APPENDIX C: TENDER RETURNABLE TECHNICAL SCHEDULES

1. GENERAL

a. This document provides the specific technical requirements and schedules for the Bidder to complete and return during the Tender phase. The returnables are for the installation of a ground-mounted PV system at Sere Wind Farm in the Western Cape Province of South Africa.

b. The Bidder completes this document with the clear understating and information presented in 474-12578, Sere Solar PV Plant Functional Specification. The Bidder is free to deliver information in a free form outside the given tables, wherever this seems to be suitable. However, the Bidder shall abide by the topics and the numbering of the schedules and completely provide the requested information together with the respective schedule.

c. The column “Tendered” shall be filled in by the Bidder for all items. The given information and specification shall be part of the agreement and binding for all delivery and services.

d. The technical data sheets shall be supplemented by additional descriptions, explanations, drawings, and all other information necessary for a clear understanding of its application to enable the Employer to undertake the necessary assessment, evaluation, and verification of the technical and performance features of the Tender.

e. The Bidder ensures that wherever the information is required in respect to multiple units, the Bidder provides the required information on a unit-by-unit basis.

f. The Bidder provides all figures in this returnable to no more than two decimal places, unless required in specific section/s.

2. EXPERIENCE AND ELIGIBILITY

2.1 EPC CONTRACTOR EXPERIENCE

Table 2-1: General information about EPC Bidder

No.	Item	Details	
1	Name of EPC Bidder		
2	Home office address		
3	Regional office address		
4	Telephone / email address		
5	Name, Position and Title of contact person		
6	Legal form [1]		
7	Area of main business		
8	No. of staff in main business	Engineers:	Others:
9	Number of Solar PV power projects successfully completed		

[1] e.g., company, partnership, cooperation, consortium, joint venture, etc.

Table 2-2: Specific EPC PV Project Experience

Item No.	Description	Unit	Required	Tendered
1	**Experience**			
1.1	Number of PV projects designed, constructed, and commissioned by EPC Bidder	Number	Successful execution of ≥ 50 MWac (cumulative capacity) completed commercial ground mounted PV project within the last seven (7) years. At least one (1) of these projects shall be ≥ 20 MWac.	
1.2	Capacities of Solar PV projects previously designed, constructed and commissioned by the EPC Bidder as principal EPC Contractor	MWac	Successful execution of ≥ 50 MWac (cumulative capacity) completed commercial ground mounted PV project within the last seven (7) years. At least one (1) of these projects shall be ≥ 20 MWac	
2	**Project Details from experience presented above[2]**			
2.1	Name of Solar PV plant	-	To be provided by Bidder	
2.2	Location of Solar PV plant	-	To be provided by Bidder	
2.3	Name of Solar PV plant Owner(s) / Developer(s)	-	To be provided by Bidder	
2.4	Contact details of Solar PV plant Owner(s) / Developer(s)	-	To be provided by Bidder	
2.5	Type of PV module technology	-	To be provided by Bidder	
2.6	Type of PV mounting (fixed-tilt, tracking)	-	To be provided by Bidder	
2.7	Installed nameplate DC capacity	MWp	≥ 50 MWp (cumulative capacity). At least one (1) ≥ 20 MWp	
2.8	Plant AC capacity	Mwac	≥ 50 MWac (cumulative capacity). At least one (1) ≥ 20 MWac	

[2] The Bidder provides the information requested in Item No. 2 for all the Solar PV projects indicated in Item No. 1 as the Bidder's claimed experience.

Item No.	Description	Unit	Required	Tendered
2.9	Duration of construction	Months	To be provided by Bidder	
2.10	Commercial operation date	-	To be provided by Bidder	
2.11	Photographs (if possible)	-	To be provided by Bidder	
2.12	Proof verifying completed Solar PV plant in the form of contract, test on completion certificate, or take over certificate, with references from solar PV plant Owner(s) / Developer(s)	-	To be provided by Bidder	

2.2 O&M CONTRACTOR EXPERIENCE

a. The EPC Contractor will perform the role of O&M Contractor during the O&M period, defined as the first two (2) years of plant operations and maintenance during the Defects Liability Period. The Bidder (or subcontracted O&M Service Provider) must have successfully performed the Operations and Maintenance (O&M) duties for at least two (2) years as the main O&M Contractor for at least two (2) ground mounted PV plants which were ≥ 10 MWac.

b. The required operations and maintenance experience must be presented as indicated in Table 2-3 and Table 2-4.

c. If the Bidder is subcontracting the work for operations and maintenance of the Project for the O&M period, then the required Subcontractor's general information must be included as indicated in Table 2-3, and the Subcontractor's operations and maintenance experience must be presented as indicated in Table 2-4. Furthermore, a signed letter of intent between the two parties shall be submitted during the tender stage.

Table 2-3: General information about O&M Service Provider

No.	Item	Details	
1	Name of O&M Service Provider		
2	Home office address		
3	Regional office address		
4	Telephone / email address		
5	Name, Position and Title of contact person		
6	Legal form [3]		
7	Area of main business		
8	No. of staff in main business	Engineers:	Others:
9	Number of Solar PV power projects successfully operated and maintained		

[3] e.g., company, partnership, cooperation, consortium, joint venture, etc.

10	Signed letter of intent between O&M Service Provider and EPC Bidder (if subcontracting O&M service)	To be provided by Bidder	

Table 2-4: Specific O&M PV Project Experience

Item No.	Description	Unit	Required	Tendered
1	**Experience**			
1.1	Number of PV projects operated and maintained by O&M Contractor	Number	Successful O&M of at least two (2) commercial ground mounted PV plants	
1.2	Capacity of individual Solar PV project(s) previously operated and maintained by the O&M Contractor	MWac	≥ 10	
1.3	Period of operations and maintenance for each of the PV projects listed	Years	Successful O&M duties for at least two (2) years per PV project	
2	**Project Details from experience presented above[4]**			
2.1	Name of Solar PV plant	-	To be provided by Bidder	
2.2	Location of Solar PV plant	-	To be provided by Bidder	
2.3	Name of Solar PV plant Owner(s) / Developer(s)	-	To be provided by Bidder	
2.4	Contact details of Solar PV plant Owner(s) / Developer(s)	-	To be provided by Bidder	
2.5	Type of PV module technology	-	To be provided by Bidder	
2.6	Type of PV mounting (fixed-tilt, tracking)		To be provided by Bidder	
2.7	Installed nameplate DC capacity	MWp	≥ 10	
2.8	Plant AC capacity	MWac	≥ 10	
2.9	Duration of operations and maintenance	Months	To be provided by Bidder	
2.10	Commercial operation date	-	To be provided by Bidder	
2.11	Photographs (if possible)	-	To be provided by Bidder	

[4] The Bidder provides the information requested in Item No. 2 for all the Solar PV projects indicated in Item No. 1 as the Bidder's claimed experience.

Item No.	Description	Unit	Required	Tendered
2.12	Proof verifying Solar PV plant O&M duties in the form of EPC Contract(s) or O&M Contract(s) contract, test on completion certificate, take over certificate, or letter from Owner(s) / Developer(s)	-	To be provided by Bidder	

3. PROJECT IMPLEMENTATION SCHEDULE

The Bidder shall provide a Level II project implementation schedule, showing all the Project activities to be performed, including activities that will be subcontracted. The entire Project scope of work shall be represented.

4. KEY PERSONNEL

a. The Bidder shall ensure that suitably qualified personnel are included in design, construction, commissioning, operation, and maintenance of the Project. The minimum requirements of key personnel for the Project are presented in Table 4-1.

b. The Bidder shall provide a detailed organogram for the entire project, including the design, construction, commissioning, operation, and maintenance phases. The organogram shall indicate the key personnel for the project.

c. The Bidder shall provide the detailed CV of each key personnel responsible for the works mentioned in Table 4-1 and indicated on the detailed organogram.

d. If any replacement is required during the design, construction, commissioning, operation, and maintenance of the Project, the Bidder shall ensure that the replacement has equivalent or higher experience and qualifications than the one being replaced.

Table 4-1: Experience of Key Personnel

Item No.	Description	Unit	Required	Tendered
1	**Designer**			
1.1	Solar PV system	Years	≥ 5	
1.2	Electrical works	Years	≥ 5	
1.3	C&I works	Years	≥ 5	
1.4	Civil / Structural works	Years	≥ 5	
1.5	Structural works	Years	≥ 5	
2	**Managers**			
2.1	Site Manager during construction	Years	≥ 5	
2.2	Site Manager during operation and maintenance	Years	≥ 3	
2.3	Project Manager	Years	≥ 3	
2.4	Commissioning Manager	Years	≥ 5	
2.5	Quality Manager	Years	≥ 5	
2.6	Health, Safety, and the Environment (HSE) Manager	Years	≥ 5	

Item No.	Description	Unit	Required	Tendered
3	**Trainers – Design, Construction, Commissioning, and O&M**			
3.1	Training Coordinator – Design, Construction, Commissioning	Years	≥ 3	
3.2	Training Coordinator – O&M	Years	≥ 5	
4	**Detailed CV of all personnel mentioned above**	-	To be provided by Bidder	
5	**Organogram for the entire project, including the design, construction, commissioning, operation, and maintenance phases**	-	To be provided by Bidder	

5. EQUIPMENT WARRANTY

a. The Bidder provides equipment warranty according to minimum requirement set in Table below.

b. In addition (and without prejudice) to the defects liability, the Bidder releases warranty on equipment (including not limited to strategic part warranty). No equipment warranty shall limit another warranty or otherwise.

c. The Bidder transfers the ownership of all manufacturer equipment warranties to the Employer during the Substantial Completion of the Project.

Table 5-1: Equipment Warranty

Equipment	Minimum Warranty Period in Years	Warranty Period in Years provided by Bidder
PV Module - Product Warranty against Manufacturing defects	10	
PV Modules – Performance	25	
Mounting structures Duration of warranty (materials)	10	
Mounting structures Lifetime design warranty	25	
Inverter	10	
LV/MV Step Up Transformer	5	
MV/LV Step Down Transformer LV/0.4kV	5	
Ring Main Unit	5	
MV Switchgear	5	
HVAC Equipment	2	
Fire Protection Equipment	2	
Water supply and reticulation Equipment Duration of warranty (materials)	10	

6. SOLAR PV PLANT CONFIGURATION AND PERFORMANCE CRITERIA

a. The Bidder ensures the Solar PV system design is performed according to all relevant standards, specifications, permits, licenses, best industry practice, and according to the site conditions.

b. The Bidder designs an optimised PV Plant within the identified constraints, complying with the requirements indicated below.

Table 6-1: Solar PV System Design

Item No.	Description	Unit	Required	Tendered
1	**Basic Design Conditions**			
1.1	Design lifetime of the plant	Years	≥ 25	
1.2	Ambient Temperature	° C	-5 to 55	
1.3	Complying with site environmental conditions	Yes/No	Yes	
1.4	Complying with Environmental Permit and Water Use license permit	Yes/No	Yes	
2	**PV Capacity (optimised within identified constraints)**			
2.1	Nominal AC capacity	MWac	≥ 14, and ≤ 19.9	
2.2	DC capacity	MWp	≥ 16.8, and ≤ 19.9	
2.3	Ratio of DC to AC capacity	-	≥ 1.1	
2.4	Total PV Plant footprint	ha	≤ 19.9	
3	**Major Components – General Information**			
3.1	Total number of PV modules offered for the project	-	To be provided by Bidder	
3.2	Total number of inverters offered for the project	-	To be provided by Bidder	
3.3	Total number of Inverter Stations offered for the project (if applicable)	-	To be provided by Bidder	
3.4	Total number of MV/LV inverter transformers offered for the project	-	To be provided by Bidder	
4	**PV Module – Inverter Configuration**			
4.1	Number of PV modules per string	-	To be provided by Bidder	
4.2	String voltage (Vmpp) at maximum operating module temperature (at 85°C module temperature)	V	≥ 110% of minimum MPP input voltage of respective inverter	
4.3	String voltage (Vmpp) at minimum operating module temperature (at 0° C module temperature)	V	Below the maximum MPP input voltage of respective inverter	
4.4	String voltage (Voc) at minimum module temperature (at 0° C module temperature)	V	Below the maximum input voltage of respective inverter	

Item No.	Description	Unit	Required	Tendered
5	**Supportive Information**			
5.1	PV Array Layout	Yes/No	Yes	
5.2	String Voltage calculation	Yes/No	Yes	
5.3	Technical datasheet of PV module	Yes/No	Yes	
5.4	Technical datasheet of PV module mounting structure / tracker	Yes/No	Yes	
5.5	Technical datasheet of inverter	Yes/No	Yes	
5.6	Technical datasheet of Inverter Stations	Yes/No	Yes	
5.7	Technical datasheet of MV/LV inverter transformer	Yes/No	Yes	

7. GUARANTEE ON PERFORMANCE AND AVAILABILITY

a. The Bidder provides guarantee on the:
   i. Plant Performance Ratio (PR), and
   ii. Plant Availability

b. These Performance Guaranteed Values will be verified during the Provisional Acceptance Tests (PAT), Intermediate Acceptance Tests (IAT), and Final Acceptance Tests (FAT).

c. The actual Performance Ratio (PR) shall be evaluated at 100% plant availability. The actual Plant Availability shall be evaluated separately.

d. The Bidder is required to provide Performance Guaranteed Values as indicated in Table 7-1.

Table 7-1: Plant Performance Guarantees

Year	Parameter	Minimum required by Employer	Guaranteed by Bidder
1	Guaranteed annual average Performance Ratio for year 1 of operation - Tests After Date of Completion (Year 1)	78 %	
	Guaranteed annual average Plant Availability for year 1 of operation - Tests After Date of Completion (Year 1)	98 %	
2	Guaranteed annual average Performance Ratio for year 2 of operation - Tests After Date of Completion (Year 2)	77.5 %	
	Guaranteed annual average Plant Availability for year 2 of operation - Tests After Date of Completion (Year 2)	98 %	

e. With regards to the “Guaranteed annual average Performance Ratio for year 1 of operation - Tests After Date of Completion (Year 1)” provided in Table 7-1, the Bidder is required to provide a monthly breakdown of this year 1 Performance Ratio (PR) guarantee, along with estimation of solar irradiation on module plane, in a tabular format as shown in Table 7-2.

f. The Performance Ratio (PR) guaranteed for the Tests After Date of Completion (Year 1) will be the corresponding monthly average PR (shown in Table 7-2) during which the test is performed. If the test duration covers period of two consecutive months, then the guaranteed PR during the Tests After Date of Completion (Year 1) is calculated based on weighted average PR of the two respective months.

Table 7-2: Monthly breakdown of Guaranteed Performance Ratio for first year

Month	Breakdown of first year annual guaranteed PR (%)	Estimated Solar Irradiation on Module Plane (kWh/m2)
January		
February		
March		
April		
May		
June		
July		
August		
September		
October		
November		
December		
Annual Average		

g. The Bidder provides the following supportive information and documents (indicated in Table 7-3) which shall verify the guaranteed level of Performance Ratio (PR).

Table 7-3: Plant Performance Estimation

Item No.	Description	Unit	Required	Tendered
1	**Documents and Diagrams**			
1.1	Energy yield assessment report	Yes/No	Yes	
1.2	TMY datasets used as input in the simulation model and energy yield assessment report.	Yes/No	Yes	
1.3	Bidder confirms that the TMY datasets, provided in 1.2 (above), were used for the Energy Yield Assessment Report in 1.1 (P50, P90, and P99 for year 1, 10-year, and 25-year return periods)	Yes/No	Yes	
1.4	PV Module tilt angle (for fixed-tilt)	°	10 – 25 degrees	
1.5	Row to row distance	m	To be provided by Bidder	
2	**Losses Estimation**			
2.1	Near shading losses	%	≤ 2.5	

Item No.	Description	Unit	Required	Tendered
2.2	Reflection (IAM) losses	%	To be provided by Bidder	
2.3	Soiling losses	%	To be provided by Bidder	
2.4	Losses due to irradiance level	%	To be provided by Bidder	
2.5	Losses due to temperature	%	To be provided by Bidder	
2.6	Mismatch losses	%	To be provided by Bidder	
2.7	Module quality losses	%	To be provided by Bidder	
2.8	DC cabling losses	%	To be provided by Bidder	
2.9	AC cabling losses	%	To be provided by Bidder	
2.10	Losses in inverter	%	To be provided by Bidder	
2.11	Technical availability	%	To be provided by Bidder	
2.12	MV/LV Transformer losses	%	To be provided by Bidder	
2.13	Self-consumption losses	%	To be provided by Bidder	
2.14	Power evacuation losses	%	To be provided by Bidder	
2.15	Annual module degradation	%	To be provided by Bidder	
2.16	Others (specify)	%	To be provided by Bidder	

8. ELECTRICAL SYSTEM

8.1 ELECTRICAL SYSTEM CRITERIA

It is a requirement that the Engineering Design be performed under the self-build agreement by the Contractor. The Contractor appointed Consulting Engineer/s should comply with standards as per 474-12578, Sere Solar PV Plant Functional Specification Appendix C: PV Plant Codes and Standards indicating required minimum certificates and standards.

Table 8-1: Electrical Single Line Diagram and Reports

Item No.	Description	Unit	Required	Response from Bidder
1	**Full Compliance to Electrical Requirements**			
1.1	The Bidder submits a list where the bid deviate from 474-12578 , Sere Solar PV Plant Functional Specification	-	To be provided by Bidder	
2	**Type Test Certificates and/or Datasheets**			
2.1	The Bidder to confirm that the Type test certificate for Primary and Secondary MV Switchgear (GIS or AIS will be provided after contract award	-	Yes/No	
2.2	The Bidder to confirm that the Type Test certificate for HV/MV Power Transformer will be provided after the contract award	-	Yes/No	
3	**Plant Electrical Single Line Diagram**			
3.1	Submission of a high level Conceptual Electrical reticulation or Single Line Drawing containing the following as a minimum: - PV Modules - DC and AC Cabling - Combiner boxes - Inverter stations - Primary and secondary Switchgear - HV/MV Transformers - Power protection and surge devices - Overhead line - Indication of Point of Connection (POC)	-	To be provided by Bidder	
4	**Power System Study**			
4.1	Submission of Power System Study report previously done by the Contractor for similar scope of work	-	To be provided by Bidder	

8.2 TECHNICAL SCHEDULES

8.2.1 PV Modules

Table 8-2: PV Modules Schedules

Item No.	Description	Unit	Required	Response from Bidder
1	**Product information**			
1.1	PV Module manufacturer	Name	To be provided by Bidder	

Item No.	Description	Unit	Required	Response from Bidder
1.2	Proof / supporting documentation that the offered PV module manufacturer is on the BNEF PV Module Tier 1 list	-	To be provided by Bidder	
1.3	Module Type	-	To be provided by Bidder	
2	**Technical Characteristics**			
2.1	PV Module/Cell technology	-	To be provided by Bidder	
2.2	String maximum Voltage	VDC	1500	
2.3	Positive Power Tolerance	W	0 to +5 (or 0 to +3%)	
2.4	Module efficiency	%	≥ 20%	
2.5	Bifaciality factor for p-type bifacial module	%	≥ 70% ±5%	
2.6	Bifaciality factor for n-type bifacial module	%	≥ 85% ±5%	
2.7	Operating temperature	°C	between -40 °C and 85 °C	
2.8	Static mechanical load	Pa	≥ 2400	
2.9	Increased distributed mechanical load on the front glass surface	Pa	≥ 5400	
2.10	Temperature coefficient	%/°C	≥ -0.37	
2.11	Light induced degradation loss	%	≤ 2	
2.12	Nominal Module Operating Temperature (NMOT) lower than or equal to	°C	≤ 45 °C ±2 °C (NMOT @800 W/m2, 20 °C, AM 1.5, Wind speed 1 m/s)	
3	**Product Performance Guarantee**			
3.1	Power output guaranteed during the first year of operation	%	Minimum: 98%	
3.2	Linear power degradation coefficient from year 2 to year 25	%/year	Maximum degradation of -0.55%/year	
3.3	Guaranteed output of the nominal power after 10 years	%	Minimum 90%	
3.4	Guaranteed output of the nominal power after 25 years	%	Minimum 80%	
4	**Minimum Certificates and Standards**			
4.1	As per 474-12578, Sere Solar PV Plant Functional Specification Appendix C: PV Plant Codes and Standards indicating required minimum certificates and standards.	Yes/No	Yes	

Item No.	Description	Unit	Required	Response from Bidder
5	**Track Record**			
5.1	Manufacturer Production track record	year	≥ 5	
5.2	Minimum annual production capacity	MWp	≥ 500	
5.3	Capacity installed	MWp	≥ 1,000	
5.4	Module type in operation in at least three (3) commercial plants of similar size (20 MWac) that have been in successful operation for at least one (1) year.	Yes/No	Yes	
5.4.1	Location of each Project	-	To be provided by Bidder	
5.4.2	Capacity of each Project	MWp	To be provided by Bidder	
5.4.3	Commercial operation date of each project	-	To be provided by Bidder	
6	**Supportive Documents**			
6.1	Module Datasheet	-	To be provided by Bidder	
6.2	Brief description of the cleaning strategy instruction (from module manufacturer)	-	To be provided by Bidder	
6.3	A letter of confirmation certifying that module manufacturer track record is as per 5.1, 5.2, and 5.3 of this table.	-	To be provided by Bidder	
6	**Additional Information – To be listed by the Bidder**			
6.1	To be defined by the Bidder	-		

8.2.2 Inverters

Table 8-3: Inverter Schedules

Item No.	Description	Unit	Required	Response from Bidder
1	**Product information**			
1.1	Inverter manufacturer	Name	To be provided by Bidder	
1.2	Inverter Type	-	To be provided by Bidder	
2	**Track Record**			
2.1	Manufacturer Production track record	year	≥ 5	
2.2	Minimum annual production capacity	MW	≥ 500	
2.3	Minimum capacity installed	MW	≥ 1,000	

Item No.	Description	Unit	Required	Response from Bidder
2.4	Inverter type or series in operation in at least three (3) commercial plants totalling 50 MWac or higher nominal power (not demonstration projects), for at least twelve (12) months and have recorded a technical availability of at least 99% for twelve (12) consecutive months of operation.	Yes/No	Yes	
2.4.1	Location of each Project	-	To be provided by Bidder	
2.4.2	Capacity of each Project	MW	To be provided by Bidder	
2.4.3	Commercial operation date of each project	-	To be provided by Bidder	
2.5	Inverter type or series in operation in similar ambient conditions (up to ≥ 50°C)	months	≥ 12	
3	**Inverter Characteristics**			
3.1	Inverter technology/type	-	Central/String	
3.2	Inverter rated capacity per unit	MVA	To be provided by Bidder	
3.3	Nominal AC output Voltage	V	To be provided by Bidder	
3.4	Maximum conversion efficiency	%	≥ 98	
3.5	European efficiency	%	≥ 98	
3.6	Operating ambient temperature range	°C	-5 … +50	
3.7	Cooling method/mechanism	-	To be provided by Bidder. (The inverter cooling method shall be designed for installation and operating site conditions to ensure the inverter functions within its operating ambient temperature range)	
3.8	Inverter Maximum DC voltage	V	1,500	
3.9	Connection phases	-	Three-Phase	
3.10	Frequency	Hz	50	
3.11	Total harmonic distortion, Power Factor, Anti-islanding protection	-	According to South African Grid code compliance: Grid	

Item No.	Description	Unit	Required	Response from Bidder
			connection code for Renewable Power Plants (RPPs) connected to the electricity Transmission system (TS) or the Distribution system (DS) in South Africa	
3.14	Protection type IP rating	IP	Indoor ≥ IP54, Outdoor ≥ IP65	
3.15	Controllability of inverter output per remote control / energy management system, if possible.	Yes/No	Yes: Dynamic adjustable	
3.16	Earthing concept/philosophy	Yes/No	Yes Earthing according to installation requirements of PV module and inverter manufacturer.	
3.17	Input Failure detection	Yes/No	Yes	
3.18	Frequency protection	Yes/No	Yes	
3.19	DC overvoltage protection	Yes/No	Yes	
3.20	Surge protection	Yes/No	Yes	
4	**Minimum required standards**			
4.1	As per 474-12578, Sere Solar PV Plant Functional Specification Appendix C: PV Plant Codes and Standards indicating required minimum certificates and standards. 562/21, Sere 19.5MW PV Proposed Primary Plant Functional Scope 562/22, Sere 19.5MW PV Proposed Control Plant Functional Scope	Yes/No	Yes	
5	**Monitoring system requirements**			
5.1	Continuous data logging to the CMS system for the defined technical plant performance parameters including events and status	Yes/No	Yes	
5.2	Connection interface to CMS	Yes/No	Yes	

Item No.	Description	Unit	Required	Response from Bidder
6	**Product Warranty Extension**			
6.1	The Bidder shall indicate if the inverter manufacturer has an option for extension of product warranty. If yes, maximum duration of the warranty shall be indicated	years	To be provided by Bidder	
7	**Supportive Documents**			
7.1	Inverter datasheet	-	To be provided by Bidder	
7.2	A letter of confirmation certifying that inverter manufacturer track record is as per 2.1, 2.2, and 2.3 of this table.	-	To be provided by Bidder	
8	**Additional Information – To be listed by the Bidder**			
8.1	To be defined by the Bidder	-		

8.2.3 Inverter Station

Table 8-4: Inverter Station Schedules

Item No.	Description	Unit	Required	Response from Bidder
1	**Product information**			
1.1	Inverter Station manufacturer	Name	To be provided by Bidder	
2	**Track Record**			
2.1	Have been used in Projects of 50 MW in capacity or more.	Yes/No	Yes	
2.1.1	Location of project	-	To be provided by Bidder	
2.1.2	Capacity of project	-	To be provided by Bidder	
2.1.3	Commercial operation date	-	To be provided by Bidder	
3	**Inverter Station Characteristics**			
3.1	For central inverter; shall at minimum house inverters and associated protection and control equipment and LV/LV auxiliary transformer.	Yes/No	Yes	
3.2	Ventilation system type	-	To be defined by the Bidder	
3.3	Degree of Protection (SANS 60529)	IP	≥ IP65	
3.4	Designed/protected to withstand outdoor conditions for at least 25 years	Yes/No	Yes	
3.5	Corrosion resistance	Yes/No	Yes	

Item No.	Description	Unit	Required	Response from Bidder
4	**Product Warranty**			
4.1	Product warranty	Year	≥ 5	
5	**Supportive Documents**			
5.1	Inverter Power Station datasheet	-	To be provided by Bidder	
6	**Additional Information – To be listed by the Bidder**			
6.1	To be defined by the Bidder	-		

8.2.4 MV/LV Inverter transformer

Table 8-5: MV/LV Inverter transformer Schedules

Item No.	Description	Unit	Required	Response from Bidder
1	**Product information**			
1.1	MV/LV Inverter transformer manufacturer	Name	To be provided by Bidder	
2	**Transformer Characteristics**			
2.1	Transformer Type	-	To be provided by Bidder	
2.2	Rated Capacity	MVA	To be provided by Bidder	
2.3	Nominal Voltage (Low voltage side)	V	To be provided by Bidder	
2.4	Nominal Voltage (Medium voltage side)	kV	To be provided by Bidder	
2.5	Rated Frequency	Hz	50	
2.6	Tap-Changer Type	-	off-load	
2.7	Tap-changer - number of steps	No.	5	
2.8	Tap-changer –Ratio of each step	%	-5% to 5%	
2.9	Type of protection	-	To be provided by Bidder	
2.10	Transformer insulating medium	Type	Biodegradable oil or Dry-type	
2.11	Transformer Cooling method	-	To be provided by Bidder	
2.12	IP Rating	IP	≥ IP55 for outdoor ≥IP4X for indoor	
2.13	No-load losses	W	To be provided by Bidder	
2.14	Load losses	W	To be provided by Bidder	

Item No.	Description	Unit	Required	Response from Bidder
2.15	Climatic class (dry-type transformer only)	-	C2	
2.16	Environmental class (dry-type transformer only)	-	E2	
2.17	Fire class (dry-type transformer only)	-	F1	
2.18	Insulation Class (dry-type transformer only)	-	F	
3	**Minimum required standards (to be proven by respective Certificate or Conformity Declaration)**			
3.1	As per 474-12578, Sere Solar PV Plant Functional Specification Appendix C: PV Plant Codes and Standards indicating required minimum certificates and standards.	Yes/No	Yes	
4	**Monitoring system requirements**			
4.1	Continuous data logging to the CMS system for the defined transformer performance parameters including events and status.	Yes/No	Yes	
4.2	Connection interface to CMS system using protocols.	Yes/No	Yes	
5	**Supportive Documents**			
5.1	Transformer Datasheet	-	To be provided by Bidder	
6	**Additional Information – To be listed by the Bidder**			
6.1	To be defined by the Bidder	-	To be provided by Bidder	

8.2.5 MV Secondary Switchgear (RMU)

Table 8-6: MV Switchgear (RMU) Schedules

Item No.	Description	Unit	Required	Response from Bidder
1	**Product information**			
1.1	Switchgear manufacturer	Name	To be provided by Bidder	
1.2	RMU Type/Model	Type	To be provided by Bidder	
2	**Ratings**			
2.1	Nominal voltage	kVrms	To be provided by Bidder	

Item No.	Description	Unit	Required	Response from Bidder
2.2	Rated voltage	kVrms	To be provided by Bidder	
2.3	System frequency	Hz	50	
3	**Design**			
3.1	Indoor/Outdoor application	-	To be provided by Bidder	
3.2	Insulating medium	-	SF6-free GIS	
3.3	Interrupting technology (switch dis-connectors/isolators)	-	Vacuum	
3.4	Interrupting technology (circuit breaker)	-	Vacuum	
4	**Supportive Documentation**			
4.1	RMU datasheet/Catalogue	-	To be provided by Bidder	
5	**Minimum required standards**			
5.1	As per 474-12578, Sere Solar PV Plant Functional Specification Appendix C: PV Plant Codes and Standards indicating required minimum certificates and standards.	Yes/No	Yes	
6	**Additional Information – To be listed by the Bidder**			
6.1	To be defined by the Bidder	-		

8.2.6 MV Primary Switchgear

Table 8-7: MV Primary Switchgear Schedules

Item No.	Description	Unit	Required	Response from Bidder
1	**Product information**			
1.1	Switchgear manufacturer	Name	To be provided by Bidder	
1.2	Type/Model	Type	To be provided by Bidder	
2	**Ratings**			
2.1	Nominal voltage	kVrms	22kV	
2.2	Rated voltage	kVrms	To be provided by Bidder	
2.3	System frequency	Hz	50	
3	**Design**			
3.1	Indoor/Outdoor application	-	Indoor	
3.2	Insulating medium	-	AIS	

Item No.	Description	Unit	Required	Response from Bidder
3.3	Type	Withdrawable or Fixed-patten	To be provided by Bidder	
3.4	Interrupting technology	-	Vacuum	
4	**Supportive Documentation**			
4.1	Switchgear datasheet/Catalogue	-	To be provided by Bidder	
5	**Minimum required standards**			
5.1	As per 474-12578, Sere Solar PV Plant Functional Specification Appendix C: PV Plant Codes and Standards indicating required minimum certificates and standards.	Yes/No	Yes	
6	**Additional Information – To be listed by the Bidder**			
6.1	To be defined by the Bidder	-		

8.2.7 Grid Code Compliance

Table 8-9: Grid Code Compliance

Item No.	Description	Unit	Required	Response from Bidder
1	**Minimum Plant Technical Grid Code Requirements for category B Plant**			
1.1	Voltage range as per Category B in the renewable Grid Code of South Africa	Yes/No	Yes	
1.2	Frequency as per Category B in the renewable Grid Code of South Africa	Yes/No	Yes	
1.3	Voltage ride through as per Category B in the renewable Grid Code of South Africa	Yes/No	Yes	
1.4	Power Quality as per Category B in the renewable Grid Code of South Africa	Yes/No	Yes	
1.5	Power Frequency response as per Category B in the renewable Grid Code of South Africa	Yes/No	Yes	
1.6	Reactive Power Capabilities as per Category B in the renewable Grid Code of South Africa	Yes/No	Yes	
1.7	Protection and fault levels as per Category B in the renewable Grid Code of South Africa	Yes/No	Yes	

Item No.	Description	Unit	Required	Response from Bidder
2	**Plant Required Control Functions**			
2.1	Voltage Control	Yes/No	Yes	
2.2	Power Factor Control	Yes/No	Yes	
2.3	Reactive Power Control	Yes/No	Yes	
3	**Minimum required standards**			
3.1	Grid Connection Code for Renewable Power Plants (RPPs) Connected to the Electricity Transmission system (TS) or the Distribution System (DS) in South Africa	Yes/No	Yes	
4	**Additional Information – To be listed by the Bidder**			
4.1	To be defined by the Bidder	-	-	

9. CONTROL AND MONITORING SYSTEM (CMS)

9.1 CMS CRITERIA

Table 9-1: CMS CRITERIA

Item No.	Description	Unit	Required	Response from Bidder
1	**Experience in CMS or SCADA systems for Utility scale PV plant applications**			
1.1	The Bidder shall provide proof of the proposed CMS/SCADA network having been successfully installed on PV plants. Proof shall be provided in a table of references with plant name, plant capacity, year commissioned, CMS system details.	-	Five (5) PV plants around the world, of ≥ 20MWac each, during the past 7 years	
1.2	The Bidder provides proof of experience with the proposed software. Proof shall be provided in a table of references with plant name, plant capacity, year commissioned, CMS system details (e.g. network layout, CMS overview report including Original Equipment Manufacturer (OEM) equipment information of all hardware and software, operator Human Machine Interface (HMI) screen dumps of the various display tabs)	-	Two (2) PV plants ≥ 20MW each, during the past 5 years	
2	**CMS Compliance**			

Item No.	Description	Unit	Required	Response from Bidder
2.1	CMS network single line diagram showing Plant Interface architecture (high level)	Yes/No	Yes	
2.2	CMS main equipment list in tabular format (basic)	Yes/No	Yes	
2.3	Field wiring philosophy (basic)	Yes/No	Yes	
2.4	CMS power supply and power distribution diagram, showing UPS and battery bank sizing (high level)	Yes/No	Yes	
2.5	19” network cabinet specifications and general arrangement drawing (basic)	Yes/No	Yes	
2.6	CMS equipment panel specifications and general arrangement drawings (basic)	Yes/No	Yes	
2.7	CMS conceptual design report describing the hardware and software, the operating philosophy, information servers and data analysis tools (basic philosophy/method statement)	Yes/No	Yes	
2.8	PV Plant Control station (in the existing Sere Wind Farm control room) layout drawing (high-level)	Yes/No	Yes	
2.9	PV Plant Server room layout drawing (high-level)	Yes/No	Yes	
3	**C&I Design Criteria**			
3.1	The system shall be designed to ensure high availability, i.e., greater than 99.9%.	Yes/No	Yes	
3.2	Data shall be stored locally and externally, with periodic backups performed with external hard drives which are to be kept in a secure location.	Yes/No	Yes	
3.3	Compliance with Eskom’s Standard for Demilitarised Zone (DMZ) Designs for Operational Technology (240-79669677), Information Security – IT/OT and Third Party Remote Access Standard (32-373), Eskom Cyber Security Standard for Operation Technology (240-55410927), and Human Machine Interface Design Requirements Standard (240-56355728)	Yes/No	Yes	
3.4	Open data exchange: data exchange interface must make it possible for the Employer’s centralized control and monitoring system to exchange data	Yes/No	Yes	

Item No.	Description	Unit	Required	Response from Bidder
	with the SCADA system for both real time and historical data.			
3.5	The Plant SCADA system and field control system shall allow for automatic start-up and shut down of the Plant.	Yes/No	Yes	
3.6	The field control system shall be designed to ensure normal operation even in the event of loss of software communication link.	Yes/No	Yes	
3.7	The Contractor shall ensure that the SCADA system has an operational life span of 25 years from the Plant's Commercial Operations Date (COD), which involves being capable of adapting to software updates. The Contract shall provide a lifecycle management plan for the SCADA system hardware and the OS and APP software.	Yes/No	Yes	
3.8	A minimum of ten (10) user licenses shall be provided to the Employer, and it shall be possible to restrict user-access to rational levels so as to protect the integrity of the system and prevent unwanted, unwarranted, and/or unsafe Project configuration changes.	Yes/No	Yes	
3.9	The SCADA system vendor must be able to offer technical support for the operational life of the system. The Contractor shall provide a lifecycle management plan for the SCADA hardware and OS and APP software.	Yes/No	Yes	
3.10	The Employer will require licenses and access to make changes to the SCADA system/PLC system and all programmable devices as and when required.	Yes/No	Yes	
4	**High-level plant interface Architecture**			
4.1	The Bidder will provide a High-level Plant Interface Architecture	-	To be provided by Bidder	

9.2 TECHNICAL SCHEDULES

Table 9-2: Control and Monitoring Systems Schedules

Item No.	Description	Unit	Required	Tendered
1	**Data Sheets (of costed items)**			
1.1	CMS Servers	Yes/No	Yes	
1.2	Network Switches	Yes/No	Yes	
1.3	GPS time server	Yes/No	Yes	
1.4	Thin clients (CPU, monitors)	Yes/No	Yes	
1.5	KVM extenders	Yes/No	Yes	
1.6	Firewall gateway	Yes/No	Yes	
1.7	Web server	Yes/No	Yes	
1.8	Fire panels	Yes/No	Yes	
1.9	Fire sensors and alarm equipment	Yes/No	Yes	
1.10	Programmable logic controllers	Yes/No	Yes	
1.11	IO cards / RTUs	Yes/No	Yes	
1.12	UPS and battery banks	Yes/No	Yes	
1.13	DC power supplies	Yes/No	Yes	
1.14	CMS application software for operating, monitoring and configuration (i.e., SCADA software manual)	Yes/No	Yes	
1.15	Antivirus software	Yes/No	Yes	
1.16	OPC server software	Yes/No	Yes	
1.17	BMS server/workstation	Yes/No	Yes	
1.18	BMS application software	Yes/No	Yes	
2	**CMS Servers**			
2.1	No of units	pcs	2 (dual redundant configuration)	
2.2	Manufacturer	-	To be provided by Bidder	
2.3	Product/Model/Type	Yes/No	Yes	
2.4	Communication capabilities Ethernet, Serial RS485, Optical fibre	Yes/No	Yes	
2.5	Redundant array of independent disks (RAID) configuration	Yes/No	Yes	
2.6	Redundant power supplies with dual power input ports	Yes/No	Yes	
2.7	Redundant case fans,	Yes/No	Yes	

Item No.	Description	Unit	Required	Tendered
2.8	19” (inch.) rack-mountable type enclosure for the servers and power supplies installed in the plant server room	Yes/No	Yes	
2.9	On-board database to continuously process and store all real time plant data for the lifespan of the plant,	Yes/No	Yes	
2.10	Front accessible universal serial bus (USB) ports.	Yes/No	Yes	
3	**SCADA/CMS Software**			
3.1	Microsoft Operating system		To be provided by Bidder	
3.2	Only industry recognised software shall be used.	Yes/No	Yes	
3.3	Licences for the software systems will be purchased by the Contractor and made available with step-in rights for the future purchasers and operators of the Plant.	Yes/No	Yes	
3.4	The Contractor shall provide all project specific software, firmware, and operating system developed for, and applicable to, the control and monitoring systems being provided. The SCADA system shall include novel modelling approaches and techno-financial indicators allowing the operators to predict failures, detect root causes of errors, and optimise the Plant operation in a cost-effective manner.	Yes/No	Yes	
3.5	The software shall be completely documented by the Contractor and be provided on a non-proprietary basis. The Contractor shall provide a remote monitoring system and software with a supervisory role and access to historic values.	Yes/No	Yes	
3.6	Custom software required to adapt or customise the control and monitoring systems shall be provided by the Contractor.	Yes/No	Yes	
3.7	CMS application software for comprehensive operating, monitoring and configuration of all plant equipment and sub-systems	pcs	≥ 2	
3.8	Web-server application software for remote clients	Yes/No	Yes	
3.9	Information server application software	pcs	≥ 2	
3.10	Hosting the anti-virus software	pcs	≥ 2	

Item No.	Description	Unit	Required	Tendered
3.11	Firewall software	Yes/No	Yes	
3.12	OPC server software	Yes/No	Yes	
3.13	Other 3rd party system software	-	To be provided by Bidder	
4	**Operator Thin Clients**			
4.1	No of CPU units	pcs	≥ 2	
4.2	Manufacturer	-	To be provided by Bidder	
4.3	Product/Model/Type	Yes/No	Yes	
4.4	Communication capabilities - Ethernet	Yes/No	Yes	
4.5	19-inch rack type	Yes/No	Yes	
4.6	100% operational availability per thin client	Yes/No	Yes	
4.7	24-inch (minimum)TFT LCD monitors	Pcs	4 (2 per thin client)	
4.8	40-inch (minimum)TFT LCD monitors	Pcs	2 (1 per thin client)	
4.9	Monitor Manufacturer	-	To be provided by Bidder	
4.10	Monitor Product/Model/Type	Yes/No	Yes	
4.11	Monitor Communication capabilities, HDMI, DisplayPort, VGA	Yes/No	Yes	
4.12	Number of keyboards and mouse sets	pcs	2	
4.13	Keyboard video and mouse (KVM) extenders per thin client	pcs	4 (2 per thin client)	
5	**CMS Web Server**			
5.1	On-site web-server for access to remote web-clients	Yes/No	Yes	
5.2	Number of web-client licences for remote monitoring (concurrent access)	-	20	
6	**Ethernet Network switches**			
6.1	Number in Server room (installed in 19” cabinet, rack mount)	pcs	2 (dual redundant)	
6.2	Number in Inverter Stations and switchgear rooms (installed in CMS panels, DIN mount)	pcs	(1 per location) No. of Inverters specified by Bidder	
6.3	Switch Manufacturer	-	To be provided by Bidder	
6.4	Product/Model/Type	-	To be provided by Bidder	
6.5	Product data sheet and manual	-	To be provided by Bidder	
6.6	Optical fibre and Ethernet ports	Yes/No	Yes	

Item No.	Description	Unit	Required	Tendered
6.7	Managed type with online management and configuration via the thin clients using a network management software installed on the CMS servers.	Yes/No	Yes	
6.8	Compatibility with Simple network management protocol version 3 (SNMP v3) and Internet protocol version 6 (IPv6).	Yes/No	Yes	
6.9	Online monitoring of the port connections, communication link status, bandwidth, and device heath status indicating alarms and faults to the server and remote users.	Yes/No	Yes	
6.10	Power supply from dual redundant power sources (230 Vac or 24 Vdc)	Yes/No	Yes	
6.11	Dual power input ports	Yes/No	Yes	
6.12	Optical fibre and Ethernet ports	Yes/No	Yes	
6.13	10% unused ports (rounded up)	Yes/No	Yes	
6.14	Wide operating temperature range (typically between -40C to +75C)	Yes/No	Yes	
6.15	Auto negotiation capability	Yes/No	Yes	
6.16	Auto crossover (MDIX) capability	Yes/No	Yes	
6.17	Full duplex communication capability	Yes/No	Yes	
6.18	Single fault tolerant, backbone CMS network	Yes/No	Yes	
6.19	Network topology (Ring, Star) with single fault tolerance	-	Ring with Redundancy Manager	
7	**Network Time Synchronisation**			
7.1	19” time server unit installed in server room	Yes/No	Yes	
7.2	GPS antenna	Yes/No	Yes	
7.3	NTP synchronisation via Ethernet	Yes/No	Yes	
7.4	Time stamping accuracy (UTC+2)	ms	≤10	
7.5	Automatic self-calibrating function	Yes/No	Yes	
7.6	Power source (UPS)	V	230	
7.7	On-board display and function keys	Yes/No	Yes	
8	**CMS Field Equipment Panels**			
8.1	Wall mounted	Yes/No	Yes	
8.2	Protection class (indoor)	IP	54	
8.3	Protection class for string combiner boxes and weather stations (outdoor)	IP	65	

Item No.	Description	Unit	Required	Tendered
8.4	Open/Close door sensor	Yes/No	Yes	
8.5	Internal ambient temperature sensor	Yes/No	Yes	
8.6	Power source (100% availability)	V ac	230	
9	**Server Room Network cabinets**			
9.1	19” rack type, 42U height	Yes/No	Yes	
9.2	Network and power cabling, bottom entry	Yes/No	Yes	
9.3	Use of grommets at cable entries	Yes/No	Yes	
9.4	Internal cable channels for routing of cables	Yes/No	Yes	
9.5	Removable blanking panels	Yes/No	Yes	
9.6	Perforated front and rear panels	Yes/No	Yes	
9.7	Perforated side panels	Yes/No	Yes	
9.8	Removable front and rear doors	Yes/No	Yes	
9.9	Open/close door sensors	Yes/No	Yes	
9.10	Internal lighting	Yes/No	Yes	
9.11	Internal ambient temperature sensor	Yes/No	Yes	
9.12	Supplied general arrangement (GA) drawings of server room network panels	Yes/No	Yes	
10	**Fire Detection System**			
10.1	No. of fire panels (depending on communication medium limits per zone)	pcs	To be provided by Bidder	
10.2	Protection class (indoor installation)	IP	54	
10.3	SANS 10139 compliance	Yes/No	Yes	
10.4	Product datasheet of fire panels	Yes/No	Yes	
10.5	Smoke/Heat sensors make and model	-	To be provided by Bidder	
10.6	Sensor and alarming products datasheet	Yes/No	Yes	
10.7	Real time monitoring at control room via operator HMI	Yes/No	Yes	
11	**CMS Power Supply**			
11.1	Dual- redundantly configured, online UPS system with seal-type battery backup, and back-up time of 12 hours	Yes/No	Yes	
11.2	Sealed type nickel cadmium or lithium-ion batteries	Yes/No	Yes	

Item No.	Description	Unit	Required	Tendered
12	**CMS Interfaces**			
12.1	Meteorological systems (weather station, instruments), Modbus RS485, TCP	Yes/No	Yes	
12.2	String combiner boxes, Modbus RS485	Yes/No	Yes	
12.3	Central inverters, Modbus RS485 or TCP	Yes/No	Yes	
12.4	Switchgear MCCBs, Modbus RS485 or TCP, 24V potential free	Yes/No	Yes	
12.5	MV and LV Transformers, Modbus RS485, 4-20mA.	Yes/No	Yes	
12.6	Energy meters, Modbus RS485 or TCP	Yes/No	Yes	
12.7	Switchgear electrical protection relays, Modbus RS485 or TCP	Yes/No	Yes	
12.8	Electrical battery tripping units (BTU),	Yes/No	Yes	
12.9	CMS uninterruptable power supply (UPS) units, TCP	Yes/No	Yes	
12.10	Internal environmental sensors of equipment panels, network cabinets, Inverter Power Stations,	Yes/No	Yes	
12.11	Balance of plant (BoP) potable water and sewage tank levels	Yes/No	Yes	
12.12	Fire detection system	Yes/No	Yes	
12.13	Heating, ventilation and air-conditioning (HVAC) system	Yes/No	Yes	
12.14	Interface to Eskom Enterprise Historian. OPC AU	Yes/No	Yes	
12.15	Firewalled connectivity to internet for full remote monitoring functionality of the PV plant	Yes/No	Yes	
12.16	The Bidder to provide internet service provider (ISP) via ADSL or 3G as a min for use on the plant during the installation and O&M period.	Yes/No	Yes	
12.17	Provision of an Eskom approved gateway interface to the NTC and NSP using the IEC 60870-5-101 and DNP3 protocols respectively.	Yes/No	Yes	
12.18	CMS interface to Skaapvlei Substation RTU	Yes/No	Yes	
12.19	A3 colour printer connected to CMS network	Yes/No	Yes	
13	**Data Communication Medium**			
13.1	CAT6 foil shielded twisted pair (FSTP)	Yes/No	Yes	

Item No.	Description	Unit	Required	Tendered
13.2	Single mode optical fibre > 2kM	Yes/No	Yes	
13.3	Multi-mode optical fibre < 2kM	Yes/No	Yes	
13.4	Wireless / Bluetooth communication	Yes/No	No	

10. CIVIL, STRUCTURAL AND INFRASTRUCTURE WORKS

10.1 CIVIL, STRUCTURAL AND INFRASTRUCTURE CRITERIA

Table 10-1: Civil, structural and infrastructure criteria

Item No.	Description	Unit	Required	Response from Bidder
1	**Work Methodology**			
1.1	Technical proposal detailing the work methodology, which complies to the full scope and describes how the scope will be executed (both design and construction phases of the project). Technical proposal must demonstrate understanding of the scope and include the following as a minimum: • Proposed plant, equipment and tools • Methodology for the proposed works • Foreseen risks and concerns • Health and safety requirements • Quality management requirements • Required temporary works (if any)	-	To be provided by Bidder	

10.2 TECHNICAL SCHEDULES

Table 10-2: Civil & Structural Compliance to Functional Specification

Item No.	Description	Unit	Required	Response from Bidder
1	**Geotechnical Investigation**			
1.1	Detailed geotechnical investigation to be carried out by the Bidder	Yes/No	Yes	
2	**Foundation for Mounting Structure**			
2.1	Foundation type	-	To be provided by Bidder	

Item No.	Description	Unit	Required	Response from Bidder
2.2	Foundation design applicable to Environmental Permit and Water Use license permit	Yes/ No	Yes	
3	**Hydrological Impact Assessment**			
3.1	Detailed hydrological impact assessment to be carried out by the Bidder	Yes/ No	Yes	
4	**Topographical survey**			
4.1	Detailed topographical survey to be carried out by the Bidder	Yes/No	Yes	
5	**Supportive Documents**			
5.1	Indicative Plant Layout drawing, including roads, fence, O&M building, Laydown area, MV/LV inverters, substation buildings and yards.	Yes/No	Yes	

11. BALANCE OF PLANT

11.1 PHYSICAL SECURITY

Table 11-1: Physical Security Schedule

Item No.	Description	Unit	Required	Response from Bidder
1	**Physical Security compliance**			
1.1	Provide a signed letter confirming that the Contractor shall fully comply with the security requirements as stipulated in 562/2 High Risk security Mesh Fence: System Technical Specification for Sere Solar PV Plant Phase 1a as well as 240-91252315 Standard for Bullet-resistant Guard facilities.	Yes/no	Yes	
1.2	If the EPC Contractor is intending to subcontract this scope of work, a signed letter of intent between the two parties shall be submitted during the tender stage. The Subcontractor shall have valid registration with PSiRA. Accountability for execution of the scope requirements as stated in 562/2 High Risk security Mesh Fence: System Technical Specification for Sere Solar PV Plant Phase 1a as well as 240-91252315 Standard for Bullet-resistant Guard facilities shall remain the responsibility of the EPC Contractor. After EPC Contract Award, the *Employer* shall also participate in the	Yes/no	Yes	

Item No.	Description	Unit	Required	Response from Bidder
	technical evaluations for the suitable Subcontractor to ensure the *Employer's* qualitative criteria as stipulated in section 6.2.1 to 6.2.5 of Appendix B: Qualitative Technical Evaluation Criteria. Criteria Weighting and Sub Weighting for section 6.2.1 to 6.2.5 shall be communicated with the main Contractor after EPC Contract Award. If the work is to be executed in-house by the Principal EPC Contractor, a letter indicating such needs to be submitted. The Principal EPC contractor will still be evaluated, after contract award, and needs to meet the minimum requirements as stipulated in section 6.2.1 to 6.2.5.			

Table 11-2: General information about the Subcontractor (if applicable)

No.	Item	Details	
1	Name of subcontractor		
2	Home office address		
3	Regional office address		
4	Telephone / email address		
5	Name, Position and Title of contact person		
6	Legal form [5]		
7	Area of main business		
8	No. of staff in main business	Technical:	Others:
9	PSiRA registration number		

11.2 FIRE PROTECTION

Table 11-3: Fire protection Schedule

Item No.	Description	Unit	Required	Response from Bidder
1	**Fire protection system design**			
1.1	The Bidder shall submit a Fire Protection Services design philosophy, covering aspects such as the fire protection/detection assessment, system and component description, system sizing approach, system design	Yes/no	Yes	

[5] e.g., company, partnership, cooperation, consortium, joint venture, etc.

Item No.	Description	Unit	Required	Response from Bidder
	and construction codes, and system process (diagram).			

11.3 WATER SUPPLY AND RETICULATION

Table 11-4: Water Supply and Reticulation Schedule

Item No.	Description	Unit	Required	Response from Bidder
1	**Potable and Process Water Supply and Reticulation System**			
1.1	The Bidder submits a Potable and Process Water Supply and Reticulation Design Philosophy Report. The report shall include system and component descriptions, system sizing approach, applicable system design and construction codes, treatment of water for cleaning PV modules, monitoring mechanisms, etc.	Yes/No	Yes	

11.4 HEATING, VENTILATION AND AIR CONDITIONING (HVAC)

Table 11:5 HVAC Schedule

Item No.	Description	Unit	Required	Response from Bidder
1	**HVAC system design**			
1.1	- The Bidder submits a HVAC Services Design Philosophy Report. The report shall include system and component descriptions, system sizing approach, applicable system design and construction codes, etc., thereby documenting the design philosophy for the various areas and rooms requiring HVAC systems.	Yes/No	Yes	

11.5 MONITORING AND METEOROLOGICAL EQUIPMENT AND INSTRUMENTATION

Table 11-6: Monitoring and Meteorological Equipment and Instrumentation Schedule

Item No.	Description	Unit	Required	Response from Bidder
1	**General**			
1.1	No. of meteorological stations	-	≥ 2	
2	**Meteorological Station Equipment and Instrumentation**			
2.1	**Irradiance**			
2.1.1	No. of Pyranometer installed at Horizontal plane to measure GHI	pcs	≥ 2	

Item No.	Description	Unit	Required	Response from Bidder
2.1.2	No. of Pyranometer installed at POA to measure POA irradiance	pcs	≥ 2	
2.1.3	No. of albedometers for bifacial modules: No. horizontally mounted albedometer installed away from the solar array in an unobstructed area OR No. of in-plane rear-side irradiance albedometers	pcs	≥ 2 ≥ 6	
2.1.4	Product type	-	To be provided by Bidder	
2.1.5	Class (according to ISO 9060)	-	Second	
2.1.6	Measurement uncertainty	%	≤ 2%	
2.1.7	Product data sheet	Yes/No	Yes	
2.1.8	Calibration certificate	Yes/No	Yes	
2.2	**PV Array Temperature Measurement**			
2.2.1	No. of temperature sensors	pcs	≥ 6	
2.2.2	Manufacturer	-	To be provided by Bidder	
2.2.3	Product/Model/Type	Yes/No	Yes	
2.2.4	Product data sheet	Yes/No	Yes	
2.2.5	Measurement accuracy	°C	±1	
2.2.6	According to IEC 61724-1 or equivalent	Yes/No	Yes	
2.2.7	Temperature range	°C	-40 to 100°C	
2.3	**Ambient temperature measurement**			
2.3.1	No. of temperature sensors	pcs	≥ 2	
2.3.2	Manufacturer	-	To be provided by Bidder	
2.3.3	Product/Model/Type	Yes/No	Yes	
2.3.4	Product data sheet	Yes/No	Yes	
2.3.5	Measurement accuracy	±°C	1	
2.3.6	According to IEC 62724-1 or equivalent	Yes/No	Yes	

Item No.	Description	Unit	Required	Response from Bidder
2.4	**Soiling**			
2.4.1	No. of soiling measurement instruments	pcs	≥ 2	
2.4.2	Manufacturer	-	To be provided by Bidder	
2.4.3	Product/Model/Type	Yes/No	Yes	
2.4.4	Product data sheet	Yes/No	Yes	
2.4.5	Calibration according to IEC 61724-1 Photovoltaic system performance.	Yes/No	Yes	
2.4.7	Uncertainty of measurement	%	≤ 3%	
2.4.8	Calibration certificate	Yes/No	Yes	
2.5	**Wind speed and Wind direction measurement**			
2.5.1	No of Anemometer	pcs	≥ 2	
2.5.2	Manufacturer/Product type	-	To be provided by Bidder	
2.5.3	Product data sheet	Yes/No	Yes	
2.5.4	Anemometer suitable of wind energy applications	Yes/No	Yes	
2.5.5	Operational Temperature	°C	-20 to 70	
2.5.6	Speed Range	m/s	0 to 70	
2.5.7	Wind direction accuracy	°	± 5°	
2.6	**Rainfall gauge**			
2.6.1	No. of rain gauge	pcs	≥ 2	
2.6.2	Manufacturer/Product type	-	To be provided by Bidder	
2.6.3	Product data sheet	Yes/No	Yes	
2.7	**Moisture Meter – Relative Humidity Measurement**			
2.7.1	No. of moisture meter	pcs	≥ 1	
2.7.2	Manufacturer/Product type	-	To be provided by Bidder	
2.7.3	Product data sheet	Yes/No	Yes	
2.7.4	Range	% RH	0 - 100	
2.7.5	Overall Accuracy	%	± 2 %	
2.7.6	Response Time	s	20 s (T90) or less	

11.6 SEWAGE AND WASTE DISPOSAL SERVICES

Table 11-7: Sewage and Waste Disposal Services Schedule

Item No.	Description	Unit	Required	Response from Bidder
1	**Sewage and Waste Disposal System**			
1.1	The Bidder submits a Sewage and Waste Disposal Design Philosophy Report. The report shall include system and component descriptions, system sizing approach, applicable system design and construction codes, monitoring mechanisms, etc.	Yes/No	Yes	

12. OPERATION AND MAINTENANCE

12.1 OPERATION AND MAINTENANCE PLAN

Table 12:1 Operations and Maintenance Schedule

Item No.	Description	Unit	Required	Response from Bidder
1	**Operations and Maintenance Plan**			
1.1	The Bidder shall submit a preliminary (high-level) operations and maintenance plan/approach, providing a general overview for operations and preventative maintenance of the main components.	Yes/No	Yes	
1.2	The Bidder shall submit a preliminary corrective maintenance approach, including envisaged response and repair times for the main components.	Yes/No	Yes	

12.2 OPERATION AND MAINTENANCE TRAINING

Table 12-2: Training Schedule

Item No.	Description	Unit	Required	Response from Bidder
1	**Training Plan**			
1.1	The Bidder shall submit a preliminary training plan. The plan shall describe the timing, type, and level of detail for the various training interventions, including O&M, Inverter, SCADA/CMS, etc.	Yes/No	Yes	

12.3 SPARE PARTS

Table 12-3: Spare parts Schedule

Item No.	Description	Unit	Required	Response from Bidder
1	**Spare parts**			
1.1	The Bidder submits a letter confirming Bidder acceptance of spare parts minimum requirements specified in 474-12578, Sere Solar PV Plant Functional Specification, section 4.15. The Bidder highlights any proposed deviations and additions.	Yes/No	Yes	

13. GRID CONNECTION WORKS

a. It is a requirement that the Engineering Design be performed under the self-build agreement by the Contractor. The Contractor appointed Consulting Engineer/s should comply with standards as per 474-12578, Sere Solar PV Plant Functional Specification including Appendix C: PV Plant Codes and Standards indicating required minimum certificates and standards as well as 562/21 Sere 19.5MW PV Proposed Primary Plant Functional Scope and 562/22 Sere 19.5MW PV Proposed Control Plant Functional Scope for Substations, Control Plant and HV lines. Details of the Consulting Engineer to be provided in Table 13-1.

b. It is a requirement that the construction works performed under the self-build agreement. Details of the HV Subcontractor to be provided in Table 13-2.

Table 13-1: General information about the Consulting Engineer

No.	Item	Details	
1	Name of Consulting Engineer		
2	Home office address		
3	Regional office address		
4	Telephone / email address		
5	Name, Position and Title of contact person		
6	Legal form [6]		
7	Area of main business		
8	Signed letter of intent between Consulting Engineer and EPC Bidder	To be provided by Bidder	

Table 13-2: General information about the HV Subcontractor

No.	Item	Details
1	Name of HV Subcontractor	
2	Home office address	

[6] e.g., company, partnership, cooperation, consortium, joint venture, etc.

3	Regional office address		
4	Telephone / email address		
5	Name, Position and Title of contact person		
6	Legal form [7]		
7	Area of main business		
10	Signed letter of intent between HV Subcontractor and EPC Bidder	To be provided by Bidder	

13.2 GRID CONNECTION SCHEDULES

13.2.1 MV Cables

Table 13-3: MV Cables Schedule

Item No.	Description	Unit	Required	Response from Bidder
1	**Cables**			
1.1	Cable type		Yes	
1.2	Cable length	m	Yes	

13.2.2 HV/MV Transformer

Table 13-4: HV/MV Transformer Schedule

Item No.	Description	Unit	Required	Response from Bidder
2	**HV/MV Transformer**			
2.1	**Product Information**			
2.1.1	Transformer manufacturer	Specify	To be provided by Bidder	
2.2	**General Requirements**			
2.2.1	No of Transformers	No.	1	
2.2.2	Nominal rating	MVA	40	
2.2.3	Primary Voltage	kV	22	
2.2.4	Secondary Voltage	kV	132	
2.2.5	Rated Frequency	Hz	50	
2.2.6	Maximum Flux density	T	1.7	
2.2.7	Tap-Changer Type	Specify	On-load	
2.2.8	Diverter Type	Specify	Vacuum	

[7] e.g., company, partnership, cooperation, consortium, joint venture, etc.

Item No.	Description	Unit	Required	Response from Bidder
2.2.9	Transformer insulating medium	Type	Biodegradable oil	
2.2.10	No-load Losses	W	To be provided by Bidder	
2.2.11	Load losses	W	To be provided by Bidder	
2.3	**General Design Conditions**			
2.3.1	Altitude above sea-level	m	20	
2.3.2	Ambient air temperatures: Maximum Yearly Average Minimum	ºC	 43.2 15.5 0.4	
2.3.3	Amount by which the temperature rise limits are reduced according to IEC60076-2	ºC	5	
2.3.4	Additional amount by which the temperature rise limit is reduced above the values stipulated in IEC60076-2, as per additional safety margin	ºC	5	
2.3.5	Total amount by which the temperature rise limit is reduced	ºC	5 + 5 = 10	
2.3.6	Humidity	%	61.5	
2.3.7	Solar radiation	kW/m2	2.5	
2.3.8	Atmospheric UV radiation	High/Low	High	
2.3.9	Pollution (Insulators)	IEC 60815 Table 1	IV- Very Heavy	
2.3.10	Seismic	IEC60068 -3-3	Yes, Mining activity, according to IEC 60076 requirements	
2.4	**Transformer Design Review**			
2.4.1	The Contractor shall make commercial allowance for appointment of a 3rd party power transformer specialist to form part of the technical design reviews and factory acceptance tests.	Yes/No	Yes	

Item No.	Description	Unit	Required	Response from Bidder
2.5	**Minimum required specifications**			
2.5.1	As per 474-12578, Sere Solar PV Plant Functional Specification Appendix C: PV Plant Codes and Standards indicating required minimum certificates and standards. 562/21, Sere 19.5MW PV Proposed Primary Plant Functional Scope 562/22, Sere 19.5MW PV Proposed Control Plant Functional Scope	Yes/No	Yes	
2.6	**Monitoring system requirements**			
2.6.1	Continuous data logging to the CMS system for the transformer performance parameters including events and status.	Yes/No	Yes	
2.6.2	On-line gas analyser with alarming and status monitoring in the Control Room	Yes/No	Yes	
2.6.3	On-line Tap-changer monitoring	Yes/No	Yes	
2.7	**Supportive Documents**			
2.7.1	Transformer Datasheet	-	To be provided by Bidder	
2.8	**Additional Information – To be listed by the Bidder**			
2.8.1	To be defined by the Bidder	-	To be provided by Bidder	

13.2.3 MV Primary Switchgear

Table 13-5: MV Primary Switchgear Schedules

Item No.	Description	Unit	Required	Response from Bidder
1	**Product information**			
1.1	Switchgear manufacturer	Name	To be provided by Bidder	
1.2	Type/Model	Type	To be provided by Bidder	
2	**Ratings**			
2.1	Nominal voltage	kVrms	22kV	
2.2	Rated voltage	kVrms	To be provided by Bidder	
2.3	System frequency	Hz	50	
3	**Design**			
3.1	Indoor/Outdoor application	-	Indoor	

Item No.	Description	Unit	Required	Response from Bidder
3.2	Insulating medium	-	AIS	
3.3	Type	Withdrawable or Fixed pattern	To be provided by Bidder	
3.4	Interrupting technology	-	Vacuum	
4	**Supportive Documentation**			
4.1	Switchgear datasheet/Catalogue	-	To be provided by Bidder	
5	**Minimum required standards**			
5.1	As per 474-12578, Sere Solar PV Plant Functional Specification Appendix C: PV Plant Codes and Standards indicating required minimum certificates and standards. 562/21, Sere 19.5MW PV Proposed Primary Plant Functional Scope 562/22, Sere 19.5MW PV Proposed Control Plant Functional Scope	Yes/No	Yes	
6	**Additional Information – To be listed by the Bidder**			
6.1	To be defined by the Bidder	-		

13.2.4 HV Primary Switchgear

Table 13-6: HV Primary Switchgear Schedules

Item No.	Description	Unit	Required	Response from Bidder
1	**Product information**			
1.1	Switchgear manufacturer	Name	To be provided by Bidder	
1.2	Type/Model	Type	To be provided by Bidder	
2	**Ratings**			
2.1	Nominal voltage	kVrms	132kV	
2.2	Rated voltage	kVrms	To be provided by Bidder	
2.3	System frequency	Hz	50	
3	**Design**			
3.1	Indoor/Outdoor application	-	Outdoor	
3.2	Insulating medium	-	To be provided by Bidder	
3.3	Type		To be provided by Bidder	

Item No.	Description	Unit	Required	Response from Bidder
3.4	Interrupting technology	-	To be provided by Bidder	
4	**Supportive Documentation**			
4.1	Switchgear datasheet/Catalogue	-	To be provided by Bidder	
5	**Minimum required standards**			
5.1	As per 474-12578, Sere Solar PV Plant Functional Specification Appendix C: PV Plant Codes and Standards indicating required minimum certificates and standards. 562/21, Sere 19.5MW PV Proposed Primary Plant Functional Scope 562/22, Sere 19.5MW PV Proposed Control Plant Functional Scope	Yes/No	Yes	
6	**Additional Information – To be listed by the Bidder**			
6.1	To be defined by the Bidder	-		

13.2.5 MV Primary Switchgear Protection

Table 13-7: MV Primary Switchgear Protection Schedules

Item No.	Description	Unit	Required	Response from Bidder
1	**Product information**			
1.1	Protection relay manufacturers	Name	To be provided by Bidder	
1.2	Type/Models/Scheme Designation	Type	To be provided by Bidder	
2	**Ratings**			
2.1	Scheme voltage		To be provided by Bidder	
3	**Design**			
3.1	Provide interlocking methodologies applied	-	To be provided by Bidder	
3.2	Provide proposed protection block diagram MV feeders, transformer bay	-	To be provided by Bidder	
3.3	Description of MV protection and control IED’s.	-	To be provided by Bidder	
3.4	Details of MV protection schemes for incoming circuits and transformer feeders	-	To be provided by Bidder	
3.5	Software communication to remote engineering device	-	Yes	

Item No.	Description	Unit	Required	Response from Bidder
3.6	Disturbance recording ability	-	Yes	
4	**Supportive Documentation**			
4.1	Protection Systems datasheets, catalogues, product brochures, background literature.	-	To be provided by Bidder	
5	**Minimum required standards**			
5.1	As per 474-12578, Sere Solar PV Plant Functional Specification Appendix C: PV Plant Codes and Standards indicating required minimum certificates and standards. 562/21, Sere 19.5MW PV Proposed Primary Plant Functional Scope 562/22, Sere 19.5MW PV Proposed Control Plant Functional Scope	Yes/No	Yes	
6	**Additional Information – To be listed by the Bidder**			
6.1			To be provided by Bidder	

13.2.6 HV Primary Switchgear Protection

Table 13-8: HV Primary Switchgear Protection Schedules

Item No.	Description	Unit	Required	Response from Bidder
1	**Product information**			
1.1	Protection relay manufacturers	Name	To be provided by Bidder	
1.2	Type/Models/Scheme Designation	Type	To be provided by Bidder	
2	**Ratings**			
2.1	Scheme voltage		To be provided by Bidder	
3	**Design**			
3.1	Provide interlocking methodologies applied	-	To be provided by Bidder	
3.2	Provide proposed protection block diagram HV feeders, transformer bay	-	To be provided by Bidder	
3.3	Description of HV protection and control IED’s.	-	To be provided by Bidder	
3.4	Details of HV protection schemes for incoming circuits and transformer	-	To be provided by Bidder	

Item No.	Description	Unit	Required	Response from Bidder
	feeders including details of interfacing to existing systems			
3.5	Description of overall HV switchboard control systems and interfacing to existing systems.	-	To be provided by Bidder	
3.6	Details of power supply for control voltages and protection systems supplies	-	To be provided by Bidder	
3.7	Software communication to remote engineering device	-	Yes	
3.8	Disturbance recording ability	-	Yes	
4	**Supportive Documentation**			
4.1	Protection Systems datasheets, catalogues, product brochures, background literature.	-	To be provided by Bidder	
5	**Minimum required standards**			
5.1	As per 474-12578, Sere Solar PV Plant Functional Specification Appendix C: PV Plant Codes and Standards indicating required minimum certificates and standards. 562/21, Sere 19.5MW PV Proposed Primary Plant Functional Scope 562/22, Sere 19.5MW PV Proposed Control Plant Functional Scope	Yes/No	Yes	
6	**Additional Information – To be listed by the Bidder**			
6.1			To be provided by Bidder	