

NTPC LIMITED

PROJECT : SINGRAULI STPP STAGE-III (2X800 MW)

PACKAGE NAME : EPC PACKAGE

“Salient Technical Features of the equipment/systems/services covered in the Bidding Document No. CS-1150-001R-2 are mentioned below. These Salient Technical Features are mentioned only to facilitate the prospective bidders to prima-facie understand the requirements under the tender and shall not in any way limit or alter the scope of work and technical features/specification of equipment/ systems/ services covered in the Bidding Documents. Detailed provisions in regard of scope of work and technical features/specification of equipment/ systems/ services, contained in the Bidding Documents shall be final and binding.”

A BRIEF SCOPE OF WORK

The Brief scope of work for the subject EPC Package for SINGRAULI STPP Stage-III (2X800 MW) is as follows:

Design, Engineering, Manufacture, Supply, Construction, Erection, Testing & Commissioning works for the EPC Package for SINGRAULI SUPER THERMAL POWER PROJECT Stage-III (2 X 800 MW), on the basis of single point responsibility, completely covering the following activities and services in respect of Steam Generator and Auxiliaries, Electrostatic Precipitator, Flue Gas Desulphurization (FGD) System, Biomass co-firing capability, Ash Handling System, Compressed Air System, Enabling Works as identified in the specification, Civil, Structural & Architectural works including Site Levelling, Boundary Wall, Roads, Drains & Sewerage, Pipe / Cable Racks, Chimney & Chimney Elevator, Steam Turbine & Auxiliaries, Generator & Auxiliaries, , Fire Detection & Protection System, Civil, Structural & Architectural works of Main Power House, Common Control Room, Service Building, Transformer Yard and Pipe / Cable Racks, CST, Generator Bus ducts and associated equipment's, Power Transformers & Reactors, HT Switchgears for complete plant facilities, LT indoor Transformer, MV Bus-duct, DC Batteries, Battery chargers, DG sets, CW system including equipment, Duct, NDCT & CW channel and associated civil works, Aux. Cooling tower including Aux CT pumps system and associated electrical and controls & Instrumentation, Raw Water and associated Electrical & civil works, Water treatment plant and associated civil works including Effluent quality Monitoring System(EQMS), ECW system for TG & SG including station auxiliaries, Condensate polishing plant (CPU) and associated controls & Instrumentation, Station Piping, Coal, Limestone & Gypsum Handling Plant System, Fuel Oil system, Mill Reject System, Air Conditioning System, Ventilation System, Packaged Sewerage Treatment Plant, LT switchgear & LT Bus Duct, Outdoor Transformers, 400KV GIS Switchyard and associated transmission line LILO portion of Both the circuit of existing twin moose conductor D/C tie line between VSTPP Stage-IV & VSTPP Stage- V at Singrauli Stage-III switchyard, HT ,LT power cables & LT control cables, Lightning Protection, DG sets for FGD, Lighting, Cabling, Earthing, Control & Instrumentation(C&I), Fireproof cable penetration sealing system, Solar PV plant on roof tops of buildings, underground facilities like drainage, sewerage, trenches, earthing mat/ grounding for the Offsite area, Miscellaneous Buildings, Rain Water Harvesting etc. covered under the specifications:

- a) Basic Engineering of the plant including preparation of Plant Definition Manuals;
- b) Detailed design of all the equipment and equipment system(s) including civil, structure steel & Architectural works included in bidder's scope.

- c) Providing engineering drawings, equipment sizing & performance data, instruction manuals, as built drawings and other information;
- d) Compliance with statutory requirements and obtaining clearances from statutory authorities, wherever required;
- e) Complete manufacturing including shop testing/type testing;
- f) The complete Civil, structural and architectural works
- g) Packing and transportation from the manufacturer's works to the site including logistic studies, insurance, customs clearance & port clearance, port charges, if any.
- h) Receipt, storage, preservation, handling and conservation of equipment at the site;
- i) Fabrication, pre-assembly, if any, erection, insurance, testing, commissioning and completion of facilities including putting into satisfactory operation all the equipment including successful completion of initial operation;
- j) Performance and guarantee tests Along with initial operation;
- k) Supply of spares on FOR site basis;
- l) Reconciliation with Customs Authorities;
- m) Satisfactory conclusion of the Contract;
- n) Insurance and other requirements

Detailed scope of work has been specified in the bidding documents.

B SALIENT TECHNICAL FEATURES

1.00.00 Steam Generator

1.01.00 Type

The Steam Generator shall be of single pass (Tower type) or two pass type using either spiral wall (inclined) or vertical plain / rifled type water wall tubing.

1.02.00 Other Features of Steam Generator Design

The Steam Generator shall be direct pulverized coal fired, top supported, single reheat, radiant, dry bottom, with balance draft furnace and shall be suitable for outdoor installation. The evaporator of Steam Generator shall be once-through type suitable for variable pressure operation from subcritical to supercritical pressure range.

1.03.00 Rating of Steam Generator(s)

Steam Generator shall be designed to cater to duty requirements at Boiler Maximum Continuous Rating (BMCR) specified below:

Capacity of Steam Generator and Rated Steam parameters:	Steam Flow (T/Hr)	Temp. (Deg C)	Pressure Kg/cm²(a)
i) At super-heater outlet	102% of the turbine VWO steam flow	The steam temperature at Superheater outlet shall be atleast 3°C	The steam pressure at superheater outlet shall be atleast 9

	requirement.	higher than the rated main steam temperature at HP turbine inlet.	kg/cm ² higher than the rated main steam pressure at HP turbine inlet
ii) At re-heater outlet	-	The steam temperature at reheater outlet shall be at least 3°C higher than the rated reheat steam temperature at IP turbine inlet.	---
iii) Feed Water Temp. at Economizer Inlet		To be optimized by the bidder but not less than 305°C	

1.04.00 Limiting Parameters for Steam Generator Design

The Steam Generator design shall comply with the following limiting parameters with 'design coal' firing, under stipulated ambient air condition i.e. 27 degree Celsius temperature and 60 % relative humidity:

Flue gas temperature at air-heater outlet - 125°C (minimum)
(Corrected) at 100 % TMCR load

1.05.00 Operating Requirements

1.	Minimum load without oil support for flame stabilization	40% BMCR
2.	Operation without HP heaters in service	Steam generator shall be capable of operation with HP heaters out of operation. The steam generator heat output under HP heaters out condition shall not be less than heat duty required for generating rated power output or design BMCR heat duty, whichever is lower. Steam generator shall also be capable of sustained operation with HP heaters out of operation so as to generate rated power output or output corresponding to design BMCR heat duty, whichever is lower.
3.	Steam generator control range	The automatic control range of Steam Generator shall be from 50% TMCR to 100% BMCR. Under the above control range, the steam temperatures at SH & RH outlets shall be maintained at their rated values.
4.	Mode of Steam Generator Operation	The Steam Generators shall be designed for variable pressure operation. Thermal design of Steam Generator and the selection of materials shall be suitable for variable pressure operational modes.

5	Rate of loading / unloading a) Ramp Rate	(i) Minimum \pm 1% per minute (30% to 50% load) (ii) Minimum \pm 3% per minute (50% to 100% load)
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1.06.00 Coal/Ash data

The primary fuel for the main steam generator shall be coal. LDO shall be used for initial start-up, coal flame stabilization and low load operation of the steam generator while firing coal.

2.00.00 NOT USED

3.00.00 Electrostatic Precipitator (ESP)

3.01.00 System Description:

The Electrostatic Precipitators shall be of outdoor type and installed on the cold end side of regenerative air preheaters. The flue gas shall be drawn from air preheater outlets of the balanced draft, pulverized coal fired Steam Generator and guided through adequately sized duct work into the specified number of independent gas streams of each ESP. Similarly, the flue gas after the Electrostatic Precipitators shall be led to the suction of the induced draft fans.

3.02.00 Service Conditions

The Steam Generators are designed to burn pulverised coal. LDO shall be used during startup and at low loads for warm up and flame stabilisation of Steam Generator. The ESP shall be designed to remove fly ash particles (to meet the stipulated ESP emission levels) from the flue gas generated in the Steam Generator with pulverized coal firing. Additionally, certain percentage of biomass firing is also envisaged in the Steam Generator.

4.00.00 Flue Gas Desulphurization System:

4.00.01 Flue Gas Desulphurization (FGD) System and its auxiliaries shall be supplied for two (02) number of steam generators each of 660 MW capacity. The FGD system shall be based on wet limestone FGD technology and is intended to reduce the emissions of sulphur dioxide in flue gas produced by coal being fired in boiler to the specified limits.

4.00.02 The FGD system shall have an independent absorber for each unit, common limestone milling systems for the two units and common gypsum dewatering system for the two units.

5.00.00 Steam Turbine

5.01.00 Type

The steam turbine shall be tandem compound, single reheat, regenerative, condensing, multi-cylinder design with separate HP, separate IP and two separate LP cylinders OR combined casing for HP-IP and two separate LP cylinders directly coupled with generator suitable for indoor installation.

5.02.00 Rating

The steam turbine generator unit shall conform to the following design and duty conditions:

1.	Output under economic maximum continuous rating (EMCR) (guaranteed output load) at generator terminals	:	800 MW
2.	Turbine throttle steam pressure	:	270 Kg/cm² (abs)
3.	Turbine throttle main steam temp.	:	600 °C
4.	Reheat steam temp. at turbine inlet	:	To be optimized by the bidder between 600 and 610 deg.C (both values inclusive) but not less than 600 deg.C
5.	Condenser pressure	:	77 mm Hg (abs)
6.	Turbine speed	:	3000 rpm
7.	Frequency variation range around rated frequency of 50 Hz	:	+ 3% to - 5% (47.5 Hz to 51.5 Hz)

5.03.00 Other Features

- (a.) Turbine shall be capable of operating continuously with valves wide open (V.W.O.) to swallow at least 105% of EMCR steam flow to the turbine at rated main steam and reheat steam parameters and also the corresponding output shall not be less than 105% of rated load with 3% make up and 77 mm Hg (abs) condenser pressure.
- (b.) The steam turbine shall have minimum eight uncontrolled extractions for regenerative feed heating based on optimized cycle and shall be suitable for satisfactory operation under tropical conditions.

6.00.00 Generator

6.01.00 Type

Three phase, horizontal mounted, indoor installed, two-pole, class-F winding insulation, Stator water/ hydrogen cooled, cylindrical hydrogen/water cooled rotor type.

6.02.00 Rating

Generator and its excitation system shall have a capability at least matching the declared maximum continuous rated output of the associated steam turbine (for the designed secondary cooling water temperature) at all power factors between 0.85 lagging and 0.95 leading with +3% to -5% frequency variation, terminal voltage variation of +/- 5% and combined voltage & frequency variation of 5%. It shall be ensured that when the Generator is working at this capability and design cooling water temperature, no part of the Generator shall attain a temperature in excess of the temperature limits specified for class-B insulation as per IEC-60034.

- 6.03.00 Also the generator and its excitation system shall be capable of continuous stable operation without any excessive temperature rise at the peak output of the associated steam turbine under VWO & HP heater out condition, etc. as available for the designed secondary cooling water temperature, at all power factors between 0.85 lagging and 0.95 leading with +3% to -5% frequency variation, terminal voltage variation of +/- 5%

and combined voltage & frequency variation of 5%. Temperature of different parts may exceed those permissible for class-B insulation under such operating conditions, but shall be lower than those permissible for class-F insulation as per IEC-60034.

6.04.00 Rated Parameters

1.	Power Factor	-	0.85 (lag)
2.	Terminal voltage	-	In the 18 to 28 kV range
3.	Frequency	-	50 Hz
4.	Speed	-	3000 rpm
5.	Short circuit ratio	-	Not less than 0.48 (without any tolerance)

7.00.00 Coal Handling System

Coal handling system shall include coal unloading in track hopper, conveying, crushing, storage in stockpile, reclaiming from stockpile & Interconnection with Existing CHP. Rated capacity of CHP shall be as specified in the technical Specification.

8.00.00 Ash Handling System

Ash handling system consists of the following sub systems:

a) Bottom Ash, Economizer, APH, Duct Hopper ash Handling System

- i. A wet ash conveying system for ash collected in the boiler furnaces, economizer hoppers, economizer outlet duct hoppers (if applicable), air preheater hoppers and duct hoppers (if applicable) including treatment system of Bottom ash hopper overflow water.

b) Dry Fly Ash Conveying system

Two alternatives for pneumatic conveying system (i.e. vacuum conveying system or pressure conveying system) are specified for conveying of fly ash from ESP Hoppers in dry form.

i) Vacuum Conveying System

It shall consist of liquid ring vacuum pumps, material handling valves, cast iron and MS pipes, instrument air compressors etc.

OR

ii) Pressure Conveying System

It shall consist of screw compressors, air lock/pump tanks, ash intake & discharge valves, CI & MS pipes, instrument air compressors etc.

c) Dry Fly Ash Transportation system

The dry fly ash from the buffer hoppers in each unit shall be transported to fly ash main storage silos/intermediate silos or Classifier Silos. The user industries shall take the dry fly ash from storage silos either in rail wagons, closed tankers or in open tankers.

d) Ash Disposal System

The unutilized fly ash and bottom ash shall be disposed to existing S1 dyke in combined (BA+FA) lean slurry form from Ash slurry pump house.

e) Ash classification and bagging system.

Fly ash from the ESP hoppers shall be led to the ash classifiers where fine ash shall be segregated from coarse ash. The fine ash shall be stored in fly ash silo dedicated for ash bagging plant. Unutilized coarse ash shall be disposed in slurry form to the existing S1 dyke.

9.00.00 CW SYSTEM

Closed loop recirculating type CW system with CW Pumps, Natural Draft Cooling Tower & CW Chemical Treatment; Equipment cooling water system for TG , SG & Station auxiliaries etc. Aux. Cooling tower (IDCT) and Auxiliary Water Pumps (Aux.CT pumps, Raw water for PT & Ash, Service water, potable water etc.) shall be provided as specified in technical specification.

10.00.00 Fire detection & protection system, Compressed air (instrument & service air) system, A/C and ventilation system, shall be as per the scope of technical specification.

11.00.00 WATER TREATMENT PLANT (WTP)

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Water Treatment Plant (WTP) consisting of the following sub systems shall be provided as per the scope of Technical Specification:

- a) Pre-Treatment Plant
- b) Chlorine Di-oxide Plant
- c) Liquid Effluent Treatment System
- d) Demineralizing plant
- e) CSSP
- f) Drain Separation & ZLD

12.00.00 CONDENSATE POLISHING PLANT

Condensate Polishing Plant (CPU) for each unit along with common external regeneration facility shall be provided as per the scope of Technical Specification.

13.00.00 **Electrical Systems**

- Generator, Excitation System and its Auxiliary Systems
- Motors
- Generator Busducts, MV Busducts
- Power Transformers, Auxiliary Oil Filled Transformers, Indoor Transformers
- MV Switchgears, LV Switchgears and LV Busducts, Numerical Relay Networking, DC System, Battery and Battery Charger
- HT Power Cables, LT Power and Control Cables, Cabling, Earthing and Lightning Protection, Station Lighting, DG Sets, VFD
- Construction Power facilities
- Switchyard Electrical and Control & Protection
- ESP, AHP & CHP Electricals
- Type Testing and Mandatory Spares as specified.

14.00.00 **C & I Systems**

All the systems/equipment being supplied under this package shall be monitored and controlled from DDCMIS in this package

The control system, called Distributed Digital Control Monitoring & Information system (DDCMIS) is envisaged to be procured under this package for control and operation of

- Integral control & protection of boiler including Burner Management System and Boiler protection system.
- The integral control & protection of Steam Turbine Generator including Electro-hydraulic control & Turbine Protection system.
- Modulating controls of the Steam Generator (SG) {Combustion Control- Fuel Flow/Air Flow; Furnace Draft Control, FW flow control etc.}.
- Modulating controls of Feedwater & Condensate Cycle {Hotwell level control, Deaerater Level control, Heater Level Control, etc.}.
- Binary control of auxiliaries of Steam Generator (SG) {Forced draft (FD) fan, Induced Draft (ID) Fan, Primary Air (PA) Fan etc.}.
- Binary control of auxiliaries of Turbine Generator (TG) {Boiler Feed Pump (BFP), Condensate Extraction Pump (CEP) etc.}.
- Electrical Breaker including synchronization circuits.
- Coal Handling Plant.
- Water System (PT Plant, DM Plant, Aux. Cooling Tower etc.).
- ACW System.
- Air Conditioning and Ventilation systems.
- Ash Handling Plant.

- FGD System
- FOPH System

Human Machine Interface & Plant Information System (HMIPIS) is based on Large Video Screen (LVS) displays supported by TFT monitor based Operator Work Stations (OWS). These devices through customized user-friendly displays, soft alarm facia and pop-up displays are used for giving fast pin-pointed faults/ status to the operator. Local ON/OFF operation of equipments is envisaged through Graphical Interface Unit (GIU). The total system is networked through a Station-Wide LAN for use of real time data of various plant areas by other users like maintenance, planning, efficiency enhancement groups etc.

The sequence of events recording & alarm annunciation are also implemented as a part of DDCMIS system. A GPS based master and slave clock system is to be provided for uniform and synchronized timing signals throughout the entire station.

The power supply for the control system is based on 24V DC provided through microprocessor based modular charger system and for the peripherals and other subsystem through 230V Single Phase UPS.

Main Equipment related instruments like Flame Monitoring system, Coal Bunker Level measurement system, gravimetric feeder control system, Acoustic Pyrometer, Acoustic Steam Leak detection system, Furnace and Flame viewing system, Turbine stress control / evaluation system, Turbine supervisory and diagnostic system etc are also procured through this package.

Field instruments like pressure, DP, flow & level transmitter, analyzers along with their process connection & piping as well as measurement systems like vibration monitoring system etc are also procured through this package.

Field bus based controls and devices are also envisaged in this package.

A plant-wide CCTV system based on IP technology is included in this package for surveillance of plant equipment as an aid to the operation.

Apart from above, an on-line Steam & Water analysis system (SWAS), PA system, operator control desks, panels, shielded twisted pair cables as well as optical fiber cables for system interconnection and all types of Instrumentation Cables are also included in this package.

15.00.00 **Civil Works**

Civil, Structural & Architectural works of all plant facilities/building within pant boundary shall be provided as specified in technical specification. Based on the borelog data, the topsoil consists Silty sand with clay bind/ silty clay/ Clayey silt with sand mixture/ dense to very dense silty sand with traces of weathered rock of thickness 4 to 12.5 m followed by highly weathered soft sandstone. The ground water table varies from 0.6m m to 10.7 m below existing ground level. As per borelog data and topographical survey drawing, Natural ground level at proposed location of cooling tower, CWPH and switchyard area is approximately 3m to 8m below finished ground level at few locations.

16.00.00 **Rooftop SPV Plants**

Solar Photo-voltaic plants to be supplied under the package shall be grid-connected rooftop SPV plants including all auxiliaries. The SPV modules must conform to latest edition of IEC

61215 / IS 14286 for crystalline silicon Terrestrial PV Modules design qualification and type approval. The modules must also conform to IEC 61730 part 1 & Part 2 or equivalent IS for construction & testing requirements respectively. In addition, the modules must also conform to IEC 62804 or equivalent IS for test methods for detection of Potential induced degradation (PID).

17.00.00 MILL REJECT SYSTEM

Mechanical conveying system shall be employed for handling of the mill rejects. Mill reject shall be stored in Mill reject Silos through a series of Mechanical conveying equipments.

18.00.00 FUEL OIL HANDLING AND STORAGE SYSTEM

Fuel oil storage system shall be provided to store light diesel oil (LDO). Existing unloading system shall be used.

19.00.00 LIMESTONE AND GYPSUM HANDLING SYSTEM

Limestone handling system shall consist of truck unloading facility, conveying, crushing and storage. Gypsum handling system shall consist of gypsum conveying to the gypsum storage shed.