



**Technical specification for** Design and Supply of Complete Floatation Platform and Accessories with Mooring and Anchoring of this Platform for 100 MW Grid Connected Floating Solar Photovoltaic Power Plant in NTPC Ramagundam-Telangana.

PS-439-1283

REV NO: 03

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## 1.0 Introduction:

Bharat Heavy Electricals Limited (BHEL), Electronics Division, Bangalore is setting up a 100 MW Grid Connected Floating Solar Photovoltaic Power Plant for NTPC at Ramagundam-Telangana. This plant has to be set up in the Raw water reservoir of the thermal plant. 500 acres of water body is available for this project.

## Project Location and approach :

100 MW Floating Solar PV Plant shall be setup at NTPC Ramagundam (<http://www.ntpc.co.in/power-generation/coal-based-powerstations/ramagundam>).

|                            |                      |
|----------------------------|----------------------|
| District                   | Peddapelli,Telangana |
| Nearest Highway            | NH-63(10KM)          |
| Nearest Railway Station    | Ramagundam (05 Km)   |
| Nearest Commercial Airport | Hyderabad(260 Km)    |

## 2.0 The scope of Bidder is as follows (In brief):

1. The design and supply of complete Floatation platform along with accessories.
2. Design and supply of Mooring / Anchoring.
3. I&C of Mooring/Anchoring.

## BHEL provides the following options to Bidders.

### Option-1

#### PV Module mounting tilt = 5 Degr.

| Orientation of the Array. | No of PV Modules to be mounted. | Remarks                                          |
|---------------------------|---------------------------------|--------------------------------------------------|
| Magnetic N-S              | 447700                          | Orientation option to be selected by the bidder. |
| Reservoir N-S             | 448620                          |                                                  |

The Supply BOQ of the bidder for this option shall be so as to mount the no of PV-Modules as shown in the table with this Option.

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## Option -2

**PV Module mounting tilt = 11, 12 or 15 degs.**

| Orientation of the Array. | No of PV Modules to be mounted. | Remarks                                          |
|---------------------------|---------------------------------|--------------------------------------------------|
| Magnetic N-S              | 436940                          | Orientation option to be selected by the bidder. |
| Reservoir N-S             | 440000                          |                                                  |

The Supply BOQ of the bidder for this option shall be so as to mount the no of PV-Modules as shown in the table with this Option.

The Bidder can choose between Option 1 or 2. This choice to be clearly indicated in the technical Bid. In case the bidder chooses option 2, he needs to clearly specify the tilt angle selected (11, 12 or 15). L1 bidder will be the person who provides lowest cost to BHEL at his selected option.

The bidder to populate the Array layout with no of PV-Modules as per his chosen option in the designated reservoir surface area. Also this Array population to cast minimum shadow ( Shadow loss of the PV-Array limited to maximum 1%). This Array layout has to be submitted to BHEL along with the technical documents for verification. The Array layout to include mandatory clearances for Inverter Rooms and other utilities.

**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.

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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. Any Cost related to O&M of the plant to be included in the price bid.

**This order shall be split among four vendors as below:**

| Vendor | Capacity (AC)-MW | No of PV-Modules-approx                               |
|--------|------------------|-------------------------------------------------------|
| L1     | 40               | Will be finalized as per Option chosen by the Bidder. |
| L2     | 20               |                                                       |
| L3     | 20               |                                                       |
| L4     | 20               |                                                       |

### 3.0 Pre Qualification Criteria :

As per Annexure.

### 4.0 Pre Bid Meeting/Clarifications:

All technical clarifications w.r.t tender to be mailed to the following email ids.

[punammishra@bhel.in](mailto:punammishra@bhel.in)

[vipindas.cp@bhel.in](mailto:vipindas.cp@bhel.in)

[sreenath@bhel.in](mailto:sreenath@bhel.in)

[yaswanth@bhel.in](mailto: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 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:

1. Declaration for accommodating Required DC Capacity in the form of Array Layout.

Declaration for accommodating Required DC Capacity - (Total no of PV-Modules) in the reservoir. Vendor has to give a clear declaration that he can mount the required no of PV Modules in the Reservoir Area ear marked. This declaration to be accompanied by

  
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the indicative Array layout from the vendor populating it with his own Pontoons employing his option and meeting NTPC requirements. In case of additional water surface requirements, same to be indicated in the technical Bid clearly.

## 2. Monthwise 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 in detail:

| # | 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.                                                                                                                                                                                                                                                                 | 1 Set | As per specification. | The preliminary design has to be submitted within 10 days of PO Placement. |
| 2 | MQP and QAP of the Floats to be submitted to BHEL/NTPC for Approval.                                                                                                                                                                                                                                                                                                                                         |       |                       |                                                                            |
| 3 | Vendor to execute demo I&C of minimum 100 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                                                                                                                                                                                                                                                               | 1 Set | As per specification. | Within 10 days of PO Placement.                                            |

  
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|    | Array placement.                                                |                              |  |  |
| 5  | Supply of the Entire BOQ as per approved design in Sl.No -1.    | 1 Set                        |  |  |
| 6  | Supply of Floats to Mount 70 LAs. (Wt of each 20 kgs).          | 1 Set                        |  |  |
| 7  | Floats to mount 960 String Combiner box ( Wt of each 30 kgs).   | 1 Set.                       |  |  |
| 8  | I & C of Mooring and Anchoring system as approved in Sl. No -1. | 1 Set                        |  |  |
| 9  | O&M Manual for the floatation system.                           |                              |  |  |
| 10 | Provision of Walkways and Cable gangways.                       |                              |  |  |
| 11 | Spares                                                          | 0.05% of each type of Float. |  |  |
| 12 | AMC                                                             | 10 Yrs                       |  |  |

**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.**

6.0 Annexures to this document:

1. BHEL-PV-Module Drawing.
2. Drawing /Photographs of the Reservoir.
3. Site Visit declaration certificate.
4. Bathymetry report as provided by End Customer-NTPC.

BHEL shall provide the following documents after PO Placement :

1. Final Bathymetry of the reservoir.
2. Geo technical Investigation report of the reservoir Bottom.

**\*\*As the vendor has to design the complete floatation platform, hence apart from the information already furnished by BHEL, the vendor has to provide the checklist of the**

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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 100 KW to ensure completeness and to make to the system intact.

#### 7.0 BHEL Scope:

- Supply of PV-Modules.
- Unloading of Floating Pontoon/Floater at Site in Stores Area.
- Storage and Security of items –supplied by Floatation vendor.
- \*\*I&C of Floatation platform only.
- Bathymetry survey of the reservoir.
- Soil investigation of the Reservoir bottom.

BHEL shall not entertain any claims regarding the correctness of Sl.no (e) and (f).

**\*\*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 100 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).

#### 2.0 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 to BHEL/NTPC.

| CODES                                     | Description                                    |
|-------------------------------------------|------------------------------------------------|
| ASTM D1693 ( or equivalent ISO Standards) | Test for Environmental Stress Cracking of HDPE |

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| 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                                                                            |

## FLOATING UNIT

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

  
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- f. 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.
- g. 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).
- h. 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.
- i. 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.
- j. 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.
- k. 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.
- l. 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.
- m. Floating system should be designed to withstand the maximum wind speed of the location.
- n. 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.
- o. The floating units shall be re-process able and recyclable at the end of its useful life.
- p. The design life of the floating units should be 25 years.
- q. 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 fixed tilt .

  
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|----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
|  | <b>Technical specification for</b> Design and Supply of Complete Floatation Platform and Accessories with Mooring and Anchoring of this Platform for 100 MW Grid Connected Floating Solar Photovoltaic Power Plant in NTPC Ramagundam-Telangana. | PS-439-1283                   |
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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 base wind speed. The results conforming to above test shall be submitted to BHEL 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 meter 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 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.

### Reservoir and Floating Details:

i. Reservoir details:

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Full reservoir Level (FRL):168 M  
Minimum Drawdown Level (MDDL):162.30 M

ii. Floating system: Floating unit, all accessories and anchoring system shall be designed for base wind speed of 158.4 km/hr.

The entire system shall be designed to withstand dynamic conditions as per IS 875-3. The bathymetric survey of the reservoir and contour map of reservoir area are furnished as tender drawings. Bidder may also carry out all required surveys for the proposed site based (if feel necessary) on its own discretion and submit for NTPC approval. However, the time taken to conduct the fresh surveys shall not be considered in project completion schedule.

#### 8.0 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.

#### 9.0 Marking and Packing instructions :

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

#### 10.0 Delivery Schedule:

As per specified in the RFQ document.

#### 11. 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.

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