

Scope of work and percentage Breakup		
Job	<b>E&amp;C of C&amp;I SYSTEM FOR ADVANCED ULTRA SUPERCRITICAL BOILER FIRE SIDE CORROSION TEST RIGTEST LOOP ERECTION AT DADRI SITE 210MW</b>	
S. No.	Work Description	% Allotted
1	Erection and Commissioning of Panels (in CCR/MCC) including base frame fabrication from structure steel – as mentioned in E, C&I BOM	10%
2	Erection and Commissioning of HMI system (work station, furniture, Network enclosure, printer, power supply module etc.) – as mentioned in E, C&I BOM	10%
3	Laying, glanding, ferruling, lugging, termination, tagging and dressing of control/instrumentation cables (from Panel to Boiler area, MCC to Boiler, Branch cablesetc) as per schedule – as mentioned in E, C&I BOM	6%
4	Laying, glanding, ferruling, lugging, termination, tagging and dressing of Power cables (from Panel to Boiler area, MCC to Boiler, Branch cablesetc) as per schedule – as mentioned in E, C&I BOM	14%
5	Erection and Commissioning of Junction Boxes including support frame fabrication from structure steel – as mentioned in E, C&I BOM	5%
6	Erection and Commissioning of cable trays (along with accessories) including support frame fabrication from structure steel – as mentioned in E, C&I BOM	10%
7	Calibration, installation and commissioning of Instruments including support rack fabrication from structure steel – as mentioned in E, C&I BOM	10%
8	Erection of earthing material as per drawing – as mentioned in E, C&I BOM	4%
9	Erection of impulse pipe (1"/2" CS/AS) along with condenser pot including hydro test of impulse pipe( limited to 500 mtr)	6%
10	Civil works – Removal of tiles, Dismantling of required fire ceiling on cable trench below DCS panel, making opening for cable entry in floors/walls, removal of glass partition of door, chipping of floor, grouting of frame, restoration of floor, tiles & glass partition- required for panels, furniture and cable tray erection related to this scope	10%
11	Commissioning of motorized actuators – 18 nos.	5%
12	Commissioning of Hydraulic PRVS with HPSU & Solenoid valve - (4 nos.)	4%
13	Assistance in connections of internal wiring in new maxDNA DCS panel (as per site requirement)	2%
14	In plant transportation of material from Storage location to erection place, preservation at site till erection and material reconciliation	4%
	<b>Grand Total</b>	<b>100%</b>

**Note -**

1. Detail scope and Special Terms and conditions for the above SOWs shall be as per **Annexure-A1** and shall strictly to be adhered and followed while execution of above job.
2. Details of the items/ materials to be handled & erected (E, C&I BOM) shall be as per **Annexure-A2**
3. Commercial Terms and conditions for the work is as per **Annexure – A3**

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<b>Detail Scope and special conditions for C&amp;I works</b>	
<b>1</b>	<b>Material Transportation within site</b>
1.1	Contractor to receive all erection material from Plant storage location and to shift erection site. Contractor to ensure that material is well preserved at site till erection and commissioning. After completion of erection work material reconciliation to be done by contractor and balance material to be handover to customer store and scrap material to shifted in identified scrap yard.
<b>2</b>	<b>Erection of Panels, JBs, Instruments and Trays</b>
2.1	Erection of panel, instruments, cable trays, JBs, Furniture's, network enclosure involves - fabrication of frames/racks by structure steel, installation of items, levelling, welding, alignment and earthing connection.
2.2	Structure steel such as ISMC, angle, plates for fabrication of frames/racks shall be provided by BHEL which are supplied by BHEL Units.
2.3	Earthing of DCS system, JBS and instruments to be done from existing earth pit/earth mat available at nearby location and to be done by contractor in quoted price.
2.4	Power distribution board mentioned in sl no. 1.3 of E,C&I BOM may be supplied in parts that needs to be assemble during erection.
2.5	Cable trays erection to be done at height in Boiler area also. Contactor to take proper safety precaution during work.
2.6	Hydro test of impulse pipes are to be done at rated pressure. Arrangement for hydro test in scope of contractor.
2.7	Before installation of instruments calibration to be performed with proper calibration tools and to be witness by BHEL and customer.
2.8	Erection of instruments also includethe erection of manifold and nut & tail piece etc.
2.9	After fabrication of frame, racks & instruments finish paintings to be done as per standard.
<b>3</b>	<b>Cabling work</b>
3.1	Cabling work involves Laying, glanding, ferruling, lugging, termination, tagging and dressing of cables.
3.2	Most of cabling shall be done on existing tray/new tray route in boiler area, this will involve the laying on height also. Contractor to take proper safety precautions for same. After laying of cables proper dressing to be done on existing tray.
3.3	Before termination of cable, loop checking to be done, so that commissioning period is reduced
<b>4</b>	<b>Civil work limited to C&amp;I scope of erection</b>
4.1	Any material required for civil work such as cement, sand, finishing tiles etc. related to C&I work is to be arranged by contractor within quoted price.
<b>5</b>	<b>Commissioning and Handing over of system</b>
5.1	Contractor to complete the commissioning work and handover the system to customer after joint inspection and preparation of protocols.
5.2	Commissioning of panels includes checking of internal hardware and wiring, proper earthing, powering of panels, software loading and loop check & functional checks of all inputs and outputs etc.
5.3	Commissioning of Instruments includes powering on instruments, loop checking till DCS/PLC panels, charging of instruments and establishing the correct reading in DCS.

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<b>5</b>	<b>Consumables and T&amp;Ps/IMTEs</b>
5.1	All consumables including electrodes, gas, filler wires, cable ties, ferrules, thinner, paints, waste cotton, emery papers, cleaning agents, copper washer, Oxygen and DA Gas cylinder etc. shall have to be arranged by the contractor free of cost.
5.2	Lugs, Glands, elbows, nuts, washers & tag plate shall be provided by BHEL which are supplied by BHEL units for cabling & trays (however if extra requirement arises, contractor to arrange same free of cost).
5.3	Sufficient & calibrated T&P/IMTEs including (Pressure calibrator up to 250Kg/cm <sup>2</sup> , Master Gauge, Temperature calibrator, Digital Multimeters, megars, mA source and current source, DC supply source, ferrule printing machine, power supply extension board, cutting sets, winches, chain pulley blocks, Welding machines, Hydra, trailer, Impulse pipe bender, Impulse pipe hydro test arrangement) etc. shall be arranged by the sub-contractor free of cost for completion of job. Any other T&P which is not listed and required to complete the work shall also arrange by the contractor free of cost.
5.4	All IMTEs shall be calibrated and calibration certificate to be produced at start of erection/calibration.
<b>6</b>	<b>Manpower to be deputed</b>
6.1	Contractor to deploy sufficient manpower for completion of work as per contract. Deployment of sufficient Skilled manpower such as instrument fitter, instrument technicians, electricians, HP welder, engineers – 2nos., supervisors, civil mason, riggers, hydra operator, unskilled helpers to be done for work completion
6.2	Work may be required to execute round the clock also. Contractor to ensure sufficient manpower for round the clock execution.
<b>7</b>	<b>Completion Period</b>
7.1	<b>Pre- shutdown work – 02 months (proposed from Mid of Aug 18 to Mid of Oct 18) Shutdown works – 01 months (Proposed in Nov 2018)</b>
7.2	Following C&I activities are tentatively proposed to be carried out in pre-shutdown period (if customer provides permit for same) Erection of Panels (sl no. 1 of scope of work) Erection of HMI items (sl no. 2 of scope of work) Laying of branch cables, network cables, main cables in non-critical area, power cables etc and termination in new panel & JB's side only. Loop checking of new cables. (sl no. 3 & 4 of SOW) Erection of Junction box & cable trays (sl no. 5 & 6 of scope of work ) Calibration & installation of instruments except MTM and Thermocouples (sl no. 7 of scope of work) Erection of GI Wire & MS Flat in non-critical area (sl no. 8 of scope of work) Civil work as per (sl no. 10 of scope of work) Commissioning of motorized actuators (sl no. 11 of Scope of work) Assistance in internal wiring in new maxDNA DCS panel (sl no. 13 of scope of work)
7.3	Balance erection activity including commissioning to be done in shutdown of unit. If proposed pre-shutdown activity are not completed before shutdown due to any reasons, then all activity to be carried out in defined shutdown period only.
7.4	As the pre-shutdown works are to be completed in running condition of machine, so before start of any erection/dismantling work - proper permit, safety clearance & power isolation shall be taken from NTPC customer.
<b>8</b>	<b>Input and Facilities to be provided by BHEL/ NTPC Customer</b>
8.1	Water, Electricity and Compressed Air supply at convenient locations
8.2	Power & welding points at convenient locations. Wherever Inconel material welding is involve BHEL welder shall be provided. Contactor to assist them.

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## Annexure A

8.3	Suitable Accommodation for sub-contractors personnel on chargeable basis subject to availability, the charges for which shall be payable by the sub-contractor directly to NTPC.
8.4	Suitable space for Stores and Office Accommodations for sub-contractors. However site office and store to be fabricated by contractor in provided space.
9	<b>Other terms and condition</b>
9.1	During erection of material, obstructions such as railings, platforms, pipes etc may require to cut/dismantle, storage and restoration of the same. That shall be included in quoted price.
9.2	If Any temporary approach is required during erection and commissioning same shall be arranged by contractor free of cost.
9.3	Since the work is to be executed in annual shutdown period and during which other agencies of NTPC will work at their part. Contractor has to execute his SOW in co-ordination with other agencies
9.4	The detailed SOW and quantity mentioned in BOQ is not exhaustive and comprehensive. Any other associated works and any other associated equipments & systems not specifically included in or excluded from the scope of work but essentially required for successful completion of work and guaranteed performance of the equipments & systems shall form integral part of the scope of work & Contractor has to execute the same as per BHEL instruction within final quoted price.
9.5	Dimension mentioned in BOQ is in MM only unless until specified.
9.6	Contractor to follow guidelines for arranging gate pass, material/manpower entry and exit as per customer requirement. The contractor has to <b>obtain all other statutory clearances and permissions from concerned authorities</b> as required for the work and they must observe and strictly adhere to all labor & industrial laws, safety rules and other statutory laws, acts & regulations as <b>applicable for the contract</b> .
9.7	The sub-contractor shall submit daily progress report and attend review meeting with BHEL on day to day basis.
9.8	The sub-contractor shall arrange accommodation, transport, medical, sanitary, safety and other arrangements for all Manpower at their own cost.
9.9	The sub-contractor must maintain proper system of documentation for Quality, Safety, HSE and other aspects so as to fulfil the requirement of ISO, OHSAS, 5S, SA 8000 and other National/International Standards.
9.10	Contractor to provide support during the steam blowing activity of test loop, Boiler light up and synchronization of unit.

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**Job - E&C of C&I SYSTEM FOR ADVANCED ULTRA SUPERCRITICAL BOILER FIRE SIDE CORROSION TEST  
RIGTEST LOOP ERECTION AT DADRI SITE 210MW**

**E, C & I BOM**

Sl no.	Detail of item	Unit	Quantity
	<b>Panels</b>		
1.1	maxDNADCS Panel (suit of 1), Dimension 750(D)x750(W)x2415(H)	No.	3
1.2	maxDNADCS Panel (suit of 2), Dimension 750(D)x1500(W)x2415(H)	No.	1
1.3	Power distribution board (415V) for electric valve actuators. Dimension: Approx2500(W)x1000(D)x2450(H)	No.	1
	<b>HMI System</b>		
2.1	Work station (OWS/EWS/Storian/LinkPC)	No.	4
2.2	Printer A4	No.	1
2.3	Installation of Ethernet switch, internet device, Firewall and router for remote connection	Set	1
2.4	HMI Furniture (Computer table –5 no, Printer table-1 no. and chair -5no.)	Set	1
2.5	Network Enclosure	No.	1
2.6	Power distribution board -UPS supply 600(H)x600(W)x300(D)	No.	2
2.7	UTP(LAN) cable laying and crimping (limited to 800mtrs and 100 crimping)	Set	1
	<b>Control and Instrumentation cables</b>		
3.1	2P X 0.5 sqmm P/O Shielded Inst. Cable	Mtr	800
3.2	8P X 0.5 sqmm P/O Shielded Inst. Cable	Mtr	3,200
3.3	4P X 0.5 sqmm O/A Shielded Inst. Cable	Mtr	3,400
3.4	2 PAIR X 0.5 sqmm Extension Cables	Mtr	400
	<b>Power cables</b>		
4.1	3C X 2.5 sqmm (CU.) XLPE Power Cable	Mtr	2,000
4.2	3C X 16 sqmm (AL.) XLPE Power Cable	Mtr	2,500
4.3	2C X 35 sqmm (AL.) XLPE Power Cable	Mtr	300
4.4	3C X 6 sqmm (AL.) XLPE Power Cable	Mtr	3,000
4.5	2C X 120 sqmm (AL.) XLPE Power Cable	Mtr	2,000
4.6	3C X 150 sqmm (AL.) XLPE Power Cable	Mtr	3,000
4.7	1C X 35 sqmm (AL.) XLPE Power Cable	Mtr	300
	<b>Junction Box</b>		
5.1	Junction Box 48 way	No.	4
5.2	FRP Junction Box for Temperature Transmitters	No.	6
	<b>Cable trays</b>		
6.1	Cable tray (perforated/Ladder) W=50 mm	No.	40
6.2	Cable tray (perforated/Ladder) W=100 mm	No.	45
6.3	Cable tray (perforated/Ladder) W=150 mm	No.	335
6.4	Cable tray (perforated/Ladder) W=300 mm	No.	225
6.5	Cable tray (perforated/Ladder) W=450 mm	No.	75
	<b>Instruments</b>		

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**Annexure A**

7.1	Steam flow Element – Flow Nozzle, Material Alloy steel	No.	1
7.2	Flow transmitter – SMART type	No.	1
7.3	Pressure Transmitter – SMART type	No.	7
7.4	K Type Thermocouple along with thermowell	No.	10
7.5	MTM Thermocouples along with pad, clamps and tubes	No.	20
7.6	Temperature Transmitters	No.	25
	<b>Earthing Material</b>		
8.1	Earthing Material - GI Wire and GI strip	Mtr	1500
8.2	Earthing material - MS Flat (50X6)	Mtr	125
	<b>Misc Erection Material to be used for Rack/ frame fabrication, cable laying &amp; cable tray erection work</b>		
1	ANGLE 50 X 50 X 6 -IS2062E250A(FE410W)	M	100
2	CHANNEL 100 X 50 - IS2062E250A(FE410W)	M	100
3	LADDER HORIZONTAL ELBOW-150W & 400R	SET	4
4	LADD VERTICAL OUTSIDE ELBOW-150W & 400R	SET	4
5	LADD VERTICAL INSIDE ELBOW-150W & 400R	SET	4
6	LADDER HORIZONTAL ELBOW-300W & 600R	SET	4
7	LADD VERTICAL OUTSIDE ELBOW -300W & 600R	SET	4
8	LADD VERTICAL INSIDE ELBOW -300W & 600R	SET	4
9	LADDER HORIZONTAL ELBOW-450W & 400R	SET	4
10	LADD VERTICAL OUTSIDE ELBOW -450W & 400R	SET	4
11	LADD VERTICAL INSIDE ELBOW-450W & 400R	SET	4
12	HOT DIP GALVANISED CHANNEL ISMC-100	M	900
13	HOT DIP GALVANISED ANGLE ISA 50X50X6	M	500
14	M8 X 50 GALAVANISED BOLT, NUT AND WASHER	NO	3,000
15	CABLE GLANDS	NO	160
16	CABLE LUGS	NO	7000
17	CABLE DRESSING MATERIAL - TAGS	NO	1000
18	CABLE DRESSING MATERIAL - TIE	NO	2000
19	ZINC PLATED BOLTS, NUTS & WASHERS	NO	100

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### Commercial Terms and Conditions

1	<b>OVERRUN COMPENSATION : NOT APPLICABLE</b>
2	<b>PRICE VARIATION CLAUSE: NOT APPLICABLE</b>
3	<b>WARRANTY/ DEFECT LIABILITY PERIOD</b>
	The warranty for the equipment/ system shall be for a period of <b>03 Months</b> from the date of completion work and all defects observed during this period shall be attended by the Sub-contractor free of cost.
4	<b>Liquidated Damages (LD): As per GSCC</b>
5	<b>TERMS OF PAYMENT:</b>
a)	<p><b>Payments shall be released on monthly pro rata basis for actual completed work at site as per % break up provided in Scope of work. The bills will be verified by BHEL site engineer and certified by BHEL Site In charge for arranging payment. GST shall be paid additionally as per the prevalent rates.</b></p> <p><b>For payments of any activity following shall be applicable -</b></p> <ol style="list-style-type: none"> <li>1. For Panels, HMI Items, Instruments and Junction Boxes - 70% payment of any activity/item shall be verified after completion of erection work and 20% after commissioning of activity/items.</li> <li>2. For cabling work – 70% of payment shall be verified after laying, glanding, ferruling and termination. 20% shall be verified after loop checking, dressing and commissioning of associated system.</li> <li>3. For impulse lines, earthing material and cable trays - 70% payment of any activity/item shall be verified after completion of erection work and 20% shall be verified after associated system commissioning.</li> <li>4. For civil and miscellaneous activity – 90% payment shall be verified after completion of work.</li> <li>5. For commissioning of motorised valve and PRVs – 90% payment shall be verified after commissioning of item.</li> </ol> <p><b>Final 10 % shall be paid after successful completion of work and handing over of system. The protocols shall be prepared jointly for completion of any activity.</b></p>
b)	<b>Security Deposit</b> shall be released only on completion of warranty period of 03 Months and fulfilment of all contractual obligations.
c)	All payments shall be subject to statutory deduction as per rule.
d)	Necessary documents as specified in GSCC shall be submitted with bill.
e)	All payment shall be made by Electronic Fund Transfer and necessary Bank Details shall be furnished by the sub-contractor.
6	<b>TAXES AND DUTIES: AS PER NIT</b>
7	<b>EXTRA WORKS</b>
a	All Major rectifications/ modifications, revamping, and reworks required for any reasons not due to the fault of the contractor, or needed due to any change in deviation from drawings and design of equipment, operation/ maintenance requirements, mismatching, or due to damages in transit, storage and erection/ commissioning, and other allied works which are not very specifically indicated in the drawings, but are found essential for satisfactory completion of the work, will be

	considered as extra works.
b	Extra works arising on account of the contractor's fault, irrespective of time consumed in rectification of the damage/loss, will have to be carried out by the contractor free of cost. Under such circumstances, any material and consumable required for this purpose will also have to be arranged by the contractor at his cost.
c	All the extra work should be carried out by a separately identifiable gang, without affecting routine activities. Daily log sheets in the pro-forma prescribed by BHEL should be maintained and shall be signed by the contractor's representative and BHEL engineer. No claim for extra work will be considered/ entertained in the absence of the said supporting documents i.e. daily log sheets. Signing of log sheets by BHEL engineer does not necessarily mean the acceptance of such works as extra works.
d	BHEL retains the right to award or not to award any of the major repair/ rework /modification/rectification/fabrication works to the contractor, at their discretion without assigning any reason for the same. The decision of BHEL site engineer w.r.t. extra work shall be final and binding upon the sub-contractor.
e	After eligibility of extra works is established and finally accepted by BHEL engineer/designer, payment will be released on competent authority's approval at the following rate: <b>MAN-HOUR RATE FOR ELIGIBLE EXTRA WORKS:</b> Single composite average labour man-hour rate, including overtime if any, supervision, use of tools and tackles and other site expenses and incidentals, consumables for carrying out any major rework/ repairs/ rectification/ modification/ fabrication as certified by site as may arise during the course of erection, testing, commissioning or extra works arising out of transit, storage and erection damages, payment, if found due will be at <b>Rs. 60/- per man hour.</b>
f	The above composite labour man hour rate towards extra works shall remain firm and not subject to any variation during execution of the work Rate revision.
<b>8</b>	<b>Other Terms &amp; conditions shall be as per GSCC. In case of any conflict between the special terms and conditions specified in the scope of work and GSCC attached, the conditions of scope of work shall prevail.</b>

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