Bharat Heavy Electricals Ltd.,

(A Government of India undertaking)

Solar Business Division

Prof CNR Rao Circle, Opp. IISC, Malleswaram, Bangalore-560012, India

E-TENDER

Quotations are invited under two-part bid system (open tender) for Supply and Commissioning Support of Solar Compact Station (SCS) for 8 MWac Solar PV Farm at Tamarind Falls, Henrietta, Mauritius through e-procurement route.

The Tender shall be procured through e-procurement route. Kindly refer Website **https://eprocurebhel.co.in/nicgep/app/** for details.

RFQ NO and date	RAJBOS0075 dated 14.06.2021 (E-tender)
RFQ due date & time	25.06.2021 up to 13.00 hrs (IST)
Date, Time & Venue of Part-I Bid Opening	25.06.2021 after 13.30 hrs (IST) (E-tender) – Website - **https://eprocurebhel.co.in/nicgep/app/**
Date, Time & Venue of Price Bid opening	Will be intimated later for technically accepted vendors
Address for Communication & Contact Person in BHEL	Mr. Rajesh S (09845634534)/ Mr. Vivek Yadav (09449039232), Email: s.rajesh@bhel.in vivekyadav@bhel.in **Engineering Department**: Mr. PVV RAVI KISHORE (7676492191) BHEL SBD, Malleswaram, opp IISC Bangalore-560 012. INDIA

Note:

1) This is not a Global Tender. Latest GOI guidelines w.r.t Make in India, MSEs, Local Suppliers, Contracts valued less than Rs.200 Crore shall be applicable to this tender. Currency of tendering is INR. Any bidder from a country which shares a land border with India will be eligible to bid in this tender only if the bidder is registered with the Competent Authority.
2) Any Deviations from or additions to the "General Conditions of Contract" or "Special Conditions of Contract" require BHEL's express written consent. The General Terms of Business or Sale of the Bidder shall not apply to this tender.

Pre-Qualification Criteria for RFQ No. RAJBOS0075

BHEL-SBD is floating an open tender for Solar Compact Station (SCS) for 8MWac Solar PV Farm at Tamarind Falls, Mauritius. Quantity of items apart from spares, commissioning support is as follows:

Sl.No.	Item Description	Qty
1	Supply of SCS	4 Sets

Pre-Qualification Criteria (PQC) :

1. Vendor shall be an Original Equipment Manufacturer (OEM) of inverter or inverter transformer or MV switchgear. Vendor shall submit the product catalogue as an evidence.

2. SCS Country of origin shall be India. Vendor shall submit a declaration that the manufacturing works of the container (where the proposed inverter, inverter transformer and MV switchgear along with the associated LT Panels and other auxiliary equipment shall be assembled) shall be in India.

3. Vendor should have supplied and commissioned similar containerized or skid or outdoor integrated solution including PCU of minimum 500 kW rating, inverter transformer and MV switchgear of 6.6 kV & above rating to any Solar PV project. PO & Commissioning certificate of the integrated solution from customer or EPC company shall be submitted as evidence.

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Technical specification

for

Supply, installation and commissioning of

Solar Compact Station (SCS)

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INTRODUCTION:

This technical specification provides required details for supply of Solar Compact Station (SCS). The solar compact station (SCS) shall be of containerized type and shall enclose the low voltage DC-distribution, the inverter modules, the low voltage AC distribution, the medium voltage step up dry type transformers, the medium voltage switchgear, the control and monitoring system, auxiliary supply, ventilation system, back-up power supply. The scope also includes commissioning of the supplied units at the project site for synchronizing the generated ac power to 22kV grid on HV side.

The solar compact station container shall be protected against corrosion and shall be protected against the extreme weather conditions of Mauritius to ensure durability. Mauritius has a tropical oceanic climate with moderately high temperatures and humidity throughout the year. Rain occurs in all months but the wettest periods is from December to April. During these months tropical cyclones occasionally strike the island or pass near enough to give very heavy rainfall and violent damaging winds in the range of 270 -300km/h. Outside the main rainy season the weather is generally sunny and pleasant with slightly lower temperatures and a strong sea breeze.

The temperature ranges between 12^0C to 38^0C and a relative humidity above 95%. There is no history of seismic activity in the area.

1.0 Scope of supply

SL No	Item Description	Quantity
a)	Supply of SCS as per the SLD BHEL-CEB-ELE-001. Containerized Central inverter suitable for outdoor installation. DC Voltage Rating of up to 1500V Power output rating of each inverter: 1 MW Number of inverters in each SCS: 2 The name plate rating shall be the output rating at 50^oC Dry type inverter transformer: 2 MVA 22 kV MV Switchgear: 1 set The detailed specification of the complete requirement is given in Clause 4.0	4 Sets
b)	**Supply of Spares** for SCS. List of items with quantity is as follows: 1) Inverter modules Quantity = 25% of total installed capacity 2) Fuses Quantity = 50 nos. of each type and rating 3) DC Disconnect (Load Break Switch) of each rating – 20 Nos. 4) Surge Protection Device Quantity = 20 nos. of each type and rating	1 set

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	5) AC Circuit Breakers Quantity = 10 nos. of each type and rating 6) Dry type inverter transformer – 1 No., 7) Dry type Auxiliary transformer – 1 No., 8) LED light fittings complete with LED Driver - 10% of total installed quantity 9) Control Cards for Inverter Quantity = 1 set of each type **Notes:** **(a) The above spare quantities are the mandatory spares to be handed over to customer, over and above the warranty requirements.** **(b) Item-wise BOQ and break-up prices shall be provided in the offer. Wherever % indicated, total quantity used in main equipment to be specified by the vendor.** **(c) Control cards of inverter refers to all the electronics cards used in the inverter including main microprocessor cards, protection cards, I/O cards, gate driver cards and any other PCB used in the inverter not specifically indicated above.**	
c)	Commissioning support of SCS along with Training BHEL scope of activities at site for installation and commissioning: (1) Movement and positioning of SCS containers at the earmarked position on the outdoor RCC pedestals. (2) Connecting the incoming (DC side) and outgoing (AC side) cables of RMUs shall be done by BHEL. This DC cable and AC cable at the RMU outgoing shall be BHEL supply. The cable lugs, glands and termination kits for the DC cable and AC cable shall be provided by vendor. Vendor scope of activities at site for commissioning: (1) Connecting at the respective termination ends (as required) of the inverters (AC side), transformers, RMU panels using the cable/bus bar, cable glands and fastening hardware (nuts, bolts, washers etc.,) provided by the vendor. (2) All the electrical checks that are required to confirm that solar DC parameters (current, voltage) are available at the DC input side of inverters. (3) Service engineers shall be present at site during installation and commissioning of SCS, providing all necessary guidance and support to achieve successful synchronization of inverter output with grid and also to trouble-shoot / resolve the technical problems associated with SCS. MV	4 AU

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	switchgear testing shall include but not limited to those detailed in IEC 62271-200 Clause 7. Commissioning / Service Engineer shall be from OEM/ OEM authorized partners. (4) Installation and commissioning support to BHEL team for commissioning of SCADA & PPC, in respect of connection of communication cables to SCS and technical problems related to receiving data signals at SCADA station from SCS. (5) Training: Vendor shall provide training at site to BHEL and customer's engineers during commissioning. Training shall cover various technical aspects such as functional/ operational features, trouble-shooting procedures, maintenance schedules, requirements, safety, emergency precautions etc. Both the theory and practical (hands on) training shall be covered. Training on inverter programming and troubleshooting, transformer & 22 kV switchgear testing and commissioning, safety measures at the manufacturer's work place shall be provided to three (3) customer's technical staffs. The training shall include classroom lectures and hands-on training. Note: Supply and installation of integrated SCADA system for the overall power plant is within BHEL scope. The lump-sum price shall include all the costs that will be incurred by the vendor towards commissioning including travel, boarding, lodging and any other contingency expenses.	

2.0 Warranty

Any defects reported during the warranty period shall be remedied by the vendor within an agreed time frame between both parties. Vendor scope includes any visit of their service representative as required, for repair/replacement of failed items and re-commissioning of the SCS equipment. Vendor shall set-up or make provision of after sales service and required spare parts for this project. Warranty support also includes software upgradations, as required and statutory compliances.

3.0 Technical Documents to be submitted along with offer

1. Vendor shall provide nil deviation letter as a confirmation to BHEL specification.

In case of any clarifications needed in this specification, the same needs to be communicated in writing at least five days earlier to the technical bid opening date.

2. Product datasheet of the offered inverter, transformer, RMU.
3. Overall General Arrangement of inverter, transformer, RMU & all other SCS equipment indicating dimensions, weight and cable cut outs/termination arrangement.
4. Itemized list of spares offered (with quantity) and without prices as per Cl. 1.2.

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5. Type test certificates of inverter and RMU complying with clause 4.1.1-b and clause 6.0 a 6 respectively of this specification. Supporting test reports shall be provided by vendor during detailed engineering.

4.0 Technical specification of SCS:

SCS can be designed and assembled in maximum two containers. The solar compact station shall have a lifetime of at least 20 years.
Solar compact station of containerized type shall be designed with an internal cooling system for each compartment to ensure nominal output power up to at least 50 °C ambient temperature. The solar station container shall be insulated with fireproof material to maintain waterproofness over time and efficient thermal insulation. The proposed station shall be supported by HVAC design calculation to be approved by BHEL.

Moreover, the solar station container shall have easy accesses to each compartment for ease of installation, maintenance and for retrieval of equipment.

4.1 Inverter:

The technical specifications for the inverter include:

#	Technical parameter	Specification
a)	Control Type	Voltage source, microprocessor assisted, output regulation
b)	Output power rating	As per Cl. 1.1. Vendor to specify ratings being offered.
c)	AC grid connection	3-phase
d)	Output frequency	50 Hz
e)	Nominal output voltage	Value to be indicated by vendor
f)	Maximum DC input voltage (Max open circuit PV voltage)	At most 1500 V DC
g)	MPPT Range of control system	Range to be indicated by vendor.
h)	Total Harmonic Distortion (THD)	less than 4% at maximum power output
i)	Operating temperature range	5 to 60 deg C.
j)	Inverter efficiency	minimum 98.6 % at full load
k)	DC side peak power	Vendor shall confirm that inverter is suitable for overloading of DC input power. Vendor to indicate the

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		value in %. Minimum requirement is 30%
l)	Compatibility to Power Plant Controller (PPC)	Inverter shall have the necessary provisions (including any additional hardware/software required) for connection to a Power Plant Controller which shall be able to monitor and control the inverter remotely (both digital and analog inverter parameters)
m)	Max DC operating current	Value to be indicated by vendor.
n)	Max AC output current	Value to be indicated by vendor corresponding to the rated output power of the inverter.
o)	Grid Operating Characteristics	As per Annexure-1

4.1.1 Basic requirements (Inverter type, Standards, Technology, Interconnections, Interfaces etc)

#	Parameter	BHEL specification
a)	Inverter type	Grid-interactive. Inverter shall be able to wake-up in the morning and shutdown in the night automatically. The power circuits of the inverter shall be separated from the control circuits. The internal copper wiring of the inverter shall have flame resistant insulation. All conductors shall be made of copper. The inverter shall go to shut down/standby mode, with its contacts open, under the following conditions before attempting an automatic restart after an appropriate time delay: □ Insufficient Solar Power Input When the power available from the PV array is insufficient to supply the losses of the inverter, the inverter shall go to a standby/shutdown mode. □ Situation of Over or Under Voltage on CEB Grid The inverter shall restart after an over or under voltage shutdown when the utility grid voltage has returned within its limits after a minimum time delay of three (3) minutes. □ Situation of Over or Under Frequency on CEB Grid The inverter shall restart after an over or under frequency shutdown when the utility grid frequency has restored within limits after a minimum time delay of three (3) minutes. □ Power factor

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		The solar farm shall be designed with the capability to supply rated power (MW) for power factors ranging between 0.95 lagging and 0.95 leading, available from 20% of rated power measured at Henrietta Substation. When operating below 20% of the rated output, the power factor may be less than 0.95 lagging. Vendor shall provide a comprehensive statement on the overall power factor control strategy for the entire solar farm from inverter output to MV system to substation delivery both during day and night time. The power delivered to the grid must at all times meet the interconnection requirements for power factor both during day and night time. A capability curve is required to illustrate the power factor control strategy.
b)	The proposed inverter shall have to comply with the following set of standards:	

Sl.	Standard	Description
1	EN 50524	Data Sheet and Name Plate for Photovoltaic Inverters
2	IEC 61000-3-2	Limits - Limits for harmonic current emissions (equipment input current up to and including 16 A per phase)
3	IEC 61000-3-3	Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection
4	IEC 61000-3-7	Assessment of emission limits for the connection of the connection of fluctuating installations to MV, HV and EHV power systems.
5	EN 61000-6-1,3	Electromagnetic Compatibility (EMC).
6	IEC 61683	Photovoltaic systems - Power conditioners – Procedure for measuring efficiency
7	IEC 62109	Safety of power converters for use in photovoltaic power systems
8	IEEE 519 -2014	IEEE Recommended practice and requirements for harmonic control of electric power systems, Institute of Electrical and Electronic Engineers, March 2014

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	The Power Conditioners deployed in the power plants must have valid test certificates for their certification as per above specified IEC / EN standards by ILAC accredited laboratories or one of the NABL Accredited Certification Centers. Where an applicable IEC/EN standard is not available, any equivalent IEC/EN standard shall be submitted. All the type test certificates as per the standards mentioned above shall be submitted for approval.	
c)	Maximum Power Point Tracking (MPPT)	MPPT shall be integrated in the power conditioning unit to maximize energy drawn from the solar PV array. The MPPT should be microprocessor based to minimize power losses. The details of working mechanism of MPPT shall be provided by the Manufacturer.
d)	Thermal management	Vendor shall submit HVAC calculations during detailed engineering.
e)	Environment protection	All PCB cards shall be provided with suitable coating (epoxy etc) for protection considering site conditions.

4.1.2 Protection systems

a)	Protection systems for current, voltage, temperature, surges, ground faults, fan failure etc. Fault indication shall be communicated to SCADA system	Overload Protection
b)		Over- Under Frequency
c)		Over- Under Voltage
d)		Loss of Main Protection
e)		Insulation Monitoring
f)		Full protection against accidental open circuit and reverse polarity at the input shall be provided.
g)		Anti-islanding protection: Fool proof protection against islanding.
h)		AC & DC over current
i)		AC & DC short circuit
j)		Array Ground fault detection
k)		SPD-based overvoltage protection on both DC and AC sides. SPD shall consist of MOV type arrestors. It shall have thermal disconnectors to interrupt surge current arising from internal / external faults. The surge protective device shall be suitable for the PV system in accordance with IEC 60364. The type, the discharge current and the impulse current of the surge protective device for the DC system shall be designed by the vendor and shall be submitted to the Employer for approval. The surge protective device shall feature a

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		local visual status indication and shall incorporate remote contact signalling to indicate normal operating state.
l)		Grid monitoring Protection against any sustained fault (lightning effect etc) in grid / feeder line.
m)		The inverter shall include appropriate self-protective and self-diagnostic features to protect itself and the PV array from damage in the event of inverter component failure or from parameters beyond the inverter's safe operating range due to internal or external causes. The self-protective features shall not allow signals from the inverter front panel to cause the inverter to be operated in a manner which may be unsafe or damaging. Faults due to malfunctioning within the inverter, including commutation failure, shall be cleared by the inverter protective devices and not by the existing site utility grid service circuit breaker.

Disconnection, Islanding and Automatic Reconnection after the Grid Failure Is Restored

Disconnection of the PV generator in the event of loss of the main grid supply is to be achieved by in built protection within the inverter. This may be achieved through rate of change of current, frequency, phase angle, unbalanced voltage or reactive load variants.
Operation outside the limits of power quality as described in Annexure-1 should cause the inverter to disconnect from the grid. In case of the above, tripping time should be less than 0.5 seconds, unless otherwise requested by the Employer.
Inverters shall have the ability to reconnect automatically to the grid following restoration of grid supply, subsequent to grid failure condition within a minimum time delay of three (3) minutes.

4.1.3 DC, AC side load break disconnecting switch / breaker provisions

a)	DC side	Load Break Switch Disconnector shall comply with IEC 60947. The terminals of the DC switch disconnector shall be shrouded against accidental contacts. The contacts of the DC switch disconnector shall be visible. Alternatively, positively linked externally visible indication for the "on", "off" may be provided subject to approval of the Employer. In addition, the "on" and "off" position of the switch disconnector shall be made available to the local SCADA system.
b)	AC side	Inverter output side shall be fitted with air circuit breaker with the following specifications: **Air Circuit Breaker:**

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		The air circuit-breaker shall be constructed and tested in accordance with IEC 60947. The air circuit-breaker shall have a rated service voltage of 690 Vac and a rated insulation voltage of 1000 V. The rated uninterrupted current and the rated short-time withstand current (1 sec) of the air circuit breaker shall be defined by the vendor based on the design of the system**.** The air circuit breaker shall be in withdrawable version. For withdrawable version, the position (connected, test, isolated) of the moving part shall be clearly indicated. It shall be impossible to rack-out the air circuit breaker unless the contacts are open. The withdrawable version shall be padlockable in "test position" and in "isolated position". The fixed version shall also be padlockable in open position. The following accessories shall be available for the air circuit breaker: □ Shunt opening/closing release □ Second shunt opening and second shunt closing release for redundancy □ Geared motor for the automatic charging of the closing springs, with limited inrush power □ Mechanical and electrical signalling of overcurrent release trip □ Trip reset release □ Auxiliary contacts (status, connected/test/disconnected position, ready to close, spring charged), pre-wired, to a small wiring terminal block. The Auxiliary contacts shall be used to provide status on the local SCADA system. The shunt devices and geared motor shall be suitable for 110 Vdc. Interlock system among circuit-breakers shall be available. The air circuit breaker shall be equipped with electronic trip release. The protection ANSI 49, ANSI 51, ANSI 50 and ANSI 51N shall be provided and adjustable. A watchdog shall be available. The configuration of the unit shall be password protected. The electronic trip release shall also be able to export information, including indication of tripped protection after a fault, alarms and warnings among others, and receive command through the local communication bus.

4.1.4 Front panel display and control

a)	Front panel screen (LCD and piezoelectric keypad operator interface Menu driven) with browsing / navigation provisions to 1) select display parameters 2) provide settings for various parameters	Instantaneous DC power input DC input voltage Total DC Current
b)		Instantaneous active AC power output Instantaneous reactive AC power output AC voltage (all the 3 phases and line) AC current (all the 3 phases and line) Frequency Power Factor

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		Energy (kWh) produced during entire day Total Energy (kWh) produced during its life
c)		Faults
d)		Other event logs
e)		Other features as may be necessary for supervisory control and operation of the inverters shall be provided.
f)		Automatic fault conditions reset for all parameters like voltage, frequency and/or black out.
g)		Each of these measurement displays shall have an accuracy of 1 percent of full scale or better. The display shall be visible from outside the inverter enclosure. Operational status of the inverter, alarms, trouble indicators and AC and the DC disconnect switch positions shall also be communicated by appropriate messages or indicator lights on the front cover of the inverter enclosure and SCADA. The parameters of the inverter shall be configurable via the communication bus on the local SCADA system.

4.1.5 Data logging, storage, retrieval, downloading, uploading

a)	Provision of built-in systems for data logging, storage, retrieval, downloading, uploading etc.	Date-cum-time stamped logging of DC and AC side parameters (current, voltage, frequency, phase, power factor, power, export energy etc), faults and other events.
b)		Data storage with retrieval features.
c)		Provision of all necessary built-in systems, ports etc for downloading the data into a PC / Laptop etc that will be required for reporting, data analysis and trouble-shooting purposes.
d)		Provision of all necessary built-in systems, ports etc for uploading of software etc that will be required for replacing, revising, upgrading the system.

4.1.6 DC Inputs and termination details.

Vendor shall supply the inverter with the termination features on DC side as tabulated below. Detailed drawings of termination arrangements with bus bar particulars such as positions, dimensions, hole sizes, spacing between holes, support to bus bar, etc shall be submitted for BHEL approval.

a)	DC input terminals	Each SMB output: ~160 kW Total no. of DC inputs shall be designed to be suitable for

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		a) SMB kW mentioned above (which includes 30% DC Overload) + 1 no. spare input b) Vendor to indicate the no. of DC inputs provided for each inverter to meet the requirement as per (a) above in offer.
b)	Fuses on DC input side	The fuse and fuse holder shall be in compliance with IEC 60947-3. Each SMB input shall be protected by a properly sized fuse with the gPV time current characteristics. The rated current and breaking capacity of the fuse shall be defined by the vendor in line with the design of the system. Fuse rating shall be finalized during detailed engineering.
c)	DC cable entry into panel	Bottom entry. Cable supply is within BHEL scope. Upto 1Cx240 sq-mm Copper, multi-strand, Armoured, XLPE insulation, PVC sheath cable will be used for each DC input. Exact type & size shall be provided during detailed engg. DC termination shall be suitable for the above cable.
d)	Gland plates	Drilled Gland plates shall be provided with holes to accommodate the cable glands.
e)	Cable glands	Nickel plated brass, double compression type cable glands of reputed make (Make: Comet or any other reputed make) shall be provided by the vendor. To enable right selection of glands, final cable O.D will be provided by BHEL at the time of manufacturing. Approval of make and type/size shall be taken from BHEL before procurement of glands. Part no. and qty shall be indicated in the BOM. Inverters shall be supplied with all the glands fixed on the gland plates.
f)	Cable lugs, plain washers, spring washers, bolts and nuts	Similarly, cable lugs, bolts, nuts & plain washers, Zinc coated spring washers shall be provided by the vendor. Make for lugs: Dowells or any other reputed make with CE/VDE/UL/CSA/BIS. Approval of make and type/size shall be taken from BHEL before procurement of lugs. Part no. and qty shall be indicated in the BOM. Inverters shall be supplied with all these items fixed on