394759/2024/CFP-FES

	TECHNICAL CONDITION OF CONTRACT	Doc. No: -	FES2324-...2024.0105
		Part	02/05
Rudrapur	GROUP : FES (FIELD ENGINEERING SERVICES)	Rev no	00

Material Handling at Site Stores/ Storage yard, Transportation to the site of work, Pre-assy, Erection/ Installation, Testing and Commissioning of Roof Top Solar (RTS)/ Ground Mounted Solar Power Project at Yadadri STPP, Capacity- 2.5 MWp,

a/c-

TSGENCO, in the premises of Yadadri STPP, Bhuvanagiri, Telangana

IMPORTANT NOTE

"BIDDER IS REQUESTED TO VISIT ALL THE SITES IN PERSON AND THEN SUBMIT THEIR BEST OFFER. ANY TYPE OF DENIAL /OBJECTION WILL NOT BE ENTERTAINED AFTER FINALIZATION OF ORDER."

28-06-2024

Sanjay Meena
Dy. Mgr (FES)

(RAJESH BABU)
Engineer/FES

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TECHNICAL CONDITION OF CONTRACT (TCC)
CONTENTS

Signature and seal of Bidder

394759/2024/CFP-FES

CHAPTER-I
PROJECT INFORMATION

1	**Project name**	5x800 MW Yadadri STPP (TSGENCO) - Bhuvanagiri, Telangana
2	**No. Of units x capacity**	2.5 MW (Roof Top Solar Power Project)
3	**Project setting up by**	BHEL
4	**Location and approach**	Bhuvanagiri, Telangana -508207
5	**Nearest railway station**	Yadadri Bhuvanagiri.
6	**Nearest major town & distance from project site**	Yadadri Town from 8 KM.
7	**Nearest airport**	Rajiv Gandhi International Airport Hyderabad
8	**Distance from airport to project site**	91 KM
9	**Nearest highway**	NH-163
10	**Temperature**	49.2° C (Max extreme recorded) & 26° C (Min.)
11	**Transport**	By Road, Train & By Air.
12	**Project site address**	Damaracherla, District: Bhuvanagiri, Telangana

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CHAPTER – II
SCOPE OF WORKS

THE SCOPE OF THE WORK WILL COMPRISE OF BUT NOT LIMITED TO THE FOLLOWING:

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

BRIEF ABOUT THE PROJECT:

(A) Building capacity and its detail: -

BUILDING CAPACITY AT YADADRI STPP				
S No	**Buildings**	**Height of building**	**Modules as per Design**	**Capacity as per Design**
1	Powerhouse Unit #01	35 Mtrs	704	383.68
2	Powerhouse Unit #02	35 Mtrs	560	305.20
3	Powerhouse Unit #03	35 Mtrs	656	357.52
4	Powerhouse Unit #04	35 Mtrs	608	331.36
5	Powerhouse Unit #05	35 Mtrs	448	244.16
6	Permanent Store	10 Mtrs	1280	697.80
7	*Canteen Building	Less than 10 Mtrs	128	69.76
8	*Workshop	Less than 10 Mtrs	96	52.32
9	*Admin Building	Less than 20 Mtrs	176	95.92
TOTAL			**4656**	**2537.52**

(B) **Type of Installation: -**

S. No.	Buildings	Type of roof	Remarks
1	Power House Unit# 1 to 5	Concrete Roof	BHEL will cast the foundation blocks for MMS only.
2	Permanent Store	Tin shed	Monorail-type aluminum alloy with anodization Monorail and its installation accessories shall be in the contractor's scope.
3	Canteen, Workshop & Admin	Concrete Roof	The contractor will cast the civil foundation for MMS

Note: -

- **Power House 1 to 5: -** Solar power system to be installed at TG roof. Civil foundation blocks for the module mounting Structure (MMS) shall be provided on the roof by the BHEL.
- **Permanent Store-** the roof is made of tin shade and mono rail type structure to be installed for the installation of modules. Contractor shall supply required mono rail as

Signature and seal of Bidder

per the specification mentioned in the tender along with all the accessories required for the installation of the monorail at the site.

- ***Admin Building, Canteen Building & workshop Building:** The casting of Civil foundation blocks for these buildings will be carried out by the contractor as per the approved drawings.

CHANGES OF BUILDING: - The above buildings are almost finalized. However, if there is any change in buildings then the same shall be accommodated in this contractor free cost. No extra claim on the account of change of buildings will be accepted.

1.2.0. **Detail scope of work**

Sl no	Description of Work
1	Material Handling, temporary storage and its security, shifting of the BHEL supplied material such as PV modules, MMS structures, inverters, LT/ACCB Panels, DC Cables, AC Cables, DCDB, ACDB, foundation hardware, nut, bolts, etc., for 2.5 MW Roof Top Solar (RTS) System at Yadadri STPP, Damaracherla, District: Bhuvanagiri, Telangana within plant premises. Contractor's scope covered all from taking it from BHEL store to the complete installation of 2.5 MW RTS.
2	Area for creating the temporary store yard to be provided by M/s BHEL for storage of BHEL Supplied material up to the installation.
3	Site office/Pota cabin fabrication /preparation is under the scope of the subcontractor. The site office will be used for keeping records, drawings, documents, site registers, etc. The site office must be provided with PCs, a Scanner, and printers in good health to carry out all official work. Also, the contractor will make a temporary storage yard adjacent to the office on the allocated land in the plant's premises for the storage of materials, tools, and tackles. Besides, the subcontractor has to create a facility in the vicinity of the site for their employee's accommodation to minimize the time of "to & fro" movement between the site, office & accommodating facility.
4	Security to be provided for the material stored at temporary storage created by the contractor round the clock. Also, the frequent patrolling of the site where work is under progress shall be arranged by the contractor at night. If any material lost at temporary storage & execution site same shall be accountable to vendor for any recovery.
5	MDR/ MRC: The Subcontractor has to make a physical inspection of all BHEL-supplied materials, before providing a receipt at project sites to the store in charge. The contractor will use appropriate machines & techniques for the shifting of material at the site. *During the inspection, if any item is found damaged and unrepairable, the contractor will inform the BHEL store in charge or Site in charge immediately for the issue of MDR (Material Discrepancy Report) by any communication mode (email/letter/MDR format)* for corrective action and resupply the material.

Signature and seal of Bidder

	During the shifting of material, if any item got damaged & found un-repairable, then the cost of the material shall be booked on the contractor's account. MRC (Material receipt Certificate) is to be completed within one week after material receipt at site with end customer at our stores.
6	Material is to be issued from BHEL authorized person at the laydown area. The contractor will prepare requisition for the material and will sign the related protocols and will maintain the material stock register on regularly basis. Also, this record to be maintained in an Excel Sheet for prompt examination. A weekly report is needed to be submitted to BHEL CFP Rudrapur.
7	After issue of material from stores, custody & security of material will be responsibility of sub-contractor to the moment it gets erected and handed over to end customer. *Frequent Patrolling at night to be ensured by contractor at the locations (wherever erection work will be under progress) for security of material.*
8	For the shifting of material from BHEL yard to temporary storage yard & from temporary storage yard to different erection sites, material handling equipments such as mobile crane, trailer etc., along with the operator & one assistance, shall be arranged by sub-contractor. Safe work practice to be ensure and before any activity method statement to be approved from BHEL/End client.
9	Bidder may visit Yadadri Super Thermal Power Project for accessing erection Site location & Storage area etc.
10	Subcontractor is responsible for erection, commissioning, testing of solar power system & its handing over to the end customer. The work comprises the following: - Installation of structure, Installation of Solar PV Modules, Installation of cable trays, laying of cables, Installation of DCDBs, String invertors, ACDBs, LT/ACCB Panels, earthing, Lightening arrestor, Firefighting, Data Logger, Weather Monitoring system, integration of system and other misc. work which is necessary requirement of system to complete the job. Details of Items and Qty ref. BOQ as per **CHAPTER – V.**
11	Mono Rail Aluminum Structure: - Supply & installation along with its accessories as per BOQ to be carried out by the contractor.
12	The contractor will arrange material for all civil work mentioned in BOQ or anywhere in this document viz. the part of the contractor scope.
13	During the erection phases of structure & its alignment minor cutting, welding, drilling and modification if required any, the contractor will be carried out the same in as per guidance provided by the BHEL's representative.
14	Subcontractor is responsible for the installation of the solar system in line with the provided approved erection manuals, drawings & FQP. Inspection/Testing of the work to be carried out as per approved FQP.
15	Sub-contractor is responsible for the commissioning of DCDB, ACDB, String inverter, LT/ACCB Panel, & integration of the generated power in to the Grid. Qualified technical person to be deployed at site during the commissioning activity going on site.
16	The subcontractor is responsible for providing a safe working environment during the erection work and arranging scaffolding, required equipment, tools & tackle, PPE Kit

Signature and seal of Bidder

	etc., for workers. Work to be execute at site as per the approved Safe working procedure and Approved HIRA.Detail is mentioned in SCC.
17	The subcontractor is responsible for attending all punch points related to solar erection raised by BHEL/Customer during the final inspection after commissioning of solar system.
18	Sub-contractor is responsible for cleaning the site and handing over of surplus material to BHEL at its dedicated storage yard with proper stacking.
19	The subcontractor will be responsible for Closing the Contract with BHEL, Rudrapur, by providing required Compliance timely.
20	Misc. Item such as cable ties, hardware for the laying of cable tray, Sticker for module identification, matt, etc. that are required to finish the job, will supply and installed by the contractor.

1.2.1. The scope of specification covers the installation, testing, and commissioning of the solar package along with accessories as detailed in Bill of Quantity – **CHAPTER – V.**

1.2.2. If any item or equipment not covered but requires being erected / commissioned, same shall be carried out by the contractor. Equivalent or proportional unit rate for that item or equipment shall be considered wherever possible from the BOQ. The rates quoted by the contractor shall be uniform as far as possible for similar items appearing in the rate schedule.

Note: - Detailed *BOQ system wise detailed specification of various equipment's and items are given in the VOLUME- IA PART-I CHAPTER-VIII. The contractor is required to go through the detailed BOQ and specification before filling the rate in the price schedule/price bid.*

1.2.3 Preassembly, Erection, Testing, Commissioning, and reliability operation of equipment.

1.2.4 Supply of consumables as per clause 1.3.6. Supply of paints and Consumables as per clause 1.3.6.

1.2.5 *Final painting including supply of suitable paints, thinner, tools & tackles for painting.*

1.2.6 It is not the intent to specify herein all details of material. Any item related to this work not covered, but necessary to complete the system will be deemed to have been included in the scope of the work.

Note:

FOR FURTHER DETAILED SCOPE OF WORKS REFER RELEVANT CHAPTERS IN THIS BOOK

Signature and seal of Bidder

CHAPTER – III

CONSUMABLES & FACILITIES IN THE SCOPE OF CONTRACTOR / BHEL (SCOPE MATRIX)

Sl. No.	Description Part-I	Scope to be taken care by		Remarks
		BHEL	BIDDER	
1.3.1	**ESTABLISHMENT OF 2.5 MW RTS AT YADADRI STPP**			
1.3.1	FOR ERECTION OF SOLAR PURPOSE:			
	Open space for office	Yes		
	Open space for storage	Yes		
	Closed space for storage of electric equipment	Yes		
	Site office for erection work and temporary storage (Closed & open) for material		Yes	
	~~Canteen facilities for the bidder's staff and engineers etc.~~		Yes	
	Firefighting equipment like buckets, fire Extinguishers etc.		Yes	
	Temporary Fencing of temporary storage area;		Yes	
1.3.2	FOR LIVING PURPOSES OF THE BIDDER			
A	Open space		Yes	
B	Living accommodation		Yes	Outside of plant premises
1.3.3	**ELECTRICITY**			
1.3.3.1	Electricity For construction purposes (to be specified whether chargeable or free)	--	--	BHEL will provide the electricity on chargeable.
1.3.3.2.	Single point source at the working sites		Yes	Chargeable basis.
1.3.3.3	Further distribution for the construction work to be done by the bidder which includes the supply of electrical materials like cable and equipment (as required) for execution		Yes	
1.3.3.4	~~Electricity for the office, stores, canteen etc. of the bidder which include:~~		Yes	

Signature and seal of Bidder

1.3.3.5	Distribution from single point including supply of materials and service		Yes	
1.3.3.6	Supply, installation and connection of material of energy meter including operation and maintenance		Yes	
1.3.3.7	Duties and deposits including statutory clearances for the above		Yes	
1.3.3.8	Living facilities for office use including charges		Yes	
1.3.3.9	Demobilization of the facilities after completion of works		Yes	
1.3.3.10	Electricity for living accommodation of the Bidder's staff, engineers, supervisors etc. on the above lines.		Yes	
1.3.3.11	EOT Crane will be provided by BHEL on chargeable basis.		Yes	
1.3.4	**WATER SUPPLY**			
1.3.4.1	Making the water available at single point		Yes	
1.3.4.2	Further distribution as per the requirement of work including supply of materials and execution		Yes	
1.3.4.3	Water supply for bidder's office, stores, canteen etc.		Yes	
1.3.5	**LIGHTING**			
1.3.5.1	For storage work (supply of all the necessary materials) At office storage area At the preassembly area At the construction site /area		Yes	
1.3.5.2	For construction work (Execution of the lighting work / arrangements) At office storage area At the preassembly area At the construction site /area		Yes	
1.3.6	**COMMUNICATION FACILITIES for site operations of the bidder**			
1.3.6.1	Desktop Computer/Laptop with internet, scanner, email facility etc.		Yes	
1.3.7	**ERECTION FACILITIES**			
	Engineering works for construction			
1.3.7.1	Providing the erection drawings for all the equipment's covered under this scope	Yes		

Signature and seal of Bidder

1.3.7.2	Preparation of Method Statement and Safety protocol for construction Activity		Yes	In consultation with BHEL
1.3.7.3	As-built drawings – wherever deviations observed and executed and also based on the decisions taken at site-	Yes	Yes	In consultation with BHEL
1.3.7.4	Shipping lists, Material control plan, etc.	Yes	Yes	In consultation with BHEL
1.3.7.5	Preparation of site erection schedules, Deployment of manpower and its tool and tackle, Daily progress monitoring, HIRA etc.	Yes	Yes	In consultation with BHEL
1.3.7.6	Review of performance and revision of site erection schedules in order to achieve the end dates and other commitments	Yes	Yes	In consultation with BHEL
1.3.7.7	Weekly erection schedules based on Sl. No 1.3.2.1.5	Yes	Yes	In consultation with BHEL
1.3.7.8	Daily erection / work plan based on Sl. No 1.3. 2.1.7		Yes	For daily monitoring meeting at site
1.3.7.9	Periodic visit of the senior official of the bidder to site to review the progress so that works are completed as per Schedule. It is suggested this review by the senior official of the bidder should be done once in every one months.		Yes	
1.3.8	**EHS**			
1.3.8.1	All required PPE, Safety facility (barricade, life line, safety net etc), calibration certificate & fitness of construction equipment, lifting equipment.		Yes	
1.3.8.2	Medical checkup of the sub-contractor employee		Yes	
1.3.8.3	First aid facility	Yes	Yes	
1.3.8.4	Insurance			
1.3.8.5	Insurance of manpower accident (Worker compensation policy)		Yes	
1.3.8.6	Security and guards for sub contractor's scope of work		Yes	Security at Main gate provided by TSGENCO/BHEL
1.3.9	**Site Work**			
1.3.9.1	Erection of the electrical equipment and accessories. Such as PV Modules, ACDB, DCDB, inverter etc.		Yes	Hardware for the installation of equipment covered in

Signature and seal of Bidder

				the scope of contractor.
1.3.9.2	Installation of the support structure such as bracket and etc.		Yes	
1.3.9.3	Erection of cable tray and conduit		Yes	Supply of installation accessories in the scope of Contractor including hardware
1.3.9.4	Erection of electrical and control/ instrument cable and connecting wiring		Yes	All the necessary accessories such as termination kits, Glands, lugs, Cable ties, ferrules and cable tags etc., in the scope of contractor.
1.3.9.5	Termination work of cable		Yes	-Do-
1.3.9.6	Inspection, Testing, checking and verification of erected solar project as per FQP		Yes	
1.3.9.7	Civil work		Yes	
1.3.9.8	Painting		Yes	
1.3.9.9	Preservation during and after erection.		Yes	

1.4 MATERIALS / CONSUMABLES TO BE ARRANGED BY THE CONTRACTOR FOR ERECTION AND COMMISSIONING AS PART OF THE SCOPE AT FREE OF COST

i. All types of welding electrodes, filler wires, Gases and requisite tool & tackle, if it is requiring at the site.
ii. Cutting wheel, drilling bit and etc
iii. Provision for temporary scaffoldings pipes & clamp, Lifeline, Net Etc.
iv. Insulation & Danger tape.
v. Protocol / Calibration report sheets as per BHEL Format.
vi. Panel sealing compound material (for cable entry from bottom / top of Panel).
vii. Materials required for cable dressing and nomenclature (GI / aluminum flats, PVC ties, ferrule etc).
viii. Copper/Aluminium Lugs of different sizes (2/2.5/4/6 sq mm) insulated/ring type as required.
ix. Anchor fasteners for wall mounted cable trays / Junction box
x. Torque Wrench (Required size)
xi. Spanners, sockets, T handle & hand tools.

Signature and seal of Bidder

394759/2024/CFP-FES

CHAPTER – IV
MATERIAL, CONSUMABLES, T&P'S and MMEs TO BE DEPLOYED BY CONTRACTOR

The following minimum major Tools & Plants shall be deployed by the contractor for execution of this contract with in the quoted rate:

Sl no	Description	Capacity	Minimum quantity
1	Arc Welding Machine	--	1 No.
2	Insulation Resistance		1 No
3	Voltage Drop Test		1 No
4	Multimeter		1 No
5	Earthing Tester		1 No.
6	Scaffolding Arrangement	--	As required at site
7	Chain Block Pulley/Winch machine	3 Ton & above	2 Nos.
8	Zig Saw cutting machine	--	1 No
9	Circular Saw Cutting Machine	--	1 No
10	Ratchet Belts	--	10 Nos.
11	Open Trailer for Local shifting, if required	--	As required at site
12	Hydraulic Mobile Crane	14 ton or more	As required at site
13	Winch Machine- For lifting		1 no

EQUIPMENT FOR TESTING & COMMISSIONING:

For loading and transportation, all necessary T&P such as Trailers, Cranes, slings, strap belts, hydraulic jacks, ropes etc. are to be arranged by the contractor. All the tools & plants required for this scope of work is to be arranged by contractor. The following testing equipment / T&P shall be brought to site by contractor in sufficient number to carry out the job simultaneously in more than one area.

1) Insulation tester:
   a. Motorized IR Tester - 0 - 1000 - 2000 - 5000V, 0 - 25000 M ohm OR of higher range.
   OR
   b. Hand operated IR Tester - 0.5 KV/1.0 KV/2.5 KV, 200 - 100 M ohm OR of higher range.
2) Earth resistance tester 0 to 1, 10, 100 ohms
3) Torque wrench up to 100 Lb-Ft.
4) Multi-meter - Digital: voltage AC & DC - 100mv - 1000 V
   Current 10-mA - 10A Resistance - 0-20 M ohms
5) Contact resistance measurement kit
6) Micro ohm meter
7) Dye Penetrant test kit (if Required).
8) Test kit for polarity injection ratio test.
9) Pyranometer tester

Signature and seal of Bidder

	TECHNICAL CONDITION OF CONTRACT	Doc. No: -	FES2324-20240105
		Part	02 / 05
Rudrapur	GROUP : FES (FIELD ENGINEERING SERVICES)	Rev no	00

NOTE FOR CONTRACTOR'S INSTRUMENTS, TOOLS & PLANTS:

a) For loading, Unloading and Internal transportation, all necessary T&P such as Trailers, Cranes, Winches, slings, jacks, sleepers, rails etc., are to be arranged by the contractor.
b) If crane and trailers are under break down, the contractor immediately has to arrange alternative crane and trailers. Erection progress should not be affected due to this reason.
c) The contractor shall arrange all the above T&P, equipment and instruments as indicated except testing instruments which are proprietary in nature.
d) The contractor at his cost shall arrange all cranes and truck / tractor, trailers required for material handling purpose and also cranes required for erection. If contractor fails to arrange required equipment for erection then BHEL will arrange the necessary equipment's and the cost of hiring thereof shall be deducted in the upcoming RA bill of contractor.
e) Necessary accessories for the above equipment shall also be provided by the contractor.
f) The above instruments / equipment will be sent for testing and calibration from time to time and maintained by contractor as required by BHEL.
g) All testing instruments shall have calibration certificate issued by recognized / accredited agencies.
h) List of such agencies and periodicity of calibration required for different instruments will be furnished by BHEL at site.
i) Contractor shall maintain calibration records as per the BHEL format and produce them whenever called for by BHEL Engineers.
j) Contractors shall arrange experienced / qualified persons for using these calibration instruments at laboratory and also at work spot.
k) Wherever frequent calibration is required, contractor shall arrange adequate number of instruments such that the work does not suffer for want of test instruments.

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CHAPTER - V
BILL OF QUANTITY (BOQ)

Sl. No	Name of Work	S/I/O	Unit	Quantity
PART (A)				
1	**Service related to supplies made by BHEL**			
1(a)	Handling, temporary storage, shifting of the BHEL supplied material such as PV modules, MMS structures, inverters, LT/ACCB Panels, DC Cables, AC Cables, DCDB, ACDB, foundation hardware, nut, bolts, etc., for 2.5 MW Roof Top Solar (RTS) System at Yadadri STPP, Damaracherla, District: Bhuvanagiri, Telangana. Contractor's scope covered all from taking it from BHEL store to the complete installation of 2.5 MW RTS.	O	KW	2537.52
2	**Installation of BHEL Supplied Items**			
2(a)	**PV Modules**- Taking delivery from the store, shifting to the respective rooftops building as per requirement, and installation of PV modules with MC4 connectors, all complete as per the directions of the engineer (**MC4 connector to be procured by the contractor without any additional cost to BHEL). Nut and bolts set of SS304 Grade for the installation of Module and MMS shall be supplied by BHEL.**	I	Nos	4656.00
2(b)	**String Inverter** (10-100KWp)- Taking delivery from the store, shifting to the respective rooftops as per requirement, and installing string Inverters at a required location with all necessary hardware like nuts, bolts, cable lugs, glands, etc.	I	Nos.	31.00
2(c)	**DCDB/SMU/ACDB (10-100 KWp)**- Taking delivery from the store, shifting to the respective rooftops as per requirement, and installation of DCDB/SMU/SCDB at a required location with all necessary hardware like nuts, bolts, cable lugs, glands, etc.	I	Nos.	62.00
2(d)	**AC Combiner Box** - Taking delivery from the store, shifting to the respective rooftops as per requirement, and installation of LT Panel/ACCB at a required location with all necessary hardware like nuts, bolts, cable lugs, glands, etc.	I	Nos.	5.00
3	**Module mounting Structure (MMS) Installation**			
3(a)	BHEL Supplied MMS: - Installation of Module Mounting structures on roof top including shifting from stores to respective roof tops, bolting, tightening and aligning, etc. all complete.	I	Per Kg	50000.00

Signature and seal of Bidder

6(c)	50-95 sqmm (300X50X1.6Tk)	1	Mtrs	1600.00
7	Installation of PVC conduit pipes of the following sizes, along with all accessories including jointing, laying, fixing to wall/roof with suitable clamps, cutting the wall and making good the same in case of recessed conduit pipes, etc., as required, all complete.			
~~7(a)~~	~~20mm~~	~~1~~	~~Mtrs~~	~~0~~
7(b)	32mm	1	Mtrs	12000
~~7(c)~~	~~40mm~~	~~1~~	~~Mtrs~~	~~0~~
7(d)	50mm	1	Mtrs	950
7(e)	110 mm	1	Mtrs	1200
8	Installation of Lightening arrestor with foundation and all accessories (ESE Type) *The contractor will supply the required hardware (if required).*	**1**	**Nos**	11
9	Installation of Earthing Strips, including jointing, welding, and applying cold galvanizing paint to joint locations, after welding, complete in all respect			
~~9(a)~~	~~25x5 mm GI Strip~~	~~1~~	~~Mtrs~~	~~0~~
9(b)	25x3 mm GI Strip or approved equivalent	1	Mtrs	6000
10	Installation of suitable Earthing pits as per specs., incl. excavation, Putting the chemical, backfilling,	1	Nos	88
11	**Installation of Isolation Transformer with cable termination, wiring fixing, etc.** *The contractor will supply all the accessories such as lugs, termination kit, etc.*	1	Nos.	5
12	Commissioning of the plant, Testing and Integration of the solar power with the existing grid supply	O	KW	2537.52
13	Danger Board/Name Plate as per drawing given by BHEL	1	Nos.	60
PART (B) Special Scope				
14	**Cleaning System**			
14(a)	Plumbing work of required pipeline for washing dia:15mm-50mm. This includes pipe laying, and fixing of GI pipe at required location. *The contractor will supply the required hardware.*	1	SET	9
15	**Canopy With the structure as per the drawing given by BHEL, material required for the canopy will be supplied by BHEL. However, hardware, installation accessories will be scope of contractor.**	1	SET	12
16	**Fire Extinguisher-Complete Installation**	1	Nos.	16

Signature and seal of Bidder

3(b)	Supply & installation of Mono Rail type Anodized Aluminum Structure (**grade of anodic coating shall be AC25 as per IS:1868**) on Tin Shed, including shifting from stores to respective roof tops, bolting, tightening and aligning, etc. all complete.	S&I	Per KW	700.00
4	**Concrete Work**			
4(a)	**Supply & Installation of Concrete Block for the erection of MMS:-** In-situ or Ex-situ (whatever its required) Casting of Concrete block with M25 (1:1:2) concrete grade, in case of ex situ casting the blocks, the blocks shifting to will be in the scope of contractor. Appropriate adhesive shall be used between the roof & block to get the required strength. **Note:-** *All the civil material such as Sand, Cement, Aggregate, etc. shall be part of contractor's scope.*	S&I	Cum	29.00
4(b)	**Casting of Civil foundation for Cleaning system, cable trays, etc:-** In-situ Casting of Concrete foundation block with M20 grade (1:1.5:3). All the civil material such as Sand, Cement, Aggregate, etc. shall be part of contractor's scope.	S&I	Cum	14.00
5	**Cable Laying**			
	Laying and fixing of the following PVC insulated and PVC sheathed/XLPE Power cables of 1.1 KV grade of following sizes, on cable trays or inside conduit pipes, as required, including tying, dressing, termination at the inverter / LT Panel or module end, fixing of the cable trays or conduit pipes to the roof, wall or structures, all complete. (Cables will be supplied by BHEL free of cost) **Note: -** *Contractor shall supply bend, elbow, tee, saddle clamp, fasteners etc. in plenty for DC cabling.*			
5(a)	DC cable 1C 4 sqmm,	I	Mtrs	38000.00
5(b)	AC Cable 4C 1 to 50 sqmm (Copper)	I	Mtrs	100.00
5(c)	AC Cable 4C 35 to 95 sqmm (Copper)	I	Mtrs	200.00
~~5(d)~~	~~AC Cable 4C 95-185 sqmm (Copper)~~	~~I~~	~~Mtrs~~	0
5(e)	3.5C up to 35 sqmm (Aluminum)	I	Mtrs	200.00
5(f)	3.5C 35 to 95 sqmm (Aluminum)	I	Mtrs	800.00
5(g)	3.5C 95 to 185 sqmm (Aluminum)	I	Mtrs	2300.00
5(h)	3.5C 185 to 400 sqmm (Aluminum)	I	Mtrs	250.00
6	**Cable Tray Installation with all accessories**			
~~6(a)~~	~~2.5mm - 6 sqmm~~	~~I~~	~~Mtrs~~	~~0~~
6(b)	10-35 sqmm (225X50X1.6Tk)	I	Mtrs	1200.00

Signature and seal of Bidder

	TECHNICAL CONDITION OF CONTRACT	Doc. No: -	FES2324-20246105
		Part	02/05
Rudrapur	GROUP : FES (FIELD ENGINEERING SERVICES)	Rev no	00

17	**Providing services for loading and Unloading during local shifting of material from central storage location to multiple site as required. Vehicle for shifting shall be placed by contractor. Ref unit of "lot" taken for 1 event of loading and 1 event of unloading. This is applicable, if two or more different premises are involved:- Building.**	O	Lots.	8

NOTE TO BOQ: Above mentioned quantity of each line items is tentative and are liable to change during the course of execution & handing over to end customer.
After completion of erection work at the site, final BOQ quantity of the line items will be verified. If any variation in quantity noticed over & above of given quantity each against any line item, amendment of contract will be carried out to include the same before processing of final bill.
Any variation in quantity noticed, lower than the mentioned quantity in the BOQ, then actual measured quantity will be processed for the payment.

LI-bidder shall be decided on over all price basis.

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CHAPTER -VI
GENERAL

THE SCOPE OF THE WORK WILL COMPRISE OF BUT NOT LIMITED TO THE FOLLOWING:

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.5.1.1 **In addition to the clause 2.8 of General Conditions of Contract (Volume- 1C of Book-II) the contractor shall comply with the following.**

1.5.1.2 The Contractor should Register their ***Establishment under BOCW Act 1996*** read with rules 1998 by submitting Form I (Application for Registration of Establishment) and Form IV (Notice of Commencement / Completion of Building other Construction Work) to the respective Labour Authorities i.e.

a) Assistant Labour Commissioner (Central) in respect of the project premises which is under the purview of Central Govt., State Govt. & PSU etc.
b) Electrical Inspector of Factories in respect of the project premises which is under the purview of State Govt. & Central Govt.

1.5.1.3 The Contractor should comply with the provisions of BOCW Welfare Cess Act 1996 in respect of the work awarded to them by BHEL

1.5.1.4 The contractor should ensure compliance regarding Registration of Building Workers as Beneficiaries, Hours of work, welfare measures and other conditions of service with particular reference to Safety and Health measures like Safety Officers, safety committee, issue of Personal protective equipment's, canteen, rest room, drinking water, Toilets, ambulance, first aid center etc.

1.5.1.5 The contractor irrespective of their nature of work and manpower (Civil, Mechanical, Electrical works etc.) should register their establishment under BOCW Act 1996 and comply with BOCW Welfare Cess Act 1996.

1.5.1.6 Identification of equipment at storage yard, technical assistance for checking and making the shortage/damage reports, taking delivery at storage yard and pre-assembly of equipment wherever required, erecting the equipment, aligning, fastening, supporting, cleaning, checking and carrying out statutory tests as required, trial operation, pre commissioning, commissioning and post commissioning activities up to the time of completion of commissioning activities and commercial operation of the unit and handing over to customer or till completion contract period whichever is earlier, along with the supply of all consumables, tools and tackles and testing instruments.

1.5.1.7 Scope of work covered under this specification requires quality workmanship, engineering and construction management. The contractor shall ensure timely completion of work. The contractor shall have adequate tools, measuring instruments, calibrating equipment etc. in his possession. He shall also have adequately trained, qualified and experienced

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engineers, supervisory staff and skilled personnel. The manpower deployment identified by contractor shall match with above scope of works.

1.5.1.8 **In case any requirement is there to compress the schedule of activities to achieve project completion, then the additional expenses if any incurred will be discussed mutually and settled. BHEL decision in this regard is final and the issue is not arbitral.**

1.5.1.9 The contractor shall have valid ELECTRICAL CONTRACTOR LICENSE, Workmen Compensation Policy as required to carry out the scope / job mentioned in the Bill of Quantity (BOQ).

1.5.2.0 All the necessary certificates and licenses required to carry out this scope of work are to be arranged by the contractor then and there at no extra cost.

1.5.2.1 It is not the intent to specify herein all details of material. Any item related this work not covered by this but necessary to complete the system will be deemed to have been included in the contractor's scope of the work (except BHEL supplied items).

1.5.2.2 Site testing wherever required shall be carried out for all items / materials installed by the contractor to ensure proper installation and functioning in accordance with drawings, specifications and manufacturer's recommendations and Field quality plans of BHEL.

1.5.2.3 The contractor shall co-ordinate and provide assistance for satisfactory testing, pre-commissioning, commissioning and trial run of the connected equipment under overall guidance of BHEL and shall locate any cause of malfunction and rectify the same for proper operation. Testing shall also include any additional tests, which the Engineer feels necessary because of site conditions and also to meet system specification.

1.5.2.4 The work shall be executed under the usual conditions without affecting power plant construction and in conjunction with other operations and contracting agencies at site. The contractor and his personnel shall co-operate with the personnel of other agencies, co-ordinate his work with others and proceed in a manner that shall not delay or hinder the progress of work as a whole.

1.5.2.5 All the work shall be carried out as per instructions of BHEL engineer. BHEL engineer's decision regarding the correctness of the work and method of working shall be final and binding on the contractor.

1.5.2.6 Contractor shall erect all items / materials etc. as per sequence prescribed by BHEL at site. BHEL engineer depending upon the availability of materials / work fronts etc. will decide the sequence of erection / commissioning methodology. No claims for extra payment from the contractor will be entertained on the grounds of deviation from the methods of erection / commissioning adopted in erection/commissioning of similar job or for any reasons whatsoever.

1.5.2.7 During the course of erection, testing and commissioning of electrical work, certain rework / modification / rectification / repairs / fabrication etc. may be necessary on account of feedback from other power stations or units already commissioned and / or units under erection and commissioned and also on account of design changes and manufacturing incompatibilities

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and site operation / maintenance requirements. Contractor shall carryout such rework / modification / rectification / fabrication / repairs etc, promptly and expeditiously.

1.5.2.8 After completing all the works, contractor shall hand over all remaining extra materials with proper identification tags in a packed condition to BHEL/Customer stores. In case of any use over actual design requirements, BHEL reserves the right to recover the cost of material used in excess or misused. Decision of BHEL engineer in this regard will be final and binding on the contractor.

1.5.2.9 Contractor shall, transport all materials to site and unload at site / working area, or pre-assembly yard for inspection and checking. All material handling equipment required shall be arranged by the contractor.

1.5.3.0 Contractor shall retain all T&P / Testing instrument / Material handling equipment etc. at site as per advice of BHEL engineer and same shall be taken out from site only after getting the clearances from engineer in charge.

1.5.3.1 The contractor at his cost shall arrange necessary security measures for adequate protection of his machinery, equipment, tools, materials etc. BHEL shall not be responsible for any loss or damage to the contractor's construction equipment and materials. The contractor may consult the Engineer-in-Charge on the arrangements made for general site security for protection of his machinery equipment tools etc.

1.5.3.2 The Contractor may have to execute work in such a place and condition where other agencies also will be under such circumstances. However, completion time for erection agreed will be subject to the condition that contractor's work is not hampered by the agencies.

1.5.3.3 wherever erection sequences are furnished by BHEL, the contractor shall follow the same sequence.

1.5.3.4 If required by BHEL, the contractor shall change the sequence of his operation so that work on priority sectors can be completed within the projects schedule. The contractor shall afford maximum assistance to BHEL in this connection without causing delay to agreed completion date.

1.5.3.5 Any wrong erection shall be removed and re-erected promptly to comply with the design requirements to the satisfaction of Site Engineer.

1.5.3.6 Contractor has to work in close co-ordination with other erection agency at site. BHEL engineer will co-ordinate area clearance. In a project of such magnitude, it is possible that the area clearance may be less / more at a particular given time. Activities and erection program have to be planned in such a way that the milestones are achieved as per schedule/ plans. Contractor shall arrange & augment the resources accordingly.

1.5.3.7 The contractor must obtain the signature and permission of the security personnel of the customer for bringing any of their materials inside the site premises. Without presenting the Entry Gate Pass these materials will not be allowed to be taken outside.

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1.5.3.8 Contractor shall remove all scrap materials periodically generated from his working area in and around power station and collect the same at one place earmarked for the same. Load of scraps is to be shifted to a place earmarked by BHEL. Failure to collect the scrap is likely to lead to accidents and as such BHEL reserves the right to collect and remove the scrap at contractor's risk and cost if there is any failure on the part of contractor in this respect. All the package materials, including special transporting frames, etc. shall be returned to the BHEL stores / customer's stores by the contractor.

1.5.3.9 The contractor shall ensure that his premises are always kept clean and tidy to the extent possible. Any untidiness noted on the part of the contractor shall be brought to the attention of the contractor's site representative who shall take immediate action to clean the surroundings to the satisfaction of the Engineering- Charge.

1.5.4.0 The contractor is strictly prohibited from using BHEL's regular components like angles, channels, beams, plates, pipe / tubes, and handrails etc for any temporary supporting or scaffolding works. Contractor shall arrange himself all such materials. In case of such misuse of BHEL materials, a sum as determined by BHEL engineer will be recovered from the contractor's bill. The decision of BHEL engineer is final and binding on the contractor.

1.5.4.1 The contractor will be responsible for the safe custody and proper accounting of all materials in connection with the work. If the contractor has drawn materials in excess of design requirements, recoveries will be affected for such excess drawls at the rate prescribed by manufacturing units.

1.5.4.2 No member of the already erected structure / platform, pipes, grills, platform, other component and auxiliaries should be cut without specific approval of BHEL engineer.

1.5.4.3 Contractors shall ensure that all their Staff / Employees are exposed to periodical training programme conducted by qualified agencies/ personnel on ISO 9001 – 2008 Standards.

1.5.4.4 For other agencies, such as civil, transformer, piping, insulation etc., to commence their work from / on the equipments coming under this scope, Contractor has to clear the front, expeditiously and promptly as instructed by BHEL Engineer. Some time it may be required to re-schedule the activities to enable other agencies to commence/continue the work so as to keep the overall project schedule.

1.5.4.5 The terminal points decided by BHEL are final and binding on the contractor for deciding the scope of work and effecting the payment for the work done up to the terminals.

1.5.4.6 Crane operators deployed by the contractor shall be tested by BHEL and have valid Driving Licensee before he is allowed to operate the cranes.

1.5.4.7 For the purpose of planning, contractor shall furnish the estimated requirement of power (month wise) for execution of work in terms of maximum KW demand.

1.5.4.8 On Completion of work, all the temporary buildings, structures, pipe lines, scaffolding, cable etc. shall be dismantled and levelled and debris shall be removed as per instruction of BHEL by the contractor at his cost. In the event of his failure to do so, the expenditure towards

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clearance of the same will be recovered from the contractor. The decision of BHEL Engineer in this regard is final.

1.5.4.9 Prior to erection of any components internal inspection to be done for any foreign materials and damages and they are to be attended as per directions of BHEL engineer.

1.5.5.0 All the equipment /material to be taken inside the plant building shall be cleaned thoroughly before taking them inside and erect.

1.5.5.1 It is the responsibility of the contractor to do the alignment of PV Solar panel with our structure if any minor modification like that of structure cutting and welding done by contractor free of cost basis. If necessary, repeatedly to satisfy BHEL Engineer / Customer Engineers with all the necessary tools and tackles, manpower etc. without any extra cost. The alignment will be completed only when jointly certified so, by the BHEL Engineer & Customer. Also, the contractor should ensure that the alignment is not disturbed afterwards.

1.5.5.2 Void

1.5.5.3 The scope of specification covers the installation, testing and commissioning of the erected equipment/ instrument along with accessories as detailed in Bill of Quantity.

1.6 SITE INSPECTION

The owner / employer or his authorized agents may inspect various stages of work during the currency of the contract awarded to him. The contractor shall make necessary arrangements for such inspection and carry out the rectification pointed out by the owner / employer without any extra cost to the owner / employer. No cost what so ever such duplication of inspection of work be entertained.

BHEL / Customer will have full power and authority to inspect the works at any time, either on the site or at the contractor's premises. ***The contractor shall arrange every facility and assistance to carry out such inspection.*** On no account will the contractor be allowed to proceed with work of any type unless such work has been inspected and entries are made in the site inspection register by customer / BHEL.

Wherever the performance of work by the contractor is not satisfactory in respect of workmanship, deployment of sufficient labour or equipment, delay in execution of work or any other matter, **BHEL shall have the right to engage labour at normal ruling rates and get the work executed through other agency and debit the cost to the contractor and the contractor shall have no right to claim compensation thereof.** In such a case, BHEL shall have the right to utilize the materials and tools brought by the contractors for the same work.

1.7 MANPOWER REQUIREMENT

1.7.1 Manpower requirement for Erection and Commissioning shall as follows:

a. There shall be a Resident manager as Site in Charge at site, under whom there shall be sufficient area engineers who shall take care of the erection activities.

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b. One Safety Engineer, One Quality Engineer & One Planning Engineer deployed at site which have a minimum qualification of Engineering Degree or Diploma in Engineering with minimum 02 years of experience.

c. Supervisor should have a minimum qualification of Diploma in Engineering or any graduate with minimum 2 years of experience in installation for solar power system.

d. Contractor should have one Qualified Store Keeper who have responsible for daily basis stock of material in store yard and properly stacking of material, Receipt of Bhel material, Issue of Bhel material for erection work and entry in material inward and outward register.

~~**e.** Three no. of Al. welder should be deployed at site for execution. All the welders have to be certified by BHEL/Customer and then inducted into the mainstream. Arrangements towards the sample testing (DP/Radiography) will be carried out by contractor.~~

1.7.2 Each engineer shall be provided with minimum one supervisor and adequate number of Technicians / electricians and other erection staff and T&P etc.

1.7.3 The Site in charge shall be provided with PCs and good communication facilities like telephone, fax, email etc. at the cost and expense of the contractor. Lack of communication facilities will not be an excuse for extension of completion date.

1.7.4 All instructions from BHEL / Customer will be directed to the contractor through the Site in-charge and he shall be responsible for all the contractor's activities at site. The contractor shall name his authorized representative prior to or immediately on commencement of operations at site.

1.7.5 The Site In charge shall be present at site during all normal working hours and his contact address after normal working hours shall be made available to BHEL so that if any emergency arises, the presence of the contractor's site Representative at site can be called for.

1.7.6 The contractor shall not change the site Representative without the consent of BHEL. Should BHEL require the replacement of the contractor's site Representative for justifiable reasons (including inadequate progress of work) the contractor shall ensure that replacement is made as soon as possible and work is not allowed suffering delay on this account.

1.7.7 The contractor shall provide to the satisfaction of BHEL sufficient and qualified staff for the execution of works. If and whenever any of the contractor's staff is found guilty of any misconduct or be incompetent or insufficiently qualified in the performance of his duties the contractor shall remove them from site as directed by Site Engineer.

1.7.8 The contractor shall ensure that all his supervisor's staff and workmen conduct themselves in a proper manner. They shall all be persons who are familiar with and skilled at the jobs allocated to them. Any misconduct / inefficiency noted on the part of the contractor's personnel shall be brought to the attention of the contractor's site representative who shall immediately take such action as necessary including the removal of such misconducting / inefficient persons, if so required by the Engineer-in-Charge.

1.7.9 The contractor shall ensure that replacement for such persons removed from site is provided immediately and the work is not allowed to suffer delay on that account.

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1.7.10 ~~Contractor shall deploy required number. of qualified Al. Welder certified by BHEL/CUSTOMER through the sample testing.~~

1.8 DOCUMENTATION

1.8.1 The following information shall be furnished by the bidder within two weeks of award of contract for purchaser's approval.

a) Bar chart covering planned activities at site.
b) Detailed organization chart.
c) Details of T&P available with contractors with documents proofs.

1.8.2 The following information shall be furnished by the bidder after testing and Inspection: Test certificates of various tests conducted at site. All inspection and test certificates shall be signed by customer's representative also, wherever called for as per field quality plan.

1.8.3 As built drawings:
After successful completion, testing and commissioning of installation work, Purchaser's drawings / documents shall be updated in line with the actual work carried out and as built drawings / documents shall be submitted by the contractor as agreed for the project.

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CHAPTER -VII
FOUNDATIONS AND GROUTING

THE SCOPE OF THE WORKS WILL COMPRISE OF BUT NOT LIMITED TO THE FOLLOWING:

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

Civil foundation blocks for the erection of module mounting structure (MMS), cable tray, cleaning system and any other system or equipment will be under the scope of contractor. For the casting of foundation for module mounting structure foundation bolt (J bolt) shall be arranged by the BHEL.

The contractor may cast foundation blocks on that particular roof where the solar system to be installed or on ground as per his suitability. If, casting is carried out on the ground then the shifting of foundation blocks to the respective roof will be part of the contractor's scope of work. No extra claim on the ground shall be processed for the payment.

Grouting is to be carried out wherever it's required free of cost as per the direction of the BHEL site in charge.

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CHAPTER -VIII
MATERIAL HANDLING AND SITE STORAGE

THE SCOPE OF THE WORKS WILL COMPRISE OF BUT NOT LIMITED TO THE FOLLOWING:

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.9.1.1 The equipment should be preferably in its original package after physical inspection, Material to be repacked as it is original package and should not be unpacked until it absolutely necessary for its installation. The equipment should be best protected in its cases. It should be arranged away from walls.

1.9.1.2 The wooden pallet provided for packing itself can be retained for raised platform to protect equipment from ground damps, sinking into around and to circulate air under the stored equipment. This will also help in lifting the packing with fork-lift truck.

1.9.1.3 Due care should be taken to ensure that the equipment is not exposed to open atmosphere etc. which can affect the Colour shade and also rusted. Structure material, GI Pipe, Earthing Strip etc. to be laid on the graveled area not directly laying on ground.

1.9.1.4 All the equipment, materials and goods kept in the store room should be identified and registered in a book. An inspection report should be recorded. Any discrepancy observed should be communicated to BHEL site Engineer.

1.9.1.5 Packing material shall be retained if the cubicle to be repacked after inspection.

1.9.1.6 Sub-Assemblies

a) All sub-assemblies should be kept in a separate place where it is easily accessible.
b) Sub-assemblies should have a protective cover in case it is stored without wooden packing / case to prevent accumulation of dust. Silica gel packets should also be kept along with it.
c) Sub-assemblies should not be stacked one above the other.

1.9.1.7 Loose items (wherever applicable) The loose items supplied (if any) for the main equipment, cable, etc., shall be stored carefully & separately.

1.9.1.8 Materials shall be stacked neatly, preserved and stored in the contractor's shed / work area in an orderly manner. In case it is necessary to shift and restack the materials kept at work area / site to enable other agencies to carry out their work, same shall be done by the contractor at no extra cost.

1.9.1.9 ~~The contractor shall provide any fixtures, concrete blocks & wooden sleepers, which are required for temporary supporting / storage of the components at site. Wooden block is used for assembly for structure and structure & bus duct laying on it.~~

1.9.10 ~~Contractor has to arrange required fire-resistant tarpaulins to protect the machined components / assembled parts during the erection/welding work at site.~~

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1.9.11 The contractor shall take delivery of item, materials, from the storage yard / stores / sheds of BHEL / customer which is within a radius of 5 kms. Contractor shall also make arrangements for safe custody, watch and ward of equipment after it has been handed over to him till they are fully erected, tested and commissioned. If any theft of material takes place before commissioning, contractor will be responsible and suitable payment deductions against theft material may be initiated in upcoming invoices.

1.9.12 The contractor shall note that items/materials shall be transported to erection site / assembly yard etc. by the prescribed route without disturbing and causing damage to other works in the most professional manner. Items, Hardware, etc. shall be stored in appropriate manner as per BHEL's instructions.

1.9.13 Loading at BHEL / Customer stores and storage yard, transport to site, unloading at site / working area of equipment placement on respective foundation/location, fabrication yard, pre-assembly bay or at working area are in the scope of work. The scope includes taking materials / Equipment's from customer stores / storage yard also. Contractors Quoted / Accepted rate shall be inclusive of the same. Required cranes, tractors, trailer or trucks / slings / tools and tackles / labour including operators Fuel lubricants etc. for loading & unloading of materials will be in the scope of contractor.

1.9.14 The equipment / materials from the storage yard shall be moved in sequence to the actual site of erection / location at the appropriate time as per the direction of BHEL Engineer so as to avoid damage / loss of such equipment at site.

1.9.15 At the time of receiving of materials, contractor store keeper should properly verify (MRC) the quantity received and inspect physically for any damages. Any damages, discrepancies (shortfall/excess) found, should be intimated to BHEL for raising MDR along with GR clearly marked the discrepancies. MRC to be completed within one-week time frame.

1.9.16 All the received materials entry to be done in the shipping list by contractor storekeeper and sent to BHEL Rudrapur.

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CHAPTER –IX
SCOPE OF WORK & TECHNICAL SPECIFICATION

THE SCOPE OF THE WORKS WILL COMPRISE OF BUT NOT LIMITED TO THE FOLLOWING:

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

It is not the intent to specify herein all details of material. Any item related to this work, not covered by this but necessary to complete the system will be deemed to have been included in the scope of the work.

SCOPE OF WORK &TECHNICAL SPECIFICATIONS

INSTALLATION, TESTING AND COMMISSIONING OF 2.5 MW ROOF TOP SOLAR POWER PROJECT AT YADADRI SUPER THERMAL POWER PLANT at Damaracherla, District: Bhuvanagiri, Telangana.

Note:

a. Each Module of 545 Wp or above (approx. 4656 Nos), Structure, Inverters, ACDB, DCDB and weather monitoring system, LT Panel/ACCB, Isolation Transformer, AC Cable, DC Cable, Cable tray, along with Data logger shall be supplied by BHEL.
b. Contractor has to supply Monorail along with all installation accessories for installation of PV module on permanent store. All required hardware to complete installation is in the scope of contractor.

Bidder to note that storage, safe keeping, Internal transportation, loading and unloading (lifting), installation of PV Solar panel, Structure and other necessary accessories for commissioning of solar power project at different building at Yadadri STPP shall be in bidder scope.

Besides the above, casting of the civil foundation blocks for modules mounting structure (MMS) for Solar RTS to be installed at Admin Building, Canteen Building & Work shop Building is part of the contractor's scope of work.

DEFINITION

A Grid Tied Solar Rooftop Photo Voltaic (SPV) power plant consists of SPV array, Module Mounting Structure (MMS), array Junction Boxes, String Monitoring system, PCU or Central / String Inverter consisting of Maximum Power Point Tracker (MPPT) with Remote Monitoring System, DC & AC cables, AC Distribution Board with MFM, switches and Controls & Protections with earthing and lightening protections. PV Array is mounted on a suitable structure. Grid tied SPV system is without battery and should be designed with necessary features to supplement the grid power during day time.

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Components and parts used in the SPV power plants including the PV modules, metallic structures, cables, junction box, switches, Central / String Inverter etc., should conform to the BIS or IEC or international specifications, wherever such specifications are available and applicable.

Solar PV system shall consist of following equipment/components.

- Solar PV modules consisting of required number of Crystalline PV modules.
- Grid interactive Power Conditioning Unit with Remote Monitoring System.
- Mounting structures.
- Junction Boxes.
- Earthing and lightening protections.
- IR/UV protected PVC Cables, pipes and accessories

Part A : General Scope

Upon award of work for a particular site - Contractor has to identify central area within the CUSTOMER/user premises for unloading and storing of BHEL supplied items like PV modules, String inverters, ACDB, DCDB or any other items. Subsequent arrangement for unloading, safekeeping, shifting of the material to site for installation shall be part of services to be offered by the Bidder associated with BHEL supplied items.

Safe storage and movement of supplied items received at site (BOQ No.: -01):

a) Contractor shall organize all necessary resources such as labour, machinery and tools, cranes, hydra, forklifts, transportation trucks/ trolleys, lifting accessories etc. for unloading the BHEL supplied items from the transport vehicle reaching identified location at site and subsequent movement to storage yards/sheds.

b) Similar arrangements shall also be made by contractor for movement of the stored items from storage yards/sheds to the exact construction locations within the project site.

c) Contractor shall maintain proper registers/ files/ records of invoices, LRs, delivery challans, material receipt certificates etc. Also, proper records shall be maintained to keep track of material entry (for storage) and material issue (for construction).

d) All such documents shall be suitably preserved for further handing over to BHEL/CUSTOMER.

e) Safety of items shall be in contractor scope. Accordingly, contractor will make all requisite arrangements for safe storage and preservation of BHEL supplied material.

f) All the equipment shall be handled very carefully to prevent any damage or loss. No untested wire ropes / slings etc. shall be used for unloading /loading for material handling. The equipment shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the stores shall be moved to the actual location at the appropriate time so as to avoid damage of such equipment at site.

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g) The material received shall be properly inspected for any damage caused during transit and the Goods Receipt Document of the Transporter shall be acknowledged after verifying the condition of goods received. Any damage shall be immediately reported to BHEL. In cases when such information is not given to BHEL in time – it will be presumed that the material was received in good condition by the contractor and damage may have taken place at a later stage. Such damage or loss shall be attributable to the contractor.

h) The contractor shall ensure that while lifting slings shall be put over the points indicated on the equipment or as indicated in the manufacturer's drawings. Slings/shackles of proper size shall be used for all lifting and rigging purposes. All care shall be taken to safeguard the equipment against any damage.

i) The contractor shall be responsible for examining all the plant and materials issued to him and notify the Engineer immediately of any damage, shortage, discrepancy, etc. before they are moved out of the stores/storage area. The contractor shall be solely responsible for any shortages or damages in transit, handling, storage, and erection of the equipment once received by him.

j) The contractor shall maintain an accurate and exhaustive record of the list of all equipment received by him for erection and keep such record open for the inspection of the engineer at any time.

k) All the material in the custody of the contractor and stored in open or dusty locations must be covered with suitable weatherproof covering material wherever applicable and shall be blocked up on a raised level above ground.

l) The contractor shall hand over all parts/materials supplied by BHEL and the remaining extra over the normal requirement with proper identification tags and measurements to BHEL before site closure. Such intimation will be given in writing to BHEL well in time.

m) It shall be the responsibility of the contractor to keep the work/storage areas neat, tidy, and working conditions. All surplus/unusable packing and other materials shall be removed and deposited at the location(s) as identified within the project premises.

n) All suitable lifting arrangements and local transport arrangements within premises for material handling at stores/yard/siding of BHEL/Customer/Contractor are included in scope.

Preservation of components

a) After taking delivery from BHEL / customer's stores, plant materials storage shall be subjected to the following protection besides other provisions indicated in these specifications elsewhere.

b) Items stored outdoors shall be stacked up at least six inches (6") off the ground. Items should not be stored in a low-lying area where water logging is a possibility.

c) Electrical items shall be stored indoors or otherwise protected against getting wet/ damaged, using suitable measures, and should be protected from direct rain.

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"Security & safekeeping of BHEL supplied material.

For all system capacities and in all situations – it is the prime responsibility of the contractor to ensure the security and safekeeping of the BHEL-supplied material till handing over of complete system in working condition to the customer. The contractor will make their assessment based on the prevailing condition at the site and will make all arrangements for the security and safekeeping of BHEL-supplied material. The contractor shall also indemnify BHEL towards any loss incurred towards loss of damage to BHEL-supplied material.

3.0 Installation of BHEL Supplied items (BOQ No.: -02)

SPV Modules {BOQ No.-2(a)}:

The Contractor Shall do the erection of the SPV module as per the approved layout design of BHEL. After placing the work order on the contractor, BHEL will provide layout drawings that will describe the exact way in which the series/parallel strings are formed. Contractor shall implement the interconnection as per these drawings. A required number of nuts and bolts for the erection of Modules shall be supplied by BHEL. These will be made **of SS 304 material - NUTS, BOLTS, AND PLAIN WASHERS.**

MC4 Connector for the installation of modules is in the scope of bidders.

Installation activity shall include Placing on base, bolting, clamping with Structure material, Ferrule Marking near String. **Other fasteners like Clamp, brackets, M6 Screws, *MC4 connectors shall also be supplied by the contractor as required additionally.***

Series interconnection of SPV modules to form strings

Contractor shall interconnect the SPV modules as follows:

1. Each module is fitted integrally with a junction box having positive and negative polarity cables (4 sq.-mm).
2. Positive cable of one module shall be connected to the negative cable of adjacent module. The cables have MC4 type of connectors to be supplied by contractor. One polarity cable has male type connector, while the other has female type connector.
3. This way, Min 16 Modules shall be connected in series. Each set of connections is called as a series string. Series formation may change as per approved layout and design.

Interconnection of SPV module strings to string inverters

1. Contractor shall connect each series string of 16 SPV modules to the DCDB/string inverter using 1Cx 4 cable, copper, XLPO, unarmored supplied by BHEL.
2. MC4 connectors shall have rating of 1000VDC (IEC), rated current of 30A. MC4 connector shall be supplied by Contractor.
3. Min. Two sets of tool kits (with box enclosure) shall be supplied. This shall include crimping plier MC4, open end spanner set MC4, stripping plier MC4, socket wrench inserts to tighten, socket wrench inserts to secure etc.

Required number of MC-4 Connectors each set having a pair of male and female parts, to join both the cables shall be supplied by Contractor.

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Installation of string inverters {BOQ No.- 2(b)}

Supply of string inverters is in BHEL scope.

(a) Installation of string Inverter on Roof:

- On roof tops, the Inverter shall be mounted on MS stand that shall be attached by welding to the Roof top MMS.
- Minimum ground clearance shall be 500mm.
- In case of outdoor installation - Structure shall have canopy (as rain shade) made of GI sheet. Canopy shall be supplied by BHEL and fabrication and installation will be done by Contractor.
- All structure items including hardware shall be in contractor scope of supply

(b) Installation of String Inverter on Wall:

- On wall, Inverter shall be mounted on mounting plate.
- Minimum wall clearance shall be 50mm.
- All structure items including hardware shall be in contractor scope of supply.
-

Installation of DCDB & ACDB {BOQ No.- 2(c)}

Supply of DC Distribution boxes (DCDB) is in BHEL scope.

a. Installation of DCDB on Roof:

- On roof tops, DCDB shall be mounted on MS stand that shall be attached by welding to the Roof top MMS.
- Minimum ground clearance shall be 500mm.
- In case of outdoor installation - Structure shall have canopy (as rain shade) made of GI sheet. Canopy shall be supplied by BHEL and fabrication and installation will be done by Contractor.
- All structure/pedestal items including hardware shall be in contractor scope of supply.

b. Installation of DCDB on Wall:

- On wall, DCDB shall be mounted on mounting plate.
- Minimum wall clearance shall be 50mm.
- All structure items including hardware shall be in contractor scope of supply.

Installation of AC Combiner Box {BOQ No.- 2(d)}

Supply of ACCB is in BHEL scope.

a) Installation of ACCB/ACDB on Roof:

- On roof tops, ACCB/ACDB shall be mounted on MS stand that shall be attached by welding to the Roof top MMS.
- Minimum ground clearance shall be 500mm.
- In case of outdoor installation - Structure shall have canopy (as rain shade) made of GI sheet. Canopy shall be supplied by BHEL and fabrication and installation will be done by Contractor.
- All structure/pedestal items including hardware shall be in contractor scope of supply.

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394759/2024/CFP-FES

	TECHNICAL CONDITION OF CONTRACT	Doc. No: -	FES2324-2024-0105
		Part	02/05
Rudrapur	GROUP : FES (FIELD ENGINEERING SERVICES)	Rev no	00

b) Installation of ACCB on Wall:

- On wall, Inverter shall be mounted on mounting plate.
- Minimum wall clearance shall be 50mm.
- All structure items including hardware shall be in contractor scope of supply.

~~**1. Installation of String Monitoring Unit (SMU)**~~

~~Supply of SMU is in BHEL scope.~~

~~**a. Installation of SMU on Roof:**~~

- ~~On roof tops, SMU shall be mounted on MS stand that shall be attached by welding to the Roof top MMS.~~
- ~~Minimum ground clearance shall be 500mm.~~
- ~~In case of outdoor installation – Structure shall have canopy (as rain shade) made of GI sheet. Canopy shall be supplied by BHEL and fabrication and installation will be done by Contractor.~~
- ~~All structure/pedestal items including hardware shall be in contractor scope of supply.~~

~~**b. Installation of SMU on Wall:**~~

- ~~On wall, SMU shall be mounted on mounting plate.~~
- ~~Minimum wall clearance shall be 50mm.~~
- ~~All structure items including hardware shall be in contractor scope of supply.~~

~~**Installation of weather monitoring station (WMS), Energy Meter & Data Loggers**~~

~~Supply of weather monitoring system (WMS), Energy meter & data logger is in BHEL scope.~~

- ~~All accessories including hardware/cables for the installation of WMS, EM & Data logger shall be in contractor scope of supply.~~
- ~~**Hardware – NUTS, BOLTS AND PLAIN WASHERS- SS 304 material**~~
- ~~**RS485/CAT6/Optical Fiber cable shall be laid/connected from data loggers to server by contractor.**~~

4.0 Installation of Structure for Module Mounting on rooftop/Shed (BOQ No.: -03)

Contractor Shall do the erection of the MMS structure as per approved design on the Roof/Tin Shed.

Wherever, welding is carried out, contractor shall arrange for proper grinding and cleaning of the weld surfaces, followed by application of Metal primer and Metallic aluminum paint. Pre-Galvanized parts shall be sprayed with Zinc spray after work.

Required number of nuts and bolts for the erection of MMS shall be supplied by BHEL.
Note: NUTS, BOLTS (M10) AND PLAIN WASHERS shall be made of SS 304.

Mono Rail Type Anodized Aluminum Structure: - Mono rail type anodized aluminum structure shall be supplied by the contractor as per IS: 1868. The grade of anodic coating shall be AC25.

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The contractor will carry out the installation of Mono rail type aluminum structure as per provided approved drawing. Sealant of appropriate grade shall be used on the tin shed roof to prevent the leakage. *All the accessories and hardware required for the installation shall be part of contractor's scope.*

5.0 Concrete Work (BOQ No-4)

(a) Casting of Concrete Block with M25 (1:1:2) grade of concrete, will be carried out the contractor as per BOQ for installation of module mounting structure. Suitable number of J-bolt shall be grouted in PCC pedestal for holding the structure base plate. *J Bolt shall be supplied by BHEL.*

In-Situ or Ex-situ Casting of blocks can be carried out as per the site situation. The contractor will inform to BHEL about the place of Block casting. To test the compressive strength of blocks, Cube test shall be carried out by the contractor as per applicable IS.

Lifting

Cost of Lifting of pedestals or raw material of pedestals up to the roof level is included in the contractor's scope. For buildings of height up to 40 Mtrs. – no additional charges shall be payable for lifting. For lifting above these levels – additional amount over the basic rates has been considered elsewhere in the BoQ.

Preparation of Roof

Marking on the roof for the placement of pedestal shall be done by the contractor as per the approved layout.
Pedestal shall be placed after placement of the NITTO BOND on the roof. For particular type of surfaces like waterproofed roof etc. – NITTO BOND may not be required. In such cases – contractor will give prior intimation in writing to BHEL that NITTO BOND is NOT being applied by them. Unless such intimation is given – the contractor will be presumed to have used NITTO BOND in all cases and this will be part of site inspection by the BHEL team.
Marked surface to be prepared cleaning the roof by wire brush after that NITTO BOND shall be applied on the prepared roof.
Supply of NITOBOND is in scope of the Contractor.

(b) In situ Casting of Concrete foundation for cleaning system, cable tray and any other equipment shall be carried out with M20 (1:1.5:3) Grade of concrete. To test the compressive strength of blocks, Cube test shall be carried out by the contractor as per applicable IS.

6.0 Cable Laying (BoQ No:-5)

All the AC and DC cables of the required size as per approved SLD shall be supplied by BHEL. Cable laying is in the scope of Contractor laying details as follows:
All accessories for cable laying, including clamps, hooks, ties, double compression cable glands, cable lugs, SS304 bolts/ nuts/ plain and spring washers, and anchoring arrangement shall be in the *contractor scope of supply*. Cutting the wall/surface and making good the same as required is also included in the scope of the contractor. The Cable lengths supplied to the site will NOT be in cut-to-size condition. The contractor has to arrange for the cutting of the

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cables and jointing by using suitable cable jointing kits. All arrangements, tools & tackles in this regard will be in the Contractor's scope.

Generally, jointing of cables in the run between two ends is not allowed. Hence, utmost care has to be taken while cutting the required length of cables. The joints, as required otherwise due to any particular reason - shall be made only after getting prior consent from BHEL.

Contractor will submit scheme for cable laying within 15 days of site mobilization. This scheme will include following details:

(A) Approximate length of various sizes of cables based on routing agreed with customer/user during joint assessment at site. (Cable sizes shall be based on BHEL's Electrical Single Line Diagram).

(B) Approximate requirement of laying through Conduits, Treys, Excavation etc.

(C) Contractor to purchase the quantity of conduits, treys etc. after getting written acceptance from BHEL.

(D) **Routing of 1Cx4 cable below the SPV modules**

a) 1Cx4 cables connecting the SPV module strings to DCDB/inverters shall be suitably routed below the SPV modules and along the horizontal purlin member of MMS structure. Also, the cables shall be fastened to the purlin using UV resistant cable ties that shall be in contractor scope of supply.

b) Spacing between two adjacent cable ties shall be so chosen as to ensure that there is no loose hanging of cables.

c) Cable ties, nylon polyamide 6.6 UV stabilized black, UL94 flammability rating V2, operating temperature up to 85 deg C, shall be used to arrest any possibility of movement or sagging. Width of the cable ties shall be minimum 4.5 mm. Length shall be so chosen as to ensure that the bunched cables are held firmly to the MMS structure. During detailed engineering, BHEL/CUSTOMER approval shall be obtained for the selected brand and sizes of cable tie.

(E) **Routing of 1Cx4 cable in GI cable trays**

Where 1Cx4 cables run between two adjacent rows of structure and also where the cables run on the roof-floor up to DCDB/string inverters, routing shall be on GI cable trays Wx Hx t = 100x50x 2 mm, perforated type, with GI cover of minimum 2mm thick, coupler plates, GI hardware as per relevant IS standard. Suitable flexible PVC conduit shall be used wherever required for covering cable at entry into GI cable tray.

(F) **Termination of 1Cx4 (DC side), 3.5/4C AC cables at string inverters & ACCB/ACDB boxes**

a) 1Cx4 cables of positive and negative polarities originating from SPV module strings shall be terminated at the DC input side of string inverters using MC4 connectors that are in contractor scope of supply for both ends.

b) For AC side connection at string inverters and ACCB/ACDB boxes, cable as per SLD, 1.1kV, Copper, XLPE, armored as per IS: 7098 part-1, together with nickel plated brass double compression cable glands, cable lugs, SS304 bolts/ nuts/ plain and spring washers shall be in contractor scope of supply. Termination shall be carried out using appropriate tools and torque setting as per BHEL/CUSTOMER approval.

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(G) **Ferruling for 1Cx4 cable**

a) For 1Cx4 DC solar array cable, contractor shall provide UV resistant ferrules printed with source/destination identification of cable connection. Printing details shall be submitted for BHEL/CUSTOMER approval during detailed engineering. Printing shall be of appropriate size to ensure readability.

b) Ferrules shall be provided on both the termination ends: module end, inverter end.

c) Supply of ferrule shall be in contractor scope. Make shall be reputed brand. Approval for make/ type/ color/ dimension etc shall be obtained from BHEL/CUSTOMER prior to procurement.

(H) Underground cable trenches and laying of cables from buildings to building if required.

Routing of cables from buildings to buildings is not envisaged. However, if required due to specific conditions, such power, control, communication cables routed from one building to another building through underground cable trench (direct burying) as per IS: 1255.

Typical trench details/dimensions are below only for tender purpose. During detailed engineering, cable trench layouts and cross section drawings as per IS: 1255 shall be submitted for BHEL/CUSTOMER approval.

i. Total trench depth = 750 mm minimum
ii. Trench width = As per number of cables/ HDPE pipes
iii. Trench shall have layers one over the other as below (from bottom to top):
    a) Bottom layer shall be sand of IS: 383 with 75mm minimum thick.
    b) 3C power cables shall be laid over the sand layer.
    c) Another layer of sand of 75 mm minimum thick.
    d) Single layer of brick as protective cover
    e) Layer of sand of IS:383 with 75mm minimum thick
    f) All communication cables shall be laid within HDPE pipe
    g) Layer of sand of IS:383 with 75mm minimum thick
    h) Single layer of brick as protective cover
    i) Trench shall, then, be filled with refill soil and compacted

Communication cables shall be routed through HDPE pipe. Communication cables and HDPE pipe shall be in contractor scope of supply. Contractor shall submit GTP/ make/ part number of the HDPE pipe, accessories and tools for BHEL/CUSTOMER approval during detailed engineering. Bending radii for cables shall be as per IS: 1255.

At pathway/road/drain/trench crossings, cables shall be routed through GI pipe of appropriate size that shall be in contractor scope of supply and technical details / brand etc shall be submitted for BHEL/CUSTOMER approval. It shall be ensured that a maximum of 60% of inner space of GI pipe shall be occupied by cables.

Contractor shall take utmost care in laying the cables in order to prevent damages on outer sheath and inner insulation. In case cables found to be damaged/ cut after the laying in trenches, contractor shall remove the damaged portion and join the cut pieces using appropriate cable jointing kits that shall be in contractor scope of supply.

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(I) Laying and termination of RS485/Cat6/Fiber cables

Contractor shall supply and install RS485 cable, copper, 2Px0.5, twisted pair, screened, armoured in daisy chain loops (a) from data loggers to string inverters and (b) from MFM meters of LT Panels to data loggers, (c) from weather monitoring system to data loggers. All cable accessories such as glands, lugs, ties, ferrules, tags, trays etc shall be in contractor scope of supply.

(J) Identification marking of cables using cable tags

- Cable tags shall be provided at both ends of the cables: at SPV modules, string Inverters, data loggers, ACCB boxes, LTPDB panels and so on.
- Cable tag shall be of rectangular shape.
- Cable tag shall be of 2mm thick aluminum with number punched (embossed) on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280.
- Reference shall be made to the "**Cable installation methodology**" of this specification. The contractor shall submit the technical details of cable tags, and ID numbering scheme for BHEL/ CUSTOMER approval during detailed engineering.

(K) Cable route markers

Cable route markers and joint markers for underground cables shall be provided along the route of the cables as per the section "Cable installation methodology" of this specification.

07. Installation of Cable trey (Sl.No.6 of BoQ)

BHEL shall supply the cable tray for the cable laying wherever it's required.

However, the installation accessories such as anchor fasteners, PVC wall Screws, etc., shall be provided by the contractor. Civil foundation for a run of cable trays on the roofs shall also be part of the contractor's scope.

Installation of Cable may include cutting the wall and making it the same as it was, the contractor does the same with any extra claim. Cable Trey shall be laid as per the approved drawing/make list/ Instruction provided by BHEL/Customer. The Cable Trey shall be of GI material

All couplers, fixing screws, 45/90-degree bends, intersections, and dividers are included in the scope of contrator.

For cable routing through exposed surfaces to rain – Cable Trey lid and Standoff brackets (for suitably raising the trey above surface for rain protection by minimum 50 mm) shall be used. Also, for important indoor locations Cable Trey lid shall be used for best aesthetic purpose.

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Cable Trey shall be lay as per the approved drawing/Instruction provided by BHEL/Customer.

08. Installation of Conduits (Sl.No.7 of BoQ)

BHEL shall supply medium class PVC conduit for the cable laying.

All accessories such as elbow, bend, tee, saddles, fasteners, etc., shall be part of the *contractor's scope of work*. Conduits pipes shall be lay as per the approved drawing/make list/ Instruction provided by BHEL/Customer.

HDPE pipe of PE63 grade, pressure rating PN6, appropriate nominal diameter and as per IS: 4984 (1995) shall be used. It shall be ensured that a max of 60% of inner space shall be occupied by the cables.

09. Lighting arrestor -special type (ESE type) (BOQ Sl. No.: -08)

BHEL shall supply ESE type lighting arrestor.

The contractor's scope comprises supply of all necessary accessories and hardware for the installation of the same. Also, the contractor will be provided separate earth pit at each building to connect the lighting arrester to the ground. The contractor shall also lay the earthing strip on ach building as per approved scheme/drawing & document provided by the BHEL.

10. Installation of Earthing strip with all accessories (Sl.No.9 of BoQ)

BHEL has to supply earthing strip of following size:

a) 25x3 mm The Scheme for laying of Earthing strips shall be submitted by contractor for approval of BHEL.
b) Laying, Installation is in the scope of contractor.

11. Installation after making of Suitable Pit and Earthing material as per standard (Sl.No.10 of BoQ)- BHEL will supply Earthing Material.

Solar array MMS structures, string inverters, data loggers, ACCB/ACDB boxes, LTPDB and lightning arrestors etc shall be provided with appropriate earthing for protection against faults as guided by **IEC 60364-4-41/60364-5-54 and IEC 61140.**
Earthing system shall be designed with consideration of the soil resistivity of the project site. Chemical earthing electrodes of 3m minimum long, 50 mm minimum diameter, perforated GI pipe, chemical compound filled, double walled shall be installed at the ground level outside the buildings. For each electrode, earth chamber shall be constructed using brick masonry.
The Earth chamber(tentative) shall have features as follows:

(a) Square sized with 300mm x 300mm minimum inner opening. Exact size shall be chosen to ensure ease of maintenance operation using spanners etc.

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(b) Brick wall thickness all around = 115 mm minimum
(c) Depth of chamber = 500 mm minimum below FGL.
(d) Projection of chamber above FGL = 150mm minimum
(e) Top of electrode shall have minimum clearance of 100 mm below cover plate.
(f) Cover plate, cast iron of 5mm minimum thickness, square shaped to fit the opening of chamber, painted with red oxide and two coatings of black paint both sides.
(g) Cover plate shall have suitable lifting hooks and padlocking arrangement.
(h) Both the outer and inner walls of the brick wall shall be plastered and painted as per relevant clauses of "General civil works" of this specification.
(i) installation of all materials shall be in contractor scope.

General points:

i. All items related to earthing viz electrodes, GI flats, hardware etc in BHEL scope of supply excluding concrete & civil work.
ii. GI bolts, nuts, plain washers shall be used. Spring washers shall be zinc/epoxy coated is in the scope of contractor.
iii. Wherever applicable, welding for GI flats shall be carried out using electric arc welding. Both the flats shall be overlapped for the full width where they are in perpendicular direction in same plane. Where the connection is along same line, both flats shall be overlapped for a minimum of 50mm. L-bend with weld length of 50mm minimum shall be adopted wherever overlap length to be ensured.
iv. Resistance of welded joint shall not be more than that of GI flat.
v. Welds shall be treated with red oxide for rust protection and then coated with bitumen compound for corrosion protection.
vi. While laying earthing electrodes, adding/mixing of chemical compound and water around the electrode in the dug hole shall be as per instructions of OEM. Contractor shall ensure visit of OEM engineer to site at the time of installation for proper guidance/ supervision.

12. Installation & commissioning of Isolation Transformer (BOQ No: - 11)

Supply of Isolation transformer is in BHEL scope.

Scope of Installation of Isolation Transformer includes making of suitable foundation, making all terminal connections on incomer and outgoing side. Supply of all accessories like lugs, cage for housing of transformer, nuts and bolts, etc. are in the scope of contractor.

13. <u>Commissioning and Performance Guarantee Test (Sl.No.12 of BoQ)</u>

Other Pre-commissioning inspections/checks/tests as per description given below:
Contractor shall organize all necessary tools/ measuring instruments required to operate the various electrical equipment at the time of commissioning: Digital megger 5KV with PI feature, Earth resistance tester, Phase sequence meter, Clamp meters etc, discharge rods, etc.

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Pre-commissioning inspections / checks / tests on DC side

Contractor shall carry out following minimum pre-commissioning checks:

a. Verification of firmness of SPV module interconnections (MC4)
b. Verification of firmness of DC cable terminations at string inverters using torque wrench (for the specified torque values)
c. Verification of firmness of RS485 cable terminations
d. Verification of firmness of all earthing connections
e. Cable megger/ continuity check for all DC power cables
f. Measurement of open circuit voltage of individual strings
g. Measurement of earth resistance at individual earth pits of solar array: (a) as disconnected from earth mat grid and also, (b) as connected to earth mat grid
h. Submission of test reports to BHEL for acceptance.

Pre-commissioning inspections/checks/tests on AC side.

i. Basic checks

1. Tightness checks:

- Terminations of AC power cables at string inverters, data loggers, ACCB box, LTPDB panels.
- Terminations of Control/ Instrumentation/ Data/ Communication cables wherever applicable.
- Terminations of earthing at all electrical equipment's/ panels. 4) Terminations of earth chambers of contractor scope

2. Electrical continuity checks
3. Megger (1kV) checks for all 1.1kV grade cables
4. AC/DC supply checks at TBs of all electrical panels/ DBs.

ii. Pre-commissioning electrical tests:

1. String inverters

- DC side open circuit voltage
- Contractor to provide technician support to service engineer of string inverters for all other pre-commissioning tests as per OEM checklist

2. Earth resistance measurements for all chambers of contractor scope

- With electrode connected to grid
- Without connecting electrode to grid
-

14. Supply and fixing of Danger Board & Name Plate (Sl.No.13 of BoQ)

The quantity mentioned in the BoQ shall be only to meet specific requirements of the Customer specification/Signage for Name plate. These will be generally of size 250x200 mm of steel material and of thickness 2 mm.

In addition to this, Contractor shall use danger boards, wherever required, to ensure safety of the persons during the work at site. For all other places where it is required to fix danger plates as per Good Engineering practice and as per Latest Electricity Act stipulations – the same shall be complied with.

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15. Additional Safety Arrangement for compliance of HSE/OHSAS requirement

This line item shall be applicable when working on RCC roofs above 4th floor (G+4 and above buildings) or on Tin Sheds above 5 Mtr. Height is required. All necessary items required for compliance of safety norms as per SCC Chapter VII of this Tender document (Part 3) will be arranged and deployed by the contractor at the erection site. The scope includes items such as Insulating mats, working platform for Tin shed/Tilted slopes, barricading on roof, safety nets, special PPEs, and all other items as required as per Chapter VII (Part 3).

It is also underlined here that for RCC roofs/Tin Sheds below the heights as mentioned above – all safety compliances as noted under SCC Chapter VII has to be mandatorily complied with. However, cost on this account is already built up within major heads of the BoQ.

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Part B Special Scope

1. **Cleaning System (BOQ Sl. No.: -14)**

Cleaning system shall be provided on each building for the regular cleaning of PV modules.

BHEL will supply motor pump set & required pipe line. Also, will provided a tap point in the vicinity of the building or on the roof, from which the water will withdrawn and use for the cleaning of modules.

The contractor's scope comprises the following: -

- making the foundation for installation (refer the s.no. 4(b) of BOQ) of motor pump set, Installation and commissioning of motor pump set.
- The contractor will lay the wire though conduit (provided by BHEL) to connect it with the allocated electricity point. And provided all the accessories in this regard.
- The contractor shall supply all the necessary accessories such as saddle, bend, tee, valve, nipples, nozzles, angle valve, ball valve, socket, tape, etc., for the piping work on the building free of cost.
- The contractor shall supply all installation hardware such as GI clamps/ screws/ bolts/ nuts/ plain washers/ spring washers etc., wherever applicable.
- The supply on contractor's part also includes the flexible pvc Hose pipes, heavy duty 15NB minimum, of required length on each building.
- All necessary labour, machinery, tools, instruments shall be in contractor scope.

2. **CANOPY (BOQ Sl. No.: -15)**

The Contractor will provide the canopy on the roof of each building to accommodate Inverter, ACDB, DCDB, data logger, SMU etc. The contractor's scope contains the following: -

- All the required material for the fabrication of the canopy such as steel structure, galvanized Colour coated sheet (minimum thickness 3 mm) etc., shall be part of contractor's scope of supply.
- The Contractor shall submit the drawing of canopy to BHEL for the approval before fabrication of the same.
- The contractor will fix the canopy at stated location on each building.
- The all required accessories and hardware shall be supplied by the contractor.

3. **FIRE EXTINGUISHERS (BOQ Sl. No.: -14)**

The firefighting system for the proposed power plant for fire protection shall be consisting of:

a) Portable fire extinguishers
b) Fire Buckets with stand.

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Fire extinguishers of required capacity & class and Fire Buckets with stand shall be supplied by BHEL.

The contractor's scope comprises installation of the same on all building including supply all the installation hardware such as clamp, anchor fastener nut bolt, etc.

4. Trial/ Reliability Run/Plant efficiency test for duration of min. 15 days or more.

In some cases – BHEL's contract with end user calls for trial/reliability run/plant efficiency test for specified duration. System output data is compiled for the duration on daily basis. In this duration – all performance parameter checks by customer/BHEL is also facilitated. Adequate manpower including experienced engineer, electrician and helpers are to be kept posted at site for continuous monitoring of system performance, data gathering, troubleshooting of any defect, shortcoming and responding to inspection team by closing the Punch Points.

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CHAPTER - X
PROGRESS OF WORK

The scope of the work will comprise of but not limited to the following:

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.13.0 Refer forms F -14 to F-18 of volume I D (Forms & Procedure) of volume –ID of Book-II. Plan and review will be done as per the formats.

1.13.1 The progress reports shall indicate the progress achieved against plan, Indicating reasons for delays, if any. The report shall also give remedial actions which the contractor intends to make good the slippage or lost time so that further works can proceed as per the original plan the slippages do not accumulate and affect the overall programme.

1.13.2 It is the responsibility of the contractor to provide all relevant information on a regular basis regarding erection progress, labour availability, equipment deployment, testing, etc with all necessary document.

1.13.3 During the course of erection, if the progress is found unsatisfactory, or if the target dates fixed from time to time for every milestone are to be advanced, or in the opinion of BHEL, if it is found that the skilled workmen like fitters, operators, technicians employed are not sufficient BHEL will induct required additional workmen to improve the progress and recover all charges incurred on this account including all expenses together with BHEL overheads from contractor's bills.

1.13.4 Contractor is required to draw mutually agreed monthly erection programs in consultation with BHEL well in advance. Contractor shall ensure achievement of agreed program and shall also timely arrange additional resources considered necessary at no extra cost to BHEL.

1.13.5 Progress review meetings will be held at site during which actual progress during the week vis-a-vis scheduled program shall be discussed for actions to be taken for achieving targets. Contractor shall also present the program for subsequent week. The contractor shall constantly update / revise his work program to meet the overall requirement. All quality problems shall also be discussed during above review meetings. Necessary preventive and corrective action shall be discussed and decided upon in such review meetings and shall be implemented by the contractor in time bound manner so as to eliminate the cause of nonconformities.

1.13.6 The contractor shall maintain a record in the format as prescribed by BHEL of all operations carried out. on each weld and maintain a record indicating the number of welds, the names of welders who welded the same, date and time of start and completion, preheat

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temperature, radiographic results, DP Result of each joint, rejection if any, percentage of rejection etc. and submit copies of the same to the BHEL Engineer as required.

1.13.7 The contractor shall submit daily, weekly and monthly progress reports, manpower reports, materials reports, consumables report, cranes availability report and other reports as per Performa considered necessary by the Engineer as per the BHEL formats.

1.13.9 The manpower reports shall clearly indicate the manpower deployed, category wise specifying also the activities in which they are engaged.

1.13.10 The monthly report shall be submitted at the end of every month as a booklet and shall contain the following details: -

a) Colour Progress photographs.
b) Site Organization chart of engineers & supervisors as on the last day of the month with further mobilization plan.
c) Safety implementation report in the format and the signed protocols.
d) Pending material and any other inputs required from BHEL for activities planned during the subsequent month.

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CHAPTER- XI
TESTING AND COMMISSIONING

THE SCOPE OF THE WORKS WILL COMPRISE OF BUT NOT LIMITED TO THE FOLLOWING:
(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.14.1 SCOPE OF PRE-COMMISSIONING / COMMISSIONING AND POST COMMISSIONING WORKS:

1.14.1.1 Scope of pre-commissioning / commissioning starts with the commissioning of various equipment erected by the contractor and making them available to commission various materials / systems and main power plant.

1.14.1.2 The contractor shall co-ordinate with BHEL and other contractor's during the main plant commissioning to ensure successful commissioning of total plant.

1.14.1.3 The pre-commissioning activities of the main power plant will start with energizing of startup power supply systems followed by trial run of solar power project 1.5 MW. Commissioning operations shall continue till trial operation of the unit. The contractor shall simultaneously start checking cables erected by him to match with the various milestone activities /commissioning programme of the project. All these works need specialized testing engineers, supervisors including electricians in each area to coordinate with BHEL Engineers and other agencies round the clock to match with commissioning schedule of unit. Contractor shall earmark separate manpower for various commissioning activities. The manpower shall not be disturbed or diverted for erection work.

1.14.1.4 The mobilization of testing team shall be planned in time and shall be undertaken round the clock. Contractor shall discuss on day to day / weekly / monthly basis the requirement of testing manpower, consumables, tools and tackles with BHEL engineer and arrange for the same. If at any time the requisite manpower, consumables, T & P are not arranged then BHEL shall make alternate arrangements and the cost will be recovered from contractor.

1.14.1.5 Prior to commissioning and after commissioning, protocols have to be made with BHEL / Customer. The formats will be given by BHEL and have to be printed by the contractor in adequate numbers. It shall be specifically noted that above personnel of the contractor may have to work round the clock along with BHEL commissioning engineers which may involve over time payment which forms part of Contractors Scope.

1.14.1.6 Any rework / rectification / modification is required to be done because of contractor's faulty erection, which is noticed during commissioning at any stage, the same has to be rectified by the contractor at his cost. During commissioning, any improvement rework / rectification / modification due to design improvement / requirement is involved, the same shall be carried out promptly and expeditiously. Claims if any, for such works from the contractor shall be governed by clauses covered elsewhere.

1.14.1.7 Minimum requirement of Man Power for testing/checking works shall be as follows: (Requirement given below is per unit):

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FOR SOALR POWER PROJECT:

	SOLAR POWER PROJECT
Engineer	---
Supervisor	1
Technician	2

The above testing / checking group shall be identified at the Pre-commissioning time. The above commissioning group shall have the knowledge of various systems referred in the tender and possess adequate experience in testing. The above manpower for commissioning is only tentative and if any additional manpower required as per site requirement, the same shall be arranged by the contractor. If the contractor fails to deploy the above Engineer / Supervisor / Technician at appropriate time of commissioning, no payment shall be made against commissioning activities as per terms of payment.

1.14.1.8 All testing activities shall be carried out as per relevant standard, code of practice, manufacturer's instructions and BHEL norms. The contractor shall follow the checklist of BHEL prior to taking up testing & commissioning activities and the activities shall be carried out in accordance with the checklist. All the above will be witnessed by BHEL engineer and the reports signed jointly.

1.14.1.9. All the tests at various stages shall be repeated till all the equipment satisfy the requirement of BHEL / Customer. Any rectifications required shall have to be done / redone by the contractor at his cost.

1.14.1.10 It shall be the responsibility of the contractor to provide various categories of workers in sufficient numbers along with Supervisors during pre-commissioning, commissioning and post commissioning of equipment and attending any problem in the equipment erected by the contractor till handing over. The contractor will provide necessary consumables, T&Ps, IMTEs etc., and any other assistance required during this period. Association of BHEL's / Client's staff during above period will not absolve contractor from above responsibilities.

1.14.1.11 The contractor shall carryout any other test as desired by BHEL Engineer on erected equipment covered under the scope of this contract during testing, pre-commissioning, commissioning, and operation, to demonstrate the completion of any part or whole work performed by the contractor

1.14.1.12 Contractor to provide necessary commissioning assistance from the pre-commissioning state onwards and up to the continuous operation of the unit & handing over to the customer. The category of personnel is to be as per site requirements and to meet the various pre-commissioning and commissioning programs made to achieve the schedule agreed with the customer.

1.14.1.13 During commissioning any improvement/repair/rework/rectification / fabrication / modification due to design improvement/requirement is involved, the same shall be carried out by the contractor promptly and expeditiously.

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1.14.1.14 The contractor shall carry out any other test not listed in the tender as desired by BHEL Engineer on erected equipment covered under the scope of this contract during testing, pre-commissioning, commissioning, and operation, to demonstrate the completion of any part or whole work performed by the contractor.

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CHAPTER- XII
DRAWINGS

Attached separately.

1. **2.5 MW SOLAR POWER PROJECT AT YADADRI SUPER THERMAL POWER STATION**

A. Layout for PV Module
B. Foundation layout for Module Mounting structure
C. Single line diagram for Solar Power System
D. Field Quality Plan
E. Test format and Check List.

(RAJESH BABU)
Engineer/FES

Signature and seal of Bidder