AND PROTECTIONS

S/N	DESCRIPTION	UNIT	REQUIREMENT	TENDERER'S GUARANTEE
7.1	The PV modules frame and array structure must be properly earthed, connected to an earth electrode via insulated stranded copper earth wire of minimum 10mm^2 and using the shortest practical direct route downwards that directs the cable away from sensitive electronic equipment and shall not enter the building. The maximum allowable earth resistance between array frame and earth electrode is 5 Ohms.	-	As Specified	
7.2	Equipment Earthing: Equipment bonding shall be used to tie together casings of all equipment and enclosures, including all electronic equipment casings (MPPT controllers, inverters), DC combiner boxes, AC combiner boxes, DC busbars and DC enclosures, with minimum 10 mm^2 earth cable, and connected via an insulated stranded copper earth wire of minimum 10 mm^2 connected to an earth electrode. The maximum allowable earth resistance between the metal parts of the devices and metal parts of the consumer earth terminal is 5 Ohms	-	As Specified	
7.3	System Earthing: The AC neutral of Power Conditioning Units must be properly earthed, connected to an earth electrode via insulated stranded copper earth wire of minimum 10 mm^2. The maximum allowable earth resistance is 5 Ohms	-	As Specified	

7.4	For PV frame & array structure earthing, equipment earthing and system earthing, plate earthing or rod earthing shall be preferred. For Plate Earthing: The earthing plate/rod/strip must be copper type. -Copper Plate Size: 600mm (L) x 600mm (B) x 3 thickness -Copper Rod Size: 1 no. of each 2.5 meters length x 16mm diameter -Down conductor Size: 25mm width x 3mm thickness copper strip -Backfill compound: 2 nos. of each 25Kg For Rod Earthing: -Copper Rod Size: 1 no. of each minimum 2.5 meters length x 25mm diameter -Down Conductor Size: 25mm width x 3 mm thickness copper strip -Backfill Compound: 2 nos. of each 25Kg	-	As Specified	
7.5	The Lightning Protection System (LPS) must be able to minimize the damage to the surrounding environment and must comply with IEC 62305-3. -Air Terminal Conductor: Stainless Steel -Down Conductor Size: 25mm width x 3 mm thickness copper strip -LPS height: Minimum 10 meters	-	As Specified	
7.6	The resulting earthing resistance must be less than 4 Ohm	-	As Specified	
7.7	DC and AC circuit breakers must be included as needed.	-	As Specified	

8. TECHNICAL SCHEDULE FOR ELECTRONIC MULTIFUNCTIONAL ENERGY AND DEMAND METER

S/N	DESCRIPTION	UNITS	REQUIREMENT	TENDERER'S GUARANTEE
8.1	Type		CT/VT fed, 3 phase 4 wire	

8.2	Inputs		1 A , 110V AC, 50Hz	
8.3	Metering Accuracy		Class 0.2s	
8.4	Load Profiling capability		Daily or monthly or yearly	
8.5	Maximum Demand Period		5, 10,15,30 or 60 Minutes	
8.6	Display		A, kV, kVA, kW, kVAr , kWh, kVArh, kVAh, in primary values, Monthly Maximum Demand, (kW) and Monthly Power Factor.	
8.7	Memory		Store at least 12 monthly billing data (kW,kWh,PF)	
8.8	Technical /Manufacturer's Brochure to be provided with the bid.	Yes/No	Yes	
8.9	Previous Type test results and/or certification to be provided with the bid	Yes/No	Yes	
8.10	Drawings showing dimensions to be provided with the bid	Yes/No	Yes	
8.11	Quality assurance certification to be provided with the bid	Yes/No	Yes	
8.12	Routine test results to be provided on delivery	Yes/No	Yes	
8.13	Applicable standard		IEC 62052-11	

9. TECHNICAL SCHEDULE FOR 33KV STEP UP BOX TYPE SUBSTATION

S/N	DESCRIPTION	UNITS	REQUIREMENT	TENDERER'S GUARANTEE
9.1	Model		Outdoor, 3 phase, 2 winding Mineral oil filled (PCB Free)	
9.2	Type		MV BOX Transformers	
9.3	Codes, Standards and Certifications		IEC 60076	
9.4	Location of transformer		Outdoor, oil filled	
9.5	Rated capacity	KVA		
9.6	Rated voltage (primary side)	kV	33	
9.7	Rated voltage (secondary side)	kV	0.8	
9.8	Voltage withstand (test voltage)	kV	HV:70kV,LV10kV	
9.9	Rated frequency	Hz	50	
9.10	Vector group		Dy11	
9.11	Type of earthing		Meet detail design.	
9.12	Efficiency	%	99.24	
9.13	Relative short-circuit voltage	%	7 (Tolerance in accordance with IEC60076)	
9.13	Full-load losses	kW	22.68	
9.14	No-Load Losses	kW	2.49	
9.15	Type of cooling		ONAN – oil filled	
9.16	Tap changer – number of steps		5	
9.17	Tap Changer – ratio of each step	%	2.5	

9.18	Tap change type	Onload / offload	±2	
9.19	Location of diverter switch		At HV side In tank	
9.20	List of Indications and protections provided: 64REF,50/51,87,49W,49Q,63PT,71Q, Surge protection			
9.21	Designed/protected to withstand large amounts of dust/sand in the air			
9.22	Protection class	IP	≥55(outdoor) ≥IP4X (indoor)	
9.23	Insulation Class		A	

10. TECHNICAL SCHEDULE FOR 11KV STEP UP BOX TYPE SUBSTATION

S/N	DESCRIPTION	UNITS	REQUIREMENT	TENDERER'S GUARANTEE
10.1	Model		Outdoor, 3 phase, 2 winding Mineral oil filled (PCB Free)	
10.2	Type		MV BOX Transformers	
10.3	Codes, Standards and Certifications		IEC 60076	
10.4	Location of transformer		Outdoor, oil filled	
10.5	Rated capacity	KVA		
10.6	Rated voltage (primary side)	kV	11	
10.7	Rated voltage (secondary side)	kV	0.4	
10.8	Voltage withstand (test voltage)	kV	HV:28kV, LV3kV	
10.9	Rated frequency	Hz	50	
10.10	Vector group		Dy11	

10.11	Type of earthing		Meet detail design.	
10.12	Efficiency	%	99.24	
10.13	Relative short-circuit voltage	%	7 (Tolerance in accordance with IEC60076)	
10.13	Full-load losses	kW	22.68	
10.14	No-Load Losses	kW	2.49	
10.15	Type of cooling		ONAN – oil filled	
10.16	Tap changer – number of steps		5	
10.17	Tap Changer – ratio of each step	%	2.5	
10.18	Tap change type	Onload / offload	±2	
10.19	Location of diverter switch		At HV side In tank	
10.20	List of Indications and protections provided: 64REF,50/51,87,49W,49Q,63PT,71Q, Surge protection			
10.21	Designed/protected to withstand large amounts of dust/sand in the air			
10.22	Protection class	IP	≥55(outdoor) ≥IP4X (indoor)	
10.23	Insulation Class		A	

11. TECHNICAL SCHEDULE FOR STEP UP BOX TYPE SUBSTATION 33KV SF6 RING MAIN UNIT

S/N	Details		Unit	Data
1.	Description			Panel type outdoor extensible ring main unit with two switch

				disconnectors and three vacuum interrupters
2.	Type			SF6 insulated extensible outdoor RMU
3.	Nominal voltage		kV	33
4.	Highest system voltage		kV	36
5.	Frequency		Hz	50
6.	Rated peak lightning withstand voltage		kV	170
7.	Rated normal current for the busbar		A	630
8.	Rated short-time withstand current		kA-rms	20 for 1 sec
9.	Degree of protection of unit offered			IP 54
10.	Configuration specification: SD – Switch Disconnector VCB – Vacuum Circuit Breaker			Leg 1: SD; Leg 2: VCB; Leg 3: SD
	Current rating		A	630 / 630 / 630
11.	Interruption medium			Vacuum
12.	Type of protection			Selectable protection features on leg 1, 2 & 3: -Over current -Earth fault -Thermal overload -Frequency -Negative phase sequence
13.	Cable test facility with interlock			Required
14.	Independent cable box required for each circuit			Required
15.	Type of cable box			Air filled
16.	Cable type			XLPE
17.	Maximum cable sizes			-Bottom entry up to 1 x 3C 300mm^2 & -Bottom entry up to 3 x 1C 500mm^2
18.	Indications			-Live circuit indication -Mechanical

				switch ON/OFF indication -Protection relay indications
19.	Language for instruction plate			English
20.	Corrosion protection			Required
21.	Color of unit			Grey
	Environmental Requirements			
22.	Operating Ambient temperature		0_C	-1 to 45
23.	Humidity		%	85
24.	Altitude above sea level		m	1400
	Other Requirements			
25.	Routine tests result to be provided on delivery			Required
26.	Previous type test certificate to be provided with bid			Required
27.	Instructions and commissioning manuals to be provided with equipment			Required
28.	Drawings showing the dimensions of the RMU offered and the arrangement of connections to be provided with bid			Required
29.	Quality assurance certification to be provided with the bid			Required
30.	Applicable standard(s)			IEC 62271

12. TECHNICAL SCHEDULE FOR STEP UP BOX TYPE SUBSTATION 11KV SF6 RING MAIN UNIT

S/N	Details		Unit	Data
1.	Description			Panel type outdoor extensible ring main unit with two switch disconnectors and three vacuum interrupters
2.	Type			SF6 insulated extensible outdoor RMU
3.	Nominal voltage		kV	11
4.	Highest system voltage		kV	12
5.	Frequency		Hz	50
6.	Rated peak lightning withstand voltage		kV	95

7.	Rated normal current for the busbar		A	630				
8.	Rated short-time withstand current		kA-rms	20 for 1 sec				
9.	Degree of protection of unit offered			IP 54				
10.	Configuration specification: SD – Switch Disconnector VCB – Vacuum Circuit Breaker			Leg 1	Leg 2	Leg 3		
				SD	VCB	SD		
	Current rating		A	630	630	630		
11.	Interruption medium			Vacuum				
12.	Type of protection			Selectable protection features on leg 1, 2 & 3: -Over current -Earth fault -Thermal overload -Frequency -Negative phase sequence				
13.	Cable test facility with interlock			Required				
14.	Independent cable box required for each circuit			Required				
15.	Type of cable box			Air filled				
16.	Cable type			XLPE				
17.	Maximum cable sizes			-Bottom entry up to 1 x 3C 300mm^2 & -Bottom entry up to 3 x 1C 500mm^2				
18.	Indications			-Live circuit indication -Mechanical switch ON/OFF indication -Protection relay indications				
19.	Language for instruction plate			English				
20.	Corrosion protection			Required				
21.	Color of unit			Grey				
	Environmental Requirements							
22.	Operating Ambient temperature		0_C	-1 to 45				
23.	Humidity		%	85				

24.	Altitude above sea level		m	1400
	Other Requirements			
25.	Routine tests result to be provided on delivery			Required
26.	Previous type test certificate to be provided with bid			Required
27.	Instructions and commissioning manuals to be provided with equipment			Required
28.	Drawings showing the dimensions of the RMU offered and the arrangement of connections to be provided with bid			Required
29.	Quality assurance certification to be provided with the bid			Required
30.	Applicable standard(s)			IEC 62271

13. TECHNICAL SCHEDULE FOR 4MWH BESS

BATTERY ASSEMBLY BOX PRODUCT PARAMETERS	
Unit Configuration	2 Units × 2.08 MWh = 4.16MWh Total Capacity
Cell Parameters	
Cell Specifications	3.2V/314Ah
Battery Type	Lithium Iron Phosphate
Battery Module Parameters	
Grouping	1P16S
Rated Voltage	51.2V
Rated Capacity	16.076kWh
Rated Charge and Discharge Current	157A
Rated Charge and Discharge Ratio	0.5C
Cooling-Down Method	Forced Air Cooling
Battery Cluster Parameters	
Grouping	1P26S
Rated Voltage	1331.2V
Rated Capacity	2.08MWh
Rated Charge and Discharge Current	785A
Rated Charge and	0.5C

Discharge Ratio	
Cooling-Down Method	Air-cooled / Liquid-cooled
Fire extinguishing and Protection	Perfluorohexane or better
Smoke Sense/ Temperature Sense	Each Cluster: one smoke sensor and one temperature sensor
Essential Parameter	
Communication Interface	LAN/RS485/CAN
IP Levels of Protection	IP54 or better.
Operating Ambient Temperature Range	-25℃~+55℃
Relative Humidity	Less than 95%RH, no condensation
Above Sea Level	1100m
Noise	≤70dB
Outline Dimension (mm)	6058*2438*2896

- Type: Li-ion (NMC, LFP), flow batteries, or alternative tech.
- Cycle Life: ≥6,000 cycles @ 80% DoD for LFP.
- Degradation: ≤2% per year (industry benchmark).
- BMS (Battery Management System): Overcharge/discharge protection, cell balancing.
- Thermal Runaway Prevention: Fire suppression (e.g., NOVEC), venting design.
- Certifications: UL 1973, IEC 62619, UN 38.3 (transport safety).
- Warranty & Degradation Guarantees: e.g., 10 years or 10,000 cycles at 70% remaining capacity.

Notes:

1) The PV Plant will be integrated to the nearest existing Substation or Distribution line (11kV or 33kV) within the Constituency.

2) The specifications for power evacuation equipment will be site specific and bidders will be expected to visit sites before bid submission.
    i) Total distance from the proposed solar plant site(s) to the point of connection shall not exceed 5 km for 11kV and 33kV networks.
    ii) The minimum conductor size on the 11kV overhead line must be 100mmsq ACSR.
    iii) The minimum conductor size on the 33kV overhead line must be 50mmsq ACSR.
    iv) The point of connection should have facilities for a protection and isolation device (i.e Autorecloser,Ring main unit,circuit breaker,isolators or drop out fuses.
3) This project adopts a containerized substation, which contains an outdoor transformer, RMU and LV panel. It enables a quick and reliable connection to the MV grids and has lower load loss and no-load loss in accordance with EN50588-1.