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Technical specification for Design and Supply of Complete Floatation Platform and Accessories with Mooring and Anchoring of the Platform at 22 MW Grid Connected Floating Solar Photovoltaic Power Plant at RAJIV GANDHI COMBINED CYCLE POWER PROJECT KAYAMKULAM IN KERALA.

Revision details :R 00	Prepared	Approved	Date
	NY	PM	26.12.2019

1.0 Introduction:

Bharat Heavy Electricals Limited (BHEL), Electronics Division, Bangalore is setting up a 22MW Grid Connected Floating Solar Photovoltaic Power Plant at RAJIV GANDHI COMBINED CYCLE POWER PROJECT KAYAMKULAM IN KERALA.

Water Body available is 170 acres. (Kayal) inside plant premises.

Project Location and approach :

22 MW Floating Solar PV Plant shall be setup at Rajiv Gandhi Combined Cycle Power Project, Kayamkulam (RGCCPP) (http://www.ntpc.co.in/powergeneration/gas-based-power-stations/jkayamkulam).

District	Allappuzha, Kerala
Nearest Highway	NH-47
Nearest Railway Station	Cheppad (5 km)
Nearest Commercial Airport	Cochin (120 KMs)

2.0 SCOPE:

The scope of this tender includes the design and supply of complete Floatation platform along with accessories and Mooring and anchoring scope. The I&C of Anchoring/Mooring is also a part of the vendor scope.

Vendor has to supply floats and Float accessories to fix 95460 nos of PV Modules.
The PV modules shall have dimensions of (1960mm in length with variation of 40mm) x (992 mm in width with variation of 20mm) approximately and weighing 23 kgs approximately. The final PV Module drawing will be issued with the Purchase Order. Lighting arrester & SCB platforms shall be an integral part of overall floating platform and the dynamics of these items also to be considered in overall design. BHEL reserves

the right to place the order with a quantity variation of +/- 10% with respect to PV modules. These PV-Modules have to be mounted at 5 deg fixed angle.
** In case the bidder proposes to use a floater design for higher angle, he may propose the same to BHEL for approval. However for higher angle also the bidder has to supply floats and Floats accessories to fix 95460 nos of PV Modules only.

Warranty for Floating system: Each Floater unit used in the plant must be warranted against crack, puncture, breakage etc for which bidder shall assure for integrity of the whole system for 25 years from date of successful completion of trial run. The thermoplastic fasteners, if used also has to be warranted against its sequential failure. Vendor has to provide 10 years warranty for his Supply BOQ and I&C of Anchoring /Mooring. In addition to above Vendor has to provide the complete installation manual for the I&C of their floatation system and the O&M requirements of this floatation system.

3.0 Pre Qualification Criteria :

As per Annexure 1.

4.0 Pre Bid Meeting/Clarifications:

All technical clarifications w.r.t tender to be mailed to the following email ids.
punammishra@bhel.in
vipindas.cp@bhel.in
sreenath@bhel.in
yaswanth@bhel.in

Alternatively, vendor can request for a pre bid meeting or Video conferencing with BHEL.

5.0 Site Visit:

Vendor has to necessarily visit the site before quoting. Vendor to give request to BHEL through email for arranging Site Visit. Vendor to fill the form at Annexure-3 after completing Site Visit and this document shall be a part of technical bid.

6.0 Mandatory documents to be submitted with the Technical Bid.

a.) Declaration for accommodating Required no of PV-Modules in the kayal. Vendor has to give a clear declaration that he can mount the required no of PV-Modules in the kayal water body. This declaration to be accompanied by the indicative Array layout from the vendor populating it with his own Pontoons employing his scheme and meeting NTPC requirements. In case of additional water surface requirements, same to be indicated in the technical Bid clearly. A schematic Array layout is made and attached for better understanding.

b.) Month wise manufacturing capacity of the HDPE Pontoons.
Vendor to submit his manufacturing capacity details along with details like address of manufacturer, details of enhancement of capacity if possible.

7.0 Vendor scope:

#	Item description	Qty	Remarks	Delivery Time
1	Design of Complete Floatation System along with Anchoring and Mooring details. This design has to be approved by BHEL and End Customer-NTPC. Lighting arrester (LA) platform, String Combiner Box (SCB) Platform shall be an integral part of overall floating platform and the	1 Set	As per specification .	The preliminary design has to be submitted within 10 days of PO Placement.

	dynamics of LA & SCB shall be considered in overall design.			
2	MQP and QAP of the Floats to be submitted to BHEL/NTPC for Approval.			
3	Vendor to execute demo I&C of minimum 50 kWp (1 set) of floaters with PV modules. This I&C shall be carried out such that PV system I&C vendor of BHEL shall be duly trained and skilled in the execution of the balance flotation platform. Vendor to provide supervision only for the Entire balance I&C of Floating Platform.(I&C of Entire Balance Floating Platform shall be done by BHEL BOS Vendor.)	1 Set		
4	Array layout, shadow analysis of the Floating platform along with PV Modules populated. Vendor to indicate the shadow loss due to his proposed Array placement.	1 Set	As per specification .	Within 10 days of PO Placement.
5	Supply of the Entire BOQ as per approved design in Sl.No -1.	1 Set		
6	Supply of Floats to Mount 18 LAs (Lightning Arrestor)-Wt of each LA shall be 50 kgs and pole height approx. 5 metres.	1 Set		

	Supply of floats to mount 80 SCBs. More details will be shared during detailed engineering.			
7	I & C of Mooring and Anchoring system only as approved in Sl. No -1.	1 Set		
8	O&M Manual for the floatation system.			
9	Provision of Walkways and Cable gangways.			
10	Spares		.05% of each type of floats.	
11	AMC	10 years		

Any other scope which is not a part of the above list, but is required for the successful operation of the Floating Platform to be specified by the vendor clearly and cost to be included in the price bid.

8.0 Annexures to this document:

1. Pre Qualification Criteria

2.Drawing and Photographs of the Reservoir.
3. Site Visit declaration certificate.
4. NTPC Vendor Approval form.
5. Water test report of the kayal.
6. Bathymetry report of the kayal area.

**As the vendor needs to design the complete floatation platform, hence apart from the information already furnished by BHEL, the vendor has to provide the checklist of the documents required from BHEL to design the floating platform along with anchoring and mooring. This list to be a part of Technical document.

The vendor shall provide support by way of providing supervision and monitoring during the course of erection of the balance floater platform other than the initial 50 KW to ensure completeness and to make to the system intact.

9.0 BHEL Scope:

a.) Supply of PV-Modules.
b.) Unloading of Floating Pontoons/Floater at Site in Stores Area.
c.) Storage and Security of items –supplied by Floatation vendor.
d.) **I&C of Floatation platform only.
e.) Soil Investigation report of the Kayal Area will be provided to vendor along with purchase order.
f.) Bathymetry report of the kayal area.

**Scope of Erection: Training shall be imparted to BHEL's I&C vendor to carry out fitting and deployment of floaters in water and for mounting of PV-Modules on the floaters to complete the floating PV-Array. Vendor to execute demo I&C of minimum 50 kWp (1 set) of floaters with PV modules.

Exception:
Installation of Mooring mechanism and anchoring system for the floating platform shall be in bidder's scope.

GENERAL
The Floating system comprises of the Floating unit, Module support structure (if applicable) and anchoring/ mooring mechanism for the Floating Solar PV system (FSPV).

10.0 CODES AND STANDARDS

The floatation system must conform to the latest edition of any of the following IEC/ equivalent standards for floating system design qualification and type approval. The reports, verified by third party NABL national or international accredited agency shall be submitted for approval by BHEL/NTPC.

CODES	Description
ASTM D1693 ,(or equivalent ISO standards)	Test for Environmental Stress Cracking of HDPE
ASTM D790, ISO 178	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics & Electrical Insulating Materials
ASTM D638, ISO 527	Standard Test Method for Tensile Properties of Plastics
ISO16770	Full Notch Creep Test (FNCT).
ASTM D2565, ISO 4892-2	Standard Practice for Xenon-Arc Exposure of Plastic intended for outdoor Applications
ASTM D4329,ISO 4892-3	Standard Practice for fluorescent ultraviolet (UV) lamp apparatus exposure of plastics

ASTM D1693-15 (or equivalent ISO Standards)	Standard Test Method for Environmental stress cracking of Ethylene plastics
RoHS directive 2002/ 95/EC	Test for Restriction of Hazardous Substances

**** Vendor to provide latest copies of all the above mentioned Codes.**

FLOATING UNIT

Floating unit, all accessories and anchoring system shall be designed for base wind speed of 140 km/hr. The entire system shall be designed to withstand dynamic conditions as per IS 875-3.

The depth of water in the lagoon is approximately 2 meters with a water level variation of 1 meter. Bidder to ascertain the same after studying the bathymetric survey report provided by BHEL.

The floatation units of module shall be modular and easily connected to each other. Once completely connected, the floating platform must be able to support the weight of PV module, module support structure, cables, support railing (if applicable) etc. The floater system shall also be able to support the load of O&M personnel, equipments such as String Combiner Box (SCB), weather monitoring station and lighting arrestor etc. Details of all above equipments shall be provided by BHEL in annexures.

TECHNICAL REQUIREMENTS OF FLOATING UNIT

The floating units shall be standardized and designed for simple onsite installation.

a. The floating units shall be prefabricated and modular in design with appropriate buoyancy to support the weight of at least one solar panel/equipment and one person (with minimum weight of 80 kg) per unit.

b. The floating unit design shall facilitate ease of assembly /disassembling, replacement of any module and enable future expansion or scaling.

c. The floatation unit should be manufactured from appropriate thermoplastic (virgin material) with UV stabilizer such that the life of floatation device shall be able to sustain for a period of 25 years.

d.) The material used in manufacturing shall withstand Environmental Stress Crack Resistance (ESCR) and have a combination of hardness and impact strength (ASTM D5397, ASTM D1693).

e.) The material used for floatation device shall be chemically resistant to acid, lye, petrol and mineral oil and also partially resistant to benzene and non-detrimental to marine life. The water test report for the area is enclosed at Annexure -5

f.) In order to increase longevity and prevent unexpected loss of buoyancy, the floating unit shall have an average material thickness of 3 mm, with moisture retention of less than 5%. (Detailed buoyancy calculation to be submitted along with drawings at the time of drawing approval).

g.) The floating unit material shall be designed to balance the thermal expansion so that PV Panel are not stretched due to effect of thermal expansion.

h.) The complete floating system shall have at least 400 mm floating corridor along the periphery comprising of module floaters and/ or walkway floater to prevent water splash.

i.) The design of the floating system shall incorporate appropriately sized walking platforms for regular maintenance and inspection. The walking platform shall be continuous with minimum width of 400 mm, excluding cable-laying arrangement, for easily accessing all modules in the array layout.

j.) The walkway platform shall be placed in such a way that each module in the array layout can be easily accessed through the continuous walking platform without any additional infrastructure.

k.) Bidder to take into consideration load of all electrical equipments and accessories during the design of floatation platform. Details of Electrical equipments and accessories are as provided by BHEL in annexures.

l.) Floating system should be designed to withstand the maximum wind speed of the location.

m.) The floating units once assembled together should form an integrated structure. The relative alignment of the floating unit subsequent to complete installation shall not misalign the solar panels.
n.) The floating units shall be re-process able and recyclable at the end of its useful life.
o.) The design life of the floating units should be 25 years.
p.) Vendor to indicate the Mandatory spares as required for his designed plant life.

MODULE SUPPORT STRUCTURE (IF APPLICABLE)

a.) The module support structure (MSS) shall be so as to allow easy replacement of any module by authorized personnel.
b.) The MSS and associated hardwares / fasteners, if used are metallic in nature, shall be non-corrosive and suitable for coastal weather conditions. The structures shall be made of anodised aluminium. All fasteners, nuts, bolts and other hardware shall be of Stainless steel – 304 or higher grade.
c.) MSS shall be designed to withstand the extreme weather conditions in the area.
d.) The modules shall be mounted at a fixed tilt of five degrees.
e.) PV fixation system shall be of proven design and subjected to Mechanical test to withstand unit failure conditions under static and fatigue conditions for wind speeds up to 200 km/hr. The results conforming to above test shall be submitted to NTPC on request.
f.) The design philosophy and the calculations for the MSS with suitable test reports shall be submitted for NTPC's approval.

Anchoring and mooring system

a.) The design life of the Anchoring system shall be 25 years.
b.) Placement of plant: The floating solar PV (FSPV) power plant should be at a distance of 4 meters from the edge of the land surface. However, the exact positioning can be finalized at the time of detailed engineering, after conducting bathymetric study.
c.) Prevailing wind load: The floating system comprising of floating unit, PV fixation system and associated anchoring system shall be designed as per base wind speed of 140 km/hr and able to withstand dynamic conditions as per IS 875-3.

d.) The design of the mooring system shall permit minimal lateral movement of the plant in case of maximum wind loads (as per IS 875-3). Anchoring design report for the project showing that the system could support the maximum wind load on site shall be submitted to NTPC.

e.) Water variability: The mooring system should accommodate any fluctuations in water level. Further the orientation of the plant needs to be maintained; hence any fluctuations in water level shall allow minimal movement of the FSPV plant as per mooring system design.

f.) The materials used in the anchoring system shall not contaminate the water and affect the aquatic ecosystem.

g.) Dedicated floating approach walk way to be provided from the end of the reservoir/ land surface to the plant, for each block in the floating system. The block size of the floating system depends on the array layout optimization. The same shall be finalized during detailed engineering.

h.) The design of complete system, including CFD modelling, comprising of Floating unit, MSS and anchoring system, shall be verified by suitable third party NABL accredited agency/ reputed institutions like IITs and submitted for NTPC's approval.

Detailed structural and stability calculations shall be submitted for BHEL/NTPC approval.

Bidder may also carry out all required surveys for the proposed site based (if feel necessary) on its own discretion and submit for BHEL/NTPC approval. However, the time taken to conduct the fresh surveys shall not be considered in project completion schedule.

Vendor has to necessarily visit the site to acquaint himself with the requirements of anchoring and mooring. BHEL shall not entertain any issue related to anchoring and mooring after PO Placement.

11.0 Test reports :

Vendor to submit the MQP and FQP of the Floatation platform and mooring and anchoring system. The MQP and FQP to essentially take care of all the criteria as listed in the technical requirements of this tender document.

12.0 Marking and Packing instructions :

Vendor to provide marking and packing instructions of the Approved BOQ.

13.0 Delivery Schedule:

As per specified in the RFQ document.

14.0 AMC:

Vendor has to furnish AMC for 10 years from the date of successful installation of the floating platform. This AMC to include the following:

1. Attending to and resolving any breakdown/fault of the floatation platform.
2. Mandatory 1 visit every quarter (once in three months) for the first 3 years to assess the floating platform for any failure or any sign which may lead to subsequent failure. Vendor to send the assessment report to BHEL through email.
3. 1 visit annually from fourth year till the end of tenth year.

Vendor to clearly indicate the O&M requirements of floating solar platform.
In case of O&M requirements the vendor to provide the O&M manual to BHEL.

Annexure 1

Appendix for Provenness Criteria of Solar PV Floaters

It is declared that the bidder/ Subcontractor……. is a manufacturer of Solar PV Floater system and have supplied for a total capacity of 100 kWp.

(I)	Whether bidder/ Subcontractor is a manufacturer of Solar PV Floater system and have supplied for a total capacity of **100 kWp**. The supplied floating system should have been successfully commissioned	**(Yes / No)**
(II)	Whether the bidder/ Subcontractor's offered system have been in **successful operation**	**(Yes / No)**
(III)	Details of the reference plant	
(IV)	Contact details of Project Owner/Beneficiary	**Phone:** **Email:**

NAME OF THE BIDDER/SUB-CONTRACTOR

Sl No	PROJECT LOCATION, CAPACITY, NAME OF CLIENT	DATE OF AWARD	DETAIL OF SYSTEM	CAPACITY OF PLANT WITH SOLAR FLOATER PV SYSTEM	DATE OF COMMISSIONING OF THE PROJECT

NOTES:-

1. THE DETAILS SHOWN IN DRAWING ARE TENTATIVE AND FOR TENDER PURPOSE ONLY.
2. THE AREA DEMARCATION ARE TENTATIVE AND ARE SUBJECT TO CHANGE DURING EXECUTION.
3. ONE WATER SOURCE WILL BE PROVIDED AT H- TYPE BUILDING FOR MODULE WASHING SYSTEM.

FOR TENDER PURPOSE ONLY

NTPC Limited
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: DEVELOPMENT OF 22MW FLOATING SOLAR AT RGCCPP KAYAMKULAM

TITLE: VICINITY MAP

REV.NO	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ES	APPD	DATE
A	TENDER DRAWING	RAVI	LDB	ASK							19.06.18

CLEARED BY

SIZE	SCALE	DRG. NO.	REV. NO.
A1		5742-004-POC-A-001	A

This drawing and the design it covers are the property of NTPC Limited and must not be copied, loaned or exhibited either in part or in whole without written permission. Any contravention is liable for prosecution.

ANNEXURE-III

Ref.
Date:

SITE INSPECTION CERTIFICATE

This is to Certify that, I / We…….

……. had inspected the proposed

construction site thoroughly and understood the scope of works to be carried out in

line with construction drawings/designs/data/Bill of quantities/schedule of items /

specifications as brought out in the Tender as desired by BHEL and as will be required during site execution.

Agreeable to all Terms & Conditions of Contract and assure to complete the work

within the stipulation time frame. BHEL shall not be responsible be any difficulties arising during site execution.

Signature of the contractor

Name:
Seal

CORPORATE QUALITY ASSURANCE
SUB-VENDOR QUESTIONNAIRE

i.	*Item/Scope of Sub-contracting*			
ii.	*Address of the registered office*	*Details of Contact Person (Name, Designation, Mobile, Email)*		
iii.	*Name and Address of the proposed Sub-vendor's works where item is being manufactured*	*Details of Contact Person: (Name, Designation, Mobile, Email)*		
iv.	*Annual Production Capacity for proposed item/scope of sub-contracting*			
v.	*Annual production for last 3 years for proposed item/scope of sub-contracting*			
vi.	***Details of proposed works***			
1.	*Year of establishment of present works*			
2.	*Year of commencement of manufacturing at above works*			
3.	*Details of change in Works address in past (if any)*			
4.	*Total Area*			
	Covered Area			
5.	*Factory Registration Certificate*	*Details attached at Annexure – F2.1*		
6.	*Design/ Research & development set-up (No. of manpower, their qualification, machines & tools employed etc.)*	*Applicable / Not applicable if manufacturing is as per Main Contractor/purchaser design) Details attached at Annexure – F2.2 (if applicable)*		
7.	*Overall organization Chart with Manpower Details (Design/Manufacturing/Quality etc)*	*Details attached at Annexure – F2.3*		
8.	*After sales service set up in India, in case of foreign sub-vendor (Location, Contact Person, Contact details etc.)*	*Applicable / Not applicable Details attached at Annexure – F2.4*		
9.	*Manufacturing process execution plan with flow chart indicating various stages of manufacturing from raw material to finished product including outsourced process, if any*	*Details attached at Annexure – F2.5*		
10.	*Sources of Raw Material/Major Bought Out Item*	*Details attached at Annexure – F2.6*		
11.	*Quality Control exercised during receipt of raw material/BOI, in-process , Final Testing, packing*	*Details attached at Annexure – F2.7*		

12.	***Manufacturing facilities*** ***(List of machines, special process facilities, material handling etc.)***	***Details attached at Annexure – F2.8***
13.	***Testing facilities*** ***(List of testing equipment)***	***Details attached at Annexure – F2.9***
14.	***If manufacturing process involves fabrication then-*** ***List of qualified Welders*** ***List of qualified NDT personnel with area of specialization***	***Applicable / Not applicable*** ***Details attached at Annexure – F2.10*** ***(if applicable)***
15.	***List of out-sourced manufacturing processes with Sub-Vendors' names & addresses***	***Applicable / Not applicable*** ***Details attached at Annexure. –F2.11*** ***(if applicable)***
16.	***Supply reference list including recent supplies***	***Details attached at Annexure – F2.12*** ***(as per format given below)***

Project/ package	*Customer Name*	*Supplied Item (Type/Rating/Model /Capacity/Size etc)*	*PO ref no/date*	*Supplied Quantity*	*Date of Supply*

17.	***Product satisfactory performance feedback letter/certificates/End User Feedback***	***Attached at annexure - F2.13***
18.	***Summary of Type Test Report (Type Test Details, Report No, Agency, Date of testing) for the proposed product (similar or higher rating)*** ***Note:- Reports need not to be submitted***	***Applicable / Not applicable*** ***Details attached at Annexure – F2.14*** ***(if applicable)***
19.	***Statutory / mandatory certification for the proposed product***	***Applicable / Not applicable*** ***Details attached at Annexure – F2.15*** ***(if applicable)***
20.	***Copy of ISO 9001 certificate*** ***(if available)***	***Attached at Annexure – F2.16***
21.	***Product technical catalogues for proposed item (if available)***	***Details attached at Annexure – F2.17***

Name:		***Desig:***		***Sign:***		***Date:***	

Company's Seal/Stamp:-

ANNEXURE -A

KAYAL WATER TEST READINGS (North of South Bund- 22MW floating Solar plan)											
	pH	Conductivity	Turbidity	CaH	Total hardness	Total Alkali	Chlorides(Cl^-)	Sulphates(So_4^{2-})	Silica(Sio_2)	Fe	Organic Matter
SAMPLE 1	7.66	7.94	2.94	130	790	22	2573.75	38.602	0.8723	0.2016	1.2
SAMPLE 2	7.67	7.85	3.79	140	770	26	2556	34.045	0.8659	0.1837	1
SAMPLE 3	7.64	7.49	4.48	120	750	28	2564.87	36.488	1.3119	0.1318	1.1

sample 1 - From east side
sample 2- From south side
Sample 3- From west side