VOLUME- IV
SECTION-09
LV POWER & CONTROL CABLE

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1 GENERAL

This specification is intended to cover the design, engineering, manufacture, assembly, testing at manufacturer's works, supply & delivery, properly packed for transport to site of LT Power & Control Cable complete with all accessories for efficient and trouble-free operation for 2 x 500 MW New Thermal Power Plant at Neyveli, Tamilnadu for Neyveli Lignite Corporation Limited.

2 CODES AND STANDARDS

All equipment and materials will be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below or any international standard acceptable to purchaser.

CODE	:	NAME OF STANDARD
IS:1554(Part I)	:	PVC insulated(heavy duty) electric cables for working voltage up to and including 1100V
IS:1554(Part II)	:	PVC insulated(heavy duty) electric cables for working voltage from 3.3kv up to and including 11Kv
IS: 3961	:	Recommended current ratings for cables.
IS: 8130	:	Conductors for insulated electric cables and flexible cords
IS:5831	:	PVC insulation and sheath of electric cables
IS: 2982	:	Copper conductor in insulated cables and cords.
IS: 3975	:	Mild steel wires, strips and tapes for armouring cables
IS: 5609	:	Specification for low frequency wirers and cables with PVC insulation and PVC sheath
IS: 6380	:	Specification of elastomeric insulation of sheath of electric cables.
IS: 434(I and II)	:	Specification for rubber insulation cables.

IEC: 540	:	The methods for insulations and sheath of electric cables and cords(elastomeric and thermoplastic compounds)
IEC: 230	:	Impulse tests on cables and their accessories
IEC: 60	:	High voltage test techniques
IEC: 287	:	Calculation of the continuous current rating of the cables (100% load factor).
IEC: 288	:	Nominal cross sectional area and composition of conductor of insulated cables.
IEC: 502	:	Extruded solid dielectric insulated power cables for rated voltages from 1kV upto 30kV.
NEMA-WC-5	:	Thermoplastic insulated wires and cables for transmission and distribution of electrical energy.
IEEE: 383	:	Standard for type test for class IE electric cables, filled splices and connection for nuclear power generation station.
IEC: 332-1	:	Test on electric cables under fire conditions.
ASTM-D-2843	:	Standard test method for density of smoke from burning/decomposition of plastics.
ASTM-D-2863	:	Test for determination of oxygen index.
IEC-754-I	:	Test method for acid gas generation
IEC-331	:	Fire resisting characteristics of electric cables
		SVENSK Standard SS-4241475 Class F3

- BICC Hand Book For cables in fire regarding temperature index-chapter-6

- Indian Electricity Rule.

Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted subject to approval of the Owner. In such case, copies of the English version of the standards adopted will have to be submitted during detail engineering.

The electrical installation will meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Codes of Practice. In addition, other rules and regulations applicable to the work will be followed.

3 DESIGN CRITERIA

The cable will be used for connection of power and control circuits of the auxiliary electrical systems.

The cable will be suitable for installation in the required site conditions.

Cables will be sized suitably with proper de-rating factors as per the installation conditions of the cable.

For continuous operation at specified rating as well as during short circuit condition the maximum conductor temperature will be limited to the permissible value as per relevant standard.

The insulation and sheath materials will be resistant to oil, acid and alkali and will be tough enough to withstand mechanical stresses during handling.

Armouring, wherever provided, will be single round/ flat wire of galvanised steel for multi-core cables and aluminium for single core cable. Cables in buried formation will be armored. Cables laid in duct banks/conduits will be unarmoured.

The outer sheath as well as the inner sheath will have flame retardant low smoke (FRLS) characteristics and will meet the requirements of additional tests specified for this purpose.

Core identification for multi-core cable will be provided by colour coding.

Power cables will be chosen taking into account the following factors:

a) System Fault level.

b) Maximum time for fault clearance (i.e, operating time of the back up protection relays plus the time of operation of the circuit breakers).

c) Full load current of the circuit.

d) Short circuit current and duration (for breaker protected cables)

e) Installation conditions.

f) Voltage drop under normal running and starting condition

g) Voltage drop at motor terminals will be within permissible limit during starting & normal running.

h) The cable should withstand the maximum fault current corresponding to the particular voltage level for the minimum time before the fault is cleared.

i) Consideration will also be given to limit the cable to the nearest standard sizes instead of using too many types.

j) The standard cable sizes, ampacities, de-rating factors, etc. will be as given in IS or relevant standard.

k) The minimum size of power cables to be used will be as follow :

Aluminium conductor	:	6 Sq. mm.
Copper conductor	:	2.5 Sq. mm.

4 SPECIFIC REQUIREMENTS

4.1 Type of Cable

LV power cables shall be stranded aluminium conductor, cross linked polyethylene (XLPE) insulated, extruded black FRLS PVC inner sheathed, armoured and overall FRLS extruded black PVC sheathed cables conforming to IS: 7098.

Control Cables shall be 1100 V grade with annealed high conductivity stranded copper conductor, PVC insulated, FRLS PVC inner sheathed, armoured and FRLS extruded black PVC outer sheathed cables conforming to IS : 1554.

4.2 Conductor

The cable conductor shall be made from standard Aluminum for LT Power cables and Copper for control cables to form compact conductor having a resistance within the limits specified. All the cables of size 25mm^2 and above shall have sector shaped conductors.

4.3 Insulation

The insulation of the LV power cable shall be XLPE type & for control the insulation shall be PVC type. It will be designed and manufactured for the specified system voltage. The manufacturing process will ensure that insulation will be free from voids. The insulation will withstand mechanical and thermal stresses under steady state and transient operating conditions. The extrusion method should give a very smooth interface between semi conducting screen and insulation. The insulation of the cables will be of high standard quality.

4.4 Inner Sheath

The sheath will be suitable to withstand the site conditions and the desired temperature. It will be of adequate thickness and applied by a continuous

process to produce a sheath of consistent quality free from all defects. PVC sheath will be extruded.

4.5 Armour

Hard drawn aluminum wire armouring/ galvanized steel tape/ wire armouring will be used for single core and multi-core cable respectively. Cables should be un-armoured wherever indicated. The hard drawn aluminium wire for armour will be of H4 grade, as per IS-8130 (having tensile strength above 150 N/mm2). The diameter of the aluminium wire will be as per the table for the dimensions of the galvanized steel wire armour given in the relevant standard.

4.6 Outer sheath

FRLS extruded black PVC serving as per IS: 1554 otherwise will be applied over the armouring with suitable additives to prevent rodent and termites. All serving must be given anti-termite treatment.

4.7 Packing

- Cables will be supplied in non-returnable drums. Drum lengths will be such so that cable joints are totally avoided. The drums will be of heavy construction. All wooden parts will be manufactured from seasoned wood. All ferrous parts used will be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage. Wooden cable drum will be treated by immersing in copper-nitrate solution.
- The ends of each cable length will be sealed before shipment. Heat shrinkable cable cap will be used for this purpose.
- A label will be securely attached to each end of the reel indicating the Purchaser's order number, Owner's identification mark i.e. "NNTPP ", length, type, voltage grade, conductor size and number of cores of the cable. A tag containing the same information will be attached to the leading end of the cable inside. An arrow and necessary instructions will be marked on the drum indicating the direction in which it should be rolled. Drum numbers are to be indicated on the cable drums.

4.8 Spare Core

Multi-core control cables will have 20% spare core, minimum one spare.

Separate cables for each type of following services / functions as applicable will be used for each feeder. Same multi-core cable using different services will not be acceptable.

a) Power.
b) Control, interlock and indication.
c) Metering and measuring.
d) Alarm and annunciation.
e) C.T. Cables.

f) V.T. Cables.

4.9 Constructional Requirements

a) Cable will have suitable fillers laid up with the conductors to provide a substantially circular cross section before the sheath is applied. Fillers will be suitable for the operating temperature of the cable and compatible with the insulating material. All materials will be new, unused and of finest quality.

b) Workmanship will be neat, clean and of the highest grade.

c) LT Power cables will be 1.1kV grade, heavy duty, stranded aluminium conductor, XLPE Insulated galvanized steel wire/strip armoured, flame retardant low smoke (FRLS) extruded PVC type outer sheathed.

d) Control cables will be 1.1kV grade, heavy duty, stranded copper conductor, PVC Type-A insulated, galvanized steel wire armoured, flame retardent low smoke (FRLS) extruded PVC of Type - ST1 outer sheathed.

e) Special Properties:
All the above cables will be conforming to the relevant Indian/IEC standard in general, with the following special properties:

- Oxygen Index of the outer sheath will not be less than 29, when tested as per ASTM-D-2863.
- Temperature Index of the outer sheath will not be less than 250°C, when tested as per ASTM-D-2863.
- Halogen acid contents in outer sheath will not be more than 20%, when tested as per IEC-60754.
- The maximum smoke density in percent light absorption should not exceed 60% in case of PVC compound and 20% in case of fire survival cables, when tested as per ASTM-D-2843.
- Swedish chimney test as per SS-4241475 class F3 and ladder test for flammability as per IEEE-383.

4.10 Joints and Terminations

Materials of construction for a joint/termination will perfectly match with the dielectric chemical and physical characteristics of the associated cables. The material and design concepts will incorporate a high degree of operating compatibility between the cable and joints. The protective outer covering (jacket) used on the joints/terminations will have the same qualities as that of the cable outer sheath in terms of ambient/operating temperature withstand capability and resistance to hazardous environments and corrosive elements. No joints will be allowed unless the cable drawn length is exceeded.

4.11 Cable Identification

Cable identification will be provided by embossing the following on the outer sheath:

a) Manufacturer's name or trade mark

b) Voltage grade
c) Year of manufacture
d) Type of insulation.
e) Type of outer sheath e.g. "FRLS" etc.
f) ISI marks
g) Nominal cross sectional area of the conductor & no of cores
h) Sequential marking
i) Owner's identification mark "NNTPS"

5 TESTS

5.1 Type Test

Cables will be type tested quality. For each type and rating of cables reports on all type tests carried out as per relevant standards will be submitted.

These reports will be for the tests conducted on the similar type of cables proposed to be supplied under this contract. These tests should have been conducted at an independent laboratory. In case the contractor is not able to submit report of the type test(s) conducted or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor will conduct all such tests in the presence of the Purchaser without cost implication and submit the reports for approval.

5.2 Shop Tests

The Cables shall be tested in accordance with relevant IS/IEC standards at manufacturers' works as given below:

- Routine tests on each drum of cables.
- Acceptance tests on drums chosen at random for acceptance of the lot shall be conducted in the presence of Consultant / purchaser or his representative.

5.3 Additional Tests

Following additional acceptance tests shall also be performed on each type of cables having outer sheath with improved fire performance (Category C1, Type FR/ Category C2, Type FRLS). All the additional tests shall be conducted in the presence of the purchaser.

a) Oxygen index test (for both C1 & C2) – The oxygen index test shall be carried out as per ASTM D2863. The Oxygen index shall not be less than 29.
b) Temperature Index Test (for both C1 & C2) - The measured value of temperature index shall be 21 at a temperature of 250°C.
c) Flame retardance test on single cable and on bunched cables (for both C1 & C2) - After the test, there should be no visible damages on the test specimen within 300mm from its upper end. After burning has ceased, the cables should be wiped clean and the charred or affected portion should not have reached a height exceeding 2.5 meter above the

bottom edge of the burner, measured at the front and rear of the cable assembly.

d) Halogen acid gas evolution test (for category C2) – This test shall be as per IEC-754-1.The level of HCL evolved shall not exceed 20 per cent by weight.

e) Smoke density test (for category C2) – Smoke generation by outer sheath under fire as per ASTM D 2843. The cables shall meet the requirements of light transmission of minimum 40% after the test.

f) Test for rodent & termite repulsion property.

6 FIRE PROOF SEALING SYSTEM

Fire proof sealing system will consist of Fire-stops/fire-seals for sealing of cable/cable tray and conduit/pipe penetrations, both horizontal and vertical, through brick or RCC walls/floors, to prevent the spread of fire from one area, which is separated from others by fire-resistant barriers. The rating of the fire proof sealing system shall be minimum two hours.

'Fire-breaks' provided on long runs of cable racks/trays to prevent the propagation of fire along the cable rack, within a single fire-area or fire- zone.

The FPS system will also include all the necessary accessories and equipment required for supporting, holding in position, fixing and installation of the fire-stop/fire-break.

The FPS system will comply in all respects with the requirements of the codes and standards listed below

IEEE-634, ASTM-E-814, ANSI-IEEE-383, IEC-331, IEC-332.

Wherever the cables pass through walls/ floors, fire proof cable penetration seals rated for two hours will be provided.

Fire stop/ seal

The FPS system adopted for cables or cable trays penetrating through walls and floor constitute a openings, or cables passing through embedded conduits / pipes / pipe- sleeves, fire stop / seal', which is meant to prevent spreading of fire between areas separated by fire-resistant barriers.

Fire Break

The fire proofing system, other than fire-stops, adopted to retard flame propagation long runs of horizontal or vertical cable trays in the same fire zone or area, in an event of a fire, will constitute a `fire-break' and will be provided by applying a suitable fire –resistance coating on cables and cable trays for the required length, with or without a fire resistant panel, at the point of the fire break to obtain the fire-rating specified.

Application of fire proof sealing system

Fire stops will be provided for cable penetration openings listed below

The passage of cables/cable trays pipe sleeves/embedded conduits through walls / floors.

Vertical raceways, which carry cables between successive floors, through openings provided in the RCC floor slab, will be sealed by fire stops at each floor level.

Cable entry through openings in floor slabs below HT/LT switchgear, MCCs, various Control and relay panels and other bottom entry panels, will be effectively sealed by fire stop

Location of fire breaks

Firebreaks will be provided on both cable rack and trenches at all cable tray Intersections and tee-offs.

On linear runs of cable trays between fire stops or fire breaks, fire breaks will be provided at intervals of 15 metres on horizontal cable runs and 5 m on vertical cable runs.

Fire breaks in linear runs of cable trenches between intersections and tee-offs will be provided at intervals of 30 metres.

Contractor will furnish the test certificates for the fire stops and fire breaks after award of contract for Owner/Owner's Representative review. If the certificates are not satisfactory all the tests will be conducted free of cost. The offered system i.e. fire stops and fire breaks will be identical (or better) with the system which is successfully type tested for the specified rating i.e. the composition density of the material, thickness of coating in case of fire breaks and any other properties of the material / system offered will be identical or better than the tested system and will be subject to Owner / Owner's Representative.

Test on fire stops

The fire stops shall be subjected to the following type tests:

- Fire Rating Test
- Hose Stream Test

Type tests shall be conducted on different fire stop test specimens described above as per IEEE-634. The sizes of the fire stop test specimens shall be similar to the largest of the sizes being used in the plant.

Preconditioning of fire stop test specimens before conducting the fire rating and hose stream tests, each test specimen shall be preconditioned for thermal ageing, water immersion and vibration.

Test on Fire Stops

During the fire rating test, the transmission of heat through the cable penetration fire stop shall not raise the temperature on its unexposed surface above the self ignition temperature of the outer cable covering, the cable penetration fire stop material, or material in contact with the cable penetration fire stop, with a maximum temperature limit on the unexposed surface of 200°C.

Tests on fire breaks

- Firebreaks shall undergo the following tests as per ANSI-IEEE-383:
- Ampacity test
- Flame test

7 DRAWINGS, DATA AND MANUALS TO BE FURNISHED FOR APPROVAL

- Cable datasheets
- Cable sizing
- QAPs & Test Reports
- Relevant catalogues

8 RATINGS AND REQUIREMENTS

8.1 L.V. Power cables 1100 V grade

1100 V grade, power cable conforming to following requirement and in line with IS-1554, IS-5831, IS-8130 & IS-3975.

S.NO.	DESCRIPTION	:	SPECIFICATION
	Conductor	:	Stranded and compacted plain aluminium of grade H2 and class 2/stranded, high conductivity annealed plain copper as per Annexure, generally conforming to IS:8130
	Insulation	:	Extruded Cross linked Polyethylene (XLPE).
	Inner Sheath	:	Extruded FRLS PVC compound conforming to type ST2 of IS: 5831 for multicore cable.
	Armour	:	Galvanised single round/ strip steel wire armour for twin and multicore cables. Non-magnetic hard drawn aluminium single round wire conforming to H4 grade for single core cables.
	Overall Sheath	:	Extruded FRLS PVC compound conforming to type

			ST2 of IS: 5831.

8.2 Control Cables 1100 V Grade

1100 V grade, 700 C rating, PVC Control cable conforming to following requirement and in line with IS-1554, IS-8130, IS-5831 & IS-3975.

S.NO.	DESCRIPTION	:	SPECIFICATION
	Conductor	:	Stranded, non-compacted & circular, high conductivity annealed plain copper, generally conforming to IS: 8130.
	Insulation	:	Extruded PVC compound conforming to type A of IS: 5831.
	Inner sheath	:	Extruded FRLS PVC compound conforming to type ST1 of IS: 5831 for multicore cables. Single core cables shall have no inner sheath
	Armour	:	Galvanised single round steel wire for twin and multicore cables.
	Overall sheath	:	Extruded FRLS PVC compound conforming to type ST1 of IS:5831

8.3 **Trailing Cables (Power & Control)**

Trailing cable, 1.1kV grade with highly flexible stranded tinned copper conductor, insulation of EPR (Ethylene-propylene Rubber) each individual core protected and covered and overall outer cover of poly-chloroprene rubber cable will conform to IS 9968 part-1.

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General

List of tests/check given under this section are indicative and for reference. Quality plan based on manufacturer's standard practices and procedure shall be submitted for approval of purchaser/consultant during detail engineering. Contractor shall conduct the tests as per relevant standard and also as per the detail given in the respective equipment chapter of technical specification.

MOTOR

Attributes / Characteristics / Item / Components	Visual	Dimensional	Make/Type/Rating /General Physical Inspection	Mech/ Chem. Properties	NDT /DP/MPI/UT		Electrical Characteristics	Welding, Brazing (WPS/PQR)	Heat Treatment
Plates for stator frame, end shield, spider etc.	Y	Y	Y	Y	Y				Y
Shaft	Y	Y	Y	Y	Y				Y
Magnetic Material	Y	Y	Y	Y	Y		Y		Y
Rotor Copper/Aluminium	Y	Y	Y	Y	Y		Y		Y
Stator copper	Y	Y	Y	Y	Y		Y		Y
SC Ring	Y	Y	Y	Y	Y		Y	Y	Y
Insulating Material	Y	Y	Y	Y	Y				Y
Tubes, for Cooler	Y	Y	Y	Y	Y				Y
Sleeve Bearing	Y	Y	Y	Y	Y		Y		Y
Stator/Rotor, Exciter Coils	Y	Y	Y	Y	Y		Y	Y	
Castings, stator frame, terminal box and bearing housing etc.	Y	Y	Y	Y	Y			Y	
Fabrication & machining of stator, rotor, terminal box	Y	Y						Y	Y
Wound stator	Y	Y			Y			Y	
Wound Exciter	Y	Y						Y	
Rotor complete	Y	Y							
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y							
Accessories, RTD, BTD,CT, Space heater, antifriction bearing, gaskets etc.	Y	Y	Y						
Complete Motor	Y	Y	Y						

TESTS/CHECKS / ITEMS/COMPONENTS	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	Routine & Acceptance tests as per IS-325/IS-4722 /IS- 9283/ IS2148/ IEC60034\IEC 60079-I	Vibration		Tan delta, shaft voltage & polarization index test	Paint shade, thickness & adhesion
Plates for stator frame, end shield, spider etc.										
Shaft										
Magnetic Material	Y		Y							
Rotor Copper/Aluminium										
Stator copper			Y							
SC Ring										
Insulating Material			Y							
Tubes for Cooler		Y								
Sleeve Bearing		Y								
Stator/Rotor, Exciter Coils										
Castings, stator frame, terminal box and bearing housing etc.										
Fabrication & machining of stator, rotor, terminal box										
Wound stator										
Wound Exciter										
Rotor complete				Y	Y					
Exciter, Stator, Rotor, Terminal Box assembly										
Accessories, RTD, BTD,CT, Space heater, antifriction bearing, gaskets etc.										
Complete Motor						Y	Y		Y	Y

L.T POWER CABLES

Item /Components Sub System / Attributes 1.1.1.1.	Make, Rating, Type & TC	Dimension/surface finish	Mechanical Properties	Chemical Composition	Electrical Properties	Spark Test	Hot set test (XLPE)	Lay length / Sequence	Armour coverage, Cross over, looseness, Gap between two armour wire/strip	Sequential marking/surface finish /cable length	Tensile strength, elongation before & after ageing of insulation & outer sheath	Thermal Stability of insulation and outer sheath*	Anti termite treatment on wooden drums	Constructional / requirement as per OWNER Spec.	Routine and acceptance test as per Relevant Standard and OWNER specification	FRLS Test
Aluminum (IS-8130)	Y	Y	Y	Y	Y											
PVC Compound (IS-5831)	Y	Y	Y		Y						Y					
XLPE Compound (IS-7098 Part-I)	Y	Y	Y		Y		Y				Y					
FRLS PVC Compound (IS-5831) ASTM-D-2843/ IS 10810 (Part-58) IEC-60754 Part-I	Y										Y					
Armour wire/strip (IS-3975)		Y	Y													
Insulated Core		Y				Y	Y					Y				
Laid up core		Y						Y								
PVC Inner sheath		Y														
Armouring		Y							Y							
Outer sheath		Y								Y	Y	Y				Y

Finish cable (IS-1554 & 7098 – Part-1) ASTM-D-2843/ IS 10810 (Part- - 58) IEC-60754 Part-I Swedish Chimney SS 4241475 for (F3 category) Flammability test IEC-60332 Part –3 Cat-B	Y	Y							Y	Y	Y	Y	Y	Y	Y	Y
Wooden drum (IS-10418) / Steel drum		Y											Y			

Note:
1. This is an indicative list of test/checks. The manufacturer is to furnish a detailed quality plan indicating the practice and procedure along with relevant supporting documents.
2. Not applicable for XLPE insulation

(1.1 KV PVC & XLPE CABLES)

ROUTINE TESTS

Routine tests will be carried out on each drum of finished cables for all types & sizes. Following will constitute routine tests:

1) Conductor Resistance test
2) High voltage test at room temperature

ACCEPTANCE TESTS

Following Acceptance tests will be carried out for each type and size of the cables on the cable drums selected at random as per sampling plan mentioned in IS: 1554 Part 1 & IS 7098 Part-I

A) For Conductor

1) Annealing test for copper conductor only
2) Tensile test for aluminium conductor only
3) Wrapping test For aluminium conductor only
4) Resistance test

B) For Armour Wires / Formed Wires (If applicable)

1) Measurement of Dimensions
2) Tensile Tests
3) Elongation Test
4) Torsion Test — For Round wires only
5) Wrapping Test
6) Resistance Test
7) Mass of Zinc coating test — For G S wires / Formed wiresonly
8) Uniformity of Zinc coating — For G S wires / Formed wires only
9) Adhesion test — For G S wires / Formed wires only
10) Freedom from defects

C) For PVC / XLPE insulation & FRLS PVC Sheath

1) Test for thickness
2) Hot set test For XLPE insulation only

3) Tensile strength & Elongation before ageing

D) For completed cables

1) Insulation resistance test (Volume resistivity method)
2) High voltage test **at room temperature**

E) Following tests will be carried out and only one sample will be take from each offered lot of all sizes for these tests:-

1) Thermal stability test on PVC insulation and outer sheath
2) Oxygen index test on outer sheath
3) Smoke density rating test on outer sheath as per ASTM –D 2843
4) Acid gas generation test on outer sheath as per IEC –60 754 (Part 1)

F) Ageing test on PVC / XLPE insulation and FRLS PVC outer sheath as per following:

Samples as per relevant IS from every size per type of cable in the offered lot will be tested for tensile strength & elongation (before ageing). The values will be compared with corresponding values mentioned in the type test report accepted by OWNER. In case values of tensile strength & elongation (before ageing) are within + /- 15% of the type test reports then 1 sample per type of cable of offered lot will be put on accelerated ageing test. The accelerated ageing test procedure: sample to be put in air oven at temperature of 130°C +/- 2°C for 5 hours, tensile strength & elongation acceptance norms as per relevant IS. However in case the tensile strength and elongation values are not within +/- 15% of type test values then ageing test will be carried out on that particular size of cable of offered lot as per relevant IS.

G) Flammability test as per IEC 60332 - Part- 3 (Category- B) on completed cable as per following sampling plan.

The test will be carried out on every size & type of power cable offered for inspection as an acceptance test. This test will be carried out using composite sampling i.e. irrespective of sizes of cables of a particular type, may be tested together as per calculations in line with the IEC (all sizes will be covered)

H) Following tests will be carried on one length of each size of offered lot:

Surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires.

I) Additional tests as per the relevant part of the specification.

LT CONTROL CABLES

Attributes 1.1.1.1 / Item / Components Sub System	Make, Rating, Type & TC	Dimension/surface finish	Mechanical Properties	Chemical Composition	Electrical Properties	Spark Test	Hot set test (XLPE)	Lay length / Sequence	Armour coverage, Cross over, looseness, Gap between two armour wire/strip	Sequential marking/surface finish /cable length	Tensile strength, elongation before & after ageing of insulation & outer sheath	Thermal Stability of insulation and outer sheath *	Anti termite treatment on wooden drums	Constructional / requirement as per OWNER Spec.	Routine and acceptance test as per Relevant Standard and OWNER specification	FRLS Test
Aluminum (IS-8130)	Y	Y	Y	Y	Y											
PVC Compound (IS-5831)	Y	Y	Y		Y						Y					
XLPE Compound(IS-7098 Part-I)	Y	Y	Y		Y		Y				Y					
FRLS PVC Compound(IS-5831) ASTM-D-2843/ IS 10810 (Part-58) IEC-60754 Part-I	Y															
Armour wire/strip (IS-3975)		Y	Y													
Insulated Core		Y				Y	Y				Y					
Laid up core		Y						Y								
PVC Inner sheath		Y														
Armouring		Y							Y							
Outer sheath		Y								Y	Y	Y				Y

Finish cable (IS-1554 & 7098 – Part-1) ASTM-D-2843/ IS 10810 (Part- - 58) IEC-60754 Part-I Swedish Chimney SS 4241475 for (F3 category) Flammability test IEC-60332 Part –3 Cat-B	Y	Y							Y	Y	Y	Y	Y	Y	Y	Y
Wooden drum (IS-10418)/Steel drum		Y											Y			

ROUTINE TESTS

Routine tests will be carried out on each drum of finished cables for all types & sizes. Following will constitute routine tests:

1) Conductor Resistance test
2) High voltage test at room temperature

ACCEPTANCE TESTS

Following Acceptance tests will be carried out for each type and size of the cables on the cable drums selected at random as per sampling plan mentioned in IS: 1554 Part 1

A) For Conductor

1) Annealing test — For copper conductor only
2) Resistance test

B) For Armour Wires / Formed Wires (If applicable)

1) Measurement of Dimensions
2) Tensile Tests
3) Elongation Test
4) Torsion Test — For Round wires only
5) Wrapping Test
6) Resistance Test
7) Mass of Zinc coating test — For G S wires / Formed wires only
8) Uniformity of Zinc coating — For G S wires / Formed wires only
9) Adhesion test — For G S wires / Formed wires Only
10) Freedom from defects

C) For PVC / XLPE insulation & FRLS PVC Sheath

1) Test for thickness
2) Tensile strength & Elongation before ageing

D) For completed cables

1) Insulation resistance test (Volume resistivity method)
2) High voltage test at room temperature

E) Following tests will be carried out and only one sample will be taken from each offered lot of all sizes for these tests:-

1) Thermal stability test on PVC insulation and outer sheath
2) Oxygen index test on outer sheath
3) Smoke density rating test on outer sheath as per ASTM –D 2843

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4) Acid gas generation test on outer sheath as per IEC –60 754 (Part 1)

F) **Ageing test on PVC insulation and FRLS PVC outer sheath as per following:**

Samples as per relevant IS from every size per type of cable in the offered lot will be tested for tensile strength & elongation (before ageing). The values will be compared with corresponding values mentioned in the type test report accepted by OWNER. In case values of tensile strength & elongation (before ageing) are within + /- 15% of the type test reports then 1 sample per type of cable of offered lot will be put on accelerated ageing test. The accelerated ageing test procedure: sample to be put in air oven at temperature of 130°C +/- 2°C for 5 hours, tensile strength & elongation acceptance norms as per relevant IS. However in case the tensile strength and elongation values are not within +/- 15% of type test values then ageing test will be carried out on that particular size of cable of offered lot as per relevant IS.

G) **Flammability test as per IEC 60332 - Part- 3 (Category- B) on completed cable as per following sampling plan.**
The test will be carried out on every size & type of control cable offered for inspection as an acceptance test. This test will be carried out using composite sampling i.e. irrespective of sizes of cables of a particular type, may be tested together as per calculations in line with the IEC (all sizes will be covered)

H) **Following tests will be carried on one length of each size of offered lot:**
Surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wire.

I) **Additional tests as per the relevant part of the specification.**

CABLING, EARTHING & LIGHTNING PROTECTION

ATTRIBUTES/ CHARACTERISTICS / ITEM/ COMPONENTS/SUB SYSTEM	Dimension	Paint shade, paint thickness, adhesion	Pre-treatment of sheet	IP protection	Proof load*	Surface finish	Deflection test*	HV & IR	Galvanize Test (If Applicable)	Functional	Bought out items/Bill of material	Routine tests as per relevant standard & specification	Acceptance tests as per relevant standard & specification	Constructional feature as per OWNER
Wall Mounted-Lighting Panel (IS-513, IS:5, IS:2629, 2633, 6745)	Y	Y	Y	Y		Y		Y	Y	Y	Y	Y	Y	Y
Switch box/junction box/ Receptacles Panel (IS-513, IS:5, IS:2629, 2633, 6745)	Y	Y	Y	Y		Y		Y	Y	Y	Y	Y	Y	Y
Cable glands (BS-6121)	Y											Y		
Cable lug (IS-8309)	Y											Y		

Lighting wire (IS-694)	Y										Y		
Conduits(Galvanize & Epoxy) IS-9537 & IS-2629,2633 ,6745	Y	Y	Y								Y		Y
RCC Hume Pipe (IS-458)											Y		Y
Cable termination & straight through joint (VDE-0278)	Y		Y								Y		
Cable Trays, Flexible supports system & accessories IS-513, 2629,2633,6745	Y	Y			Y	Y	Y	Y	Y	Y	Y		Y
Trefoil clamp	Y										Y		Y
GI flats for earthing & lighting protection (IS 2062, 2629, 6745, 2633)	Y	Y									Y		Y
GI wire (IS-280)	Y										Y		Y
Fire Sealing System (BS –476)	Y										Y		Y

NOTE:

1. This is an indicative list of tests /checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. *Deflection Test on cable trays and Proof Load test on cable trays support system will be as per details given in the OWNER technical specification & approved MQP. The above acceptance tests shall be done only on one sample from each size of offered lot.
3. Make of all items will be subject to OWNER approval.

MANUFACTURER'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT: 2X500 MW NNTPS (SG)
	ITEM: EOT CRANES - SINGLE GIRDER	REV Rev 00	PACKAGE: Single Girder EOT Crane
		DATE	P.O.NO –
	CAPACITY: -	PAGE Page 1 of 5	BHEL NO: PE-V0-400-524-A100
			CONTRACTOR: BHEL

S.NO.	Component & Operation	Characteristics	Class	Type of check	Quantum of check	Reference Document	Acceptance Norms	Format of Record	Agency				Remark
									D	M	C	N	
1	2	3	4	5	6	7	8	9		10			11
`	***FOR EOT CRANE***												
1.0	**RECEVING INSPECTION**												
1.1	Structural-Plates/RSJ for Main Girders, End Carriages Trolley, Pulley, Gearbox housing , rope drum (if fabricated) etc.	Physical & Chemical	Major	Lab Analysis	100%	IS:2062 Gr. A or B / As per approved G.A.		MTC / Lab Report	_/	P/V	V	V	
1.2	Rope Drum (Seamless Pipe)	Chemical Mechanical	Major	Lab Analysis	1/pipe	Approved drg/DS ASTM A106 Gr A or B		Lab Report	_/	P	V	V	
		Flattening & Acid etching Test Surface defect	Major	Mech test Visual	1/pipe 100%	no cracks, pitting, rusting, damage ,etc		I.R.	_/	P	V	V	
1.3	Gears, pinions, shafts, axles & wheels (#)	Chemical& Mechanical,	Major Major	Lab Analysis UT	1/lot 100%	IS:2004 (45C8/55C8) (Relevant IS/appd drg) ASTM A388/NOTE 1		MTC I.R	_/ _/	P P	V V	V V	# If wheel, gears, pinions, shafts & axle diameter / thickness is equal to or more than 50 mm UT shall be carried out, ref & acceptance norm at S.no.1.4(UT of hook) to be followed
1.4	Hook	Chemical & Mechanical	Major	Lab Analysis	100%	IS: 15560 Related Std. As per appd. Drg./data sheet		MTC	_/	V	V	V	
		UT (above 50 mm dia)	Major	UT on shank portion only	100%	ASTM A388 / ASME Sec VIII Divn 2 – NOTE:1		MTC/ ALC/QCR /UT report	_/	P	V	V	

MANUFACTURER	CONTRACTOR	LEGEND: CLASS A: Critical, B: Major, C: Minor		DOC. NO.:
NAME & SIGNATURE		** M: MANUFACTURER / SUB-CONTRACTOR D: Records for Data Fold C: CONTRACTOR /NOMINATED INSPECTION AGENCY, ND: NDT LAB N: Customer R: Test / Dim Report, IR-Inspection Report INDICATE "P" PERFORMS, "W" WITNESS, MTC: Mfr's Test Cert. "V" VERIFICATION, ALC: Approved Laboratory Certificate, QCR: Quality Control Report		NAME & SIGN OF APPROVING AUTHORITY & SEAL

MANUFACTURER'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT: 2X500 MW NNTPS (SG)
	ITEM: EOT CRANES - SINGLE GIRDER	REV Rev 00	PACKAGE: Single Girder EOT Crane
		DATE	P.O.NO –
	CAPACITY: -	PAGE Page 2 of 5	BHEL NO: PE-V0-400-524-A100
			CONTRACTOR: BHEL

S.NO.	Component & Operation	Characteristics	Class	Type of check	Quantum of check	Reference Document	Acceptance Norms	Format of Record	Agency				Remark
									D	M	C	N	
1	2	3	4	5	6	7	8	9		10			11
1.5	Wire Rope	Examination of report of breaking load Dimension & Type, construction	Major	Review of TC Measurement	100% 100%	IS: 2266 Appd G A drg	IS: 2266 Appd G A drg	Mfr's TC QCR	_/	P P	V V	V V	
1.6	Motors & cables. Brakes	Make/Type/Rating/ Routine test Make/ type / rating/ HV/IR functional test	Major	Visual / Measurement	100%	Appd drg/DS/Tech spec/Rel IS	I.R	STC	_/	P	V	V	For motor, ref. Note 2
1.7	Sheaves	Mech		Tensile & Hardness	1/lot	Approved Drg / Mfg drg		MTC	_/	P	V	V	
1.8	Limit switch, SFU, Relays, MCB, Fuses, Push buttons Etc Control transformer	Make/Type/Rating Functional /continuity Make , type, rating, input/output	Major	Review of TC	100%	Appd drg./DS/Scheme/NLC Spec./Manu.Std		QCR Routine TC/COC of mfgr	_/	V	V	V	
1.9	DSL	Make , type, rating, Dimension.	Major	Review of TC	100%	Appd drg./DS/Scheme /NLC Spec./ Manu.Std		QCR Routine TC/COC of mfgr.	_/	V	V	V	
2	**INPROCESS- INSPECTION**												
2.1	WPS,PQR & WPQ	Verification of approval				WPS,PQR & WPQ / Qualified by NTPC/ LLOYDS / EIL / TPL			_/	P	V	V	IN CASE OF NTPC/ LLOYDS / EIL / TPL QUALIFIED WELDERS AVAILABLE, REQUALIFICATION OF WELDER IS NOT REQUIRED
2.2	Assembled gear box	No load run test backlash & contact pattern, noise, vibration & oil temp rise (for oil lubrictd)	Major	Performance	100%	Apprvd drg/DS/Mfg std Noise 85dbA max, vibration 75 microns max, oil temp rise – 30 °C above ambient max			_/	P	V	V	

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MANUFACTURER'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT: 2X500 MW NNTPS (SG)
	ITEM: EOT CRANES - SINGLE GIRDER	REV Rev 00	PACKAGE: Single Girder EOT Crane
		DATE	P.O.NO –
	CAPACITY: -	PAGE Page 3 of 5	BHEL NO: PE-V0-400-524-A100
			CONTRACTOR: BHEL

S.NO.	Component & Operation	Characteristics	Class	Type of check	Quantum of check	Reference Document	Acceptance Norms	Format of Record	Agency				Remark
									D	M	C	N	
1	2	3	4	5	6	7	8	9		10			11
2.3	Welding of end carriage, Main Girder, Trolley , rope drum (if fabricated) etc.,	DPT of Welds(all)	Major	LPI	100% on butt&10% on fillet	ASTM E165 or Eq. / No crack or linear indication		I.R.	_/	P	V	V	
		RT of Butt weld	Major	RT	100%/10%	ASME Sec.VIII,Div.1, UW 51/52		RT film & report	_/	P	V	V	@RT-100%, for Butt weld in tension & 25% in compression. 100% RT on butt weld for fabricated rope drum
2.4	Hook	Dimension	Major	Measurement	100%	Mfr's drg / Related Std. As per appd. Drg./data sheet/		QCR	_/	P	V	V	
		Proof Load	Major	Load Test		IS: 15560	IS: 15560	QCR	_/	P	V	V	
		NDT after proof load	Major	LPI	100%	ASTME 165 or Eq. / No crack or linear indication		I.R.		P	V	V	
2.5	Gears, pinions, shafts, axles & wheels (#)	Hardness Surface Defect (after machining)	Major	DPT	100%	Approved Drg/ Data sheet ASTM E-165 No linear indication		MTC	_/	P	V	V	
3	**FINAL INSPECTION**												
3.1	Overall dimensions	Dimensions (span) level, alignment	Critical	Measurement	100%	Appd GA drg & IS: 3177/IS:3938		I.R.	_/	P	W	W	FUNCTIONAL CHECK OF PENDENT &
3.2a	Assembled Crane along with individual control panel & pendant station	Current & speed for Cross Travel & Hoisting, interlocking sequencing, inching operation, Limit switch operation	Critical	Measure /Verify	100%	Appd GA drg & IS: 3177/Appd data sheet		I.R.	_/	P	W	W	PANEL FOR SPECIFIC CRANE
		Deflection at SWL		Measurement					_/	P	W	W	
3.2b	Overload test at 125% of SWL	Holding capacity of brakes		Lifting from mid Air	100%	Appd GA drg & IS: 3177/ IS:3938/ Appd data sheet		I.R.	_/	P	W	W	

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MANUFACTURER'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT: 2X500 MW NNTPS (SG)
	ITEM: EOT CRANES - SINGLE GIRDER	REV Rev 00	PACKAGE: Single Girder EOT Crane
		DATE	P.O.NO –
	CAPACITY: -	PAGE Page 4 of 5	BHEL NO: PE-V0-400-524-A100
			CONTRACTOR: BHEL

S.NO.	Component & Operation	Characteristics	Class	Type of check	Quantum of check	Reference Document	Acceptance Norms	Format of Record	Agency				Remark
									D	M	C	N	
1	2	3	4	5	6	7	8	9		10			11
3.3	Control Panel & Pendant station	1. Make/type/rating of Bois. 2.IR-HV functional &interlocks 3.DOP by paper insertion for panel	Major Major do	Visual, Operational & Functional Measurement do	100% 100% 100%	Approved drawing / Data sheet / is: 3177 Paper should not go easily.		I.R.		P P	W W	W W	HV of power circuit at 2kV and control circuit at 1kV. IR of power & control circuit with 500V Meggar with acceptance norm of 0.5 Mega Ohm.
3.4	Painting	Examination – shade	Minor	Visual & measurement	100%	Customer's / Approved Painting Procedure				P	V	-	
		Dry Film Thickness	Major	Measurement	Sample					P	V	-	

NOTE1:'**' When back wall echo is set to 100% in sound area then,
a) defect echo shall not exceed 20%
b) Back echo shall be minimum 80% in any area

Note 2:- Less than 30 KW. Acceptance of motor less than 30 KW is based on COC of the manufacturer & the contractor confirming as follows : It is hereby confirmed that the above mentioned motor/motors was/were manufactured taking care of NLC specific requirement regarding ambient temp, voltage & frequency variation, hot start, pull out torque, starting KVA/KW, temp rise, distance between center of stud and gland plate and tested in accordance with approved drawing/data sheet.

		LEGEND: CLASS A: Critical, B: Major, C: Minor		DOC. NO.:
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MANUFACTURER	CONTRACTOR			
NAME & SIGNATURE				

MANUFACTURER'S NAME & ADDRESS :	**MANUFACTURING QUALITY PLAN** **ITEM :** SINGLE GIRDER HOT CRANE **QP No.:** PE-TS-400-524-A001 **REV**.:0, **Date.: DEC 2014, PAGE**: 1 OF 5	**PROJECT : 2X500 MW NNTPS (SG)** **PACKAGE : SINGLE GIRDER HOT CRANE** **VOL IIB, SEC C**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
										M	C	N	
1.	2.	3.	4.	5.	6.	7.	8.	9.		10.			11.
1	**RAW MATERIAL & B/OUT ITEMS:**												
1.1	STRUCTURAL-PLATES/RSJ FOR MAIN GIRDERS, END CARRIAGES TROLLEY, PULLEY, GEARBOX HOUSING , ROPE DRUM (IF FABRICATED) ETC.	Physical & Chemical	Major	Lab Analysis	100%	IS:2062 Gr. A or B / As per approved G.A.	IS:2062 Gr. A or B / As per approved G.A.	MTC / Lab Report	✓	P	V	V	
	HOOKS	DIMENSIONS, CHEMICAL COMPOSITION. IDENTIFICATION & COMPLIANCE WITH TC. MECHANICAL, PHYSICAL PROPERTIES	MA MA MA	LAB ANALYSIS HARDNESS MECHANICAL PROPERTIES	One sample PER LOT	IS: 15560 Gr. M OR APPD. DRAWING	IS: 15560 Gr. M or APPD. DRG.	MFR's T.C.	✓	P	V	V	
1.3	LOAD CHAIN	- DIMENSIONS - BREAKING STRENGTH - PROOF LOAD	MA MA MA	MEASUREMENT -TENSILE TEST -TENSILE TEST	100 % 100% 100%	IS: 6216 OR APPD. DRAWINGS	IS: 6216 & APPD. DRGS.	MFR'S TC	✓	P	V	V	
1.4	RAW MATL. FOR GEAR/ RATCHET PAWL / RATCHET WHEEL	CHEMICAL COMPOSITION MECHANICAL	MA MA	LAB ANALYSIS HARDNESS	ONE SAMPLE PER LOT	BS 970/ DIN 17210/SAE/ IS	En 9 / En 3A 16MnCr5	TC TC	✓ ✓	P P	V	V V	TC or inspection report for components shall

	LEGEND:	FOR CUSTOMER USE	
UFACTURER / CONTRACTOR CONTRACTOR SIGNATURE	** M : MANUFACTURER / SUB-CONTRACTOR C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION	REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

MANUFACTURER'S NAME & ADDRESS :	**MANUFACTURING QUALITY PLAN** **ITEM :** SINGLE GIRDER HOT CRANE **QP No.:** PE-TS-400-524-A001 **REV**.:0, **Date.: DEC 2014, PAGE**: 2 OF 5	**PROJECT : 2X500 MW NNTPS (SG)** **PACKAGE : SINGLE GIRDER HOT CRANE** **VOL IIB, SEC C**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
										M	C	N	
1.	2.	3.	4.	5.	6.	7.	8.	9.		10.			11.
							/16Mn5Cr4				V		be given.
1.4.	LOAD CHAIN WHEELS	- CHEMICAL COMPOSITION PHYSICAL PROPERTIES	MA MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT	IS 1865 OR APPD. DRG.	Gr 500/7 OR APPD. DRG.	MFR'S TC	✓	P	V	V	
	BEARINGS	MAKE, TYPE, CATALOUGE NO.	MA	VISUAL	RANDOM	APP DRG / MFR"S CATALOGUE	APP DRG / MFR"S CATALOGUE	IR	✓	P	V	V	
1.6	HAND CHAIN WHEEL	CHEMICAL PHYSICAL PROPERTIES	MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT	AS PER DRAWING	AS PER DRAWING	IR/TC	✓	P	V	V	
1.7	HAND CHAIN	GRADE/ DIMENSION	MA	GRADE DIMENSION	ONE SAMPLE PER LOT	AS PER DRAWING	AS PER DRAWING	IR/TC	✓	P	V	V	
1.8	TROLLEY GEARS, PINION,WHEELS, AXLE	CHEMICAL & MECHANICAL	MA	LAB ANALYSIS,	100%	APPVD DRGS	APPVD DRGS	IR/TC	✓	P	V	V	
2	**IN PROCESS**												

	LEGEND:	FOR CUSTOMER USE	
UFACTURER / CONTRACTOR CONTRACTOR SIGNATURE	** M : MANUFACTURER / SUB-CONTRACTOR C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION	REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

MANUFACTURER'S NAME & ADDRESS :	**MANUFACTURING QUALITY PLAN** **ITEM :** SINGLE GIRDER HOT CRANE **QP No.:** PE-TS-400-524-A001 **REV**.:0, **Date.: DEC 2014, PAGE**: 3 OF 5	**PROJECT : 2X500 MW NNTPS (SG)** **PACKAGE : SINGLE GIRDER HOT CRANE** **VOL IIB, SEC C**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
										M	C	N	
1.	2.	3.	4.	5.	6.	7.	8.	9.		10.			11.
2.1	WPS,PQR & WPQ	Verification of approval	MA				WPS,PQR & WPQ / Qualified by NTPC/ LLOYDS / EIL / TPL		✓	P	V	V	IN CASE OF NTPC/ LLOYDS / EIL / TPL QUALIFIED WELDERS AVAILABLE, REQUALIFICATION OF WELDER IS NOT REQUIRED
	HOOKS	-PROOF LOAD,	MA	LOAD TEST	100 %	IS:15560	IS:15560	IR	✓	P	V	V	-UT FOR SHANK IF DIA. > 50 MM)
		-DPT /MPI AFTER	MA	DPT/MPI	100 %	ASTM E165	NO DEFECT	IR	✓	P	V	V	
		P / LOAD	MA	UT	100%	ASTM A388	20% DF Max., 80% BWE Min.	IR	✓	P	V	V	
2.3	RATCHET PAWL / RATCHET WHEEL	-HARDNESS	MA	HARDNESS	100%	IS:3832/ APPD DRG.	IS:3832/ APPD. DRG.	IR	✓	P	V	V	
		-SURFACE CRACK	MA	DPT	100 %	ASTM E165	NO DEFECT	IR	✓	P	V	V	
2.4	GEARS AND PINIONS	SURFACE HARDNESS HEAT TREATMENT,	MA	HARDNESS	RANDOM	MFG STANDARD	MFG STANDARD	IR	✓	P	V	V	HT Chart to be provided
		SURFACE CRACK, CASE DEPTH		HT CHART, DPT FOR SURFACE CRACK	ASTM E 165 FOR DPT	NO DEFECT		IR	✓	P	V	V	
3.0	**FINAL INSPECTION**												

	LEGEND:	FOR CUSTOMER USE	
UFACTURER / CONTRACTOR CONTRACTOR SIGNATURE	** M : MANUFACTURER / SUB-CONTRACTOR C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION	REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

MANUFACTURER'S NAME & ADDRESS :	**MANUFACTURING QUALITY PLAN** **ITEM :** SINGLE GIRDER HOT CRANE **QP No.:** PE-TS-400-524-A001 **REV**.:0, **Date.: DEC 2014, PAGE**: 4 OF 5	**PROJECT : 2X500 MW NNTPS (SG)** **PACKAGE : SINGLE GIRDER HOT CRANE** **VOL IIB, SEC C**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY M C N	REMARKS
1.	2.	3.	4.	5.	6.	7.	8.	9.		10.	11.
3.1	COMPLETE ASSEMBLY	OVERALL DIMENSION	MA	MEASUREMENT	100 %	IS:3832 /APPD DRG	IS:3832 /APPD DRG	IR	✓	P W W	
		PROOF LOAD TEST	CR	LOAD TEST	100%	-DO-	No cracks, flaws & other defects	IR	✓	P W W	
		LIGHT LOAD TEST	MA	LOAD TEST	100%	IS 3832 Cl NO 9.3.1	IS 3832	IR	✓	P W W	
		HEIGHT OF LIFT	MA	MEASUREMENT	100%	-DO-	-DO –	IR	✓	P W W	
		SWIVELING OF HOOK	MA	VISUAL	100 %	-DO-	-DO-	IR	✓	P W W	
		EFFORT	MA	PULL ON CHAIN	100%	-DO-	-DO-	IR	✓	P W W	
3.2	PAINTING	-CLEANING - SHADE & DFT OF PAINT (Blue / Black)	MA MI	VISUAL VISUAL	AT RANDOM AT RANDOM	APPROVED DRAWING/ **SPECIFICATION**	APPROVED DRAWING/ **SPECIFICATION**	IR IR		P --- --- p W ---	
3.3	NAME PLATE	VERIFICATION	MA	VISUAL	100%			IR		P V ---	
3.4	PACKING	-VERIFICATION	MI	VISUAL	100%	SPECS.	SPECS.	IR		P --- ---	
3.5	REVIEW OF QA DOCUMENTATION	VERIFICATION	MA	VISUAL	100%	APPD. QP	APPD. QP		✓	V V V	

CR – CRITICAL, MA – MAJOR , MI – MINOR

UFACTURER / CONTRACTOR CONTRACTOR SIGNATURE	LEGEND: ** M : MANUFACTURER / SUB-CONTRACTOR C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION	FOR CUSTOMER USE REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

	MANUFACTURER'S NAME & ADDRESS :	**MANUFACTURING QUALITY PLAN** **ITEM :** SINGLE GIRDER HOT CRANE **QP No.:** PE-TS-400-524-A001 **REV**.:0, **Date.: DEC 2014, PAGE**: 5 OF 5	**PROJECT : 2X500 MW NNTPS (SG)** **PACKAGE : SINGLE GIRDER HOT CRANE** **VOL IIB, SEC C**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									M	C	N	
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.			11.

NOTE: BACK WALL ECHO SHALL BE ADJUSTED TO 100% OF FULL SCREEN HEIGHT IN SOUND (DEFECT FREE) AREA. DEFECT ECHO HEIGHT MORE THAN 20% OF SCREEN HEIGHT SHALL BE TREATED AS UNACCEPTABLE. BACK WALL ECHO SHALL NOT BE LESS THAN 80% OF SCREEN HEIGHT IN ANY CASE.
NOTE 2: RECORDS IDENTIFIED WITH TICK SHALL BE ESSENTIALLY INLCUDED IN QA DOCUMENTATION.

	LEGEND:	FOR CUSTOMER USE	
IUFACTURER / CONTRACTOR CONTRACTOR SIGNATURE	** M : MANUFACTURER / SUB-CONTRACTOR C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION	REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

ANNEXURE – I TO SECTION – C : STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR
PROJECT: 2X500 MW NNTPS (TG)

PACKAGE : SINGLE GIRDER CRANES REV : 0 DATE : 22.12.14

S. NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V Local Starter Panel	Vendor	BHEL	BHEL will provide one number 415 V supply feeders up to DSL for cranes
2	Power cables, control cables, screened control cables and any special cables (if required) between equipment supplied by vendor.	Vendor	BHEL	
3	Cabling material (cable trays, accessories, cable tray supporting system, conduits etc).	Vendor	BHEL	
4	Equipment Earthing	Vendor	BHEL	All equipments metallic enclosures / frames, metal structure etc. shall be grounded at two points each to the nearest grounding points / risers provided by BHEL / customer.
5	Motors	Vendor	BHEL	
6	Cable glands and lugs for equipment supplied by vendor	Vendor	BHEL	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type tinned copper heavy duty lugs for power cables. 3 solderless crimping type heavy duty copper lugs for control cables.
7	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for C & I systems for vendor supplied equipment shall be furnished during detail engineering by vendor in soft copies in the BHEL cable schedule format.
8	Equipment layout drawings	Vendor	-	
9	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

1.0 **EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER :**

a) Services and equipment as per "Electrical Scope between BHEL and Vendor".
b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
c) Erection and Commissioning spares.
d) Erection & Maintenance tools & tackles.
e) Electrical load requirement for crane
f) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
g) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer /BHEL approval without any commercial and delivery implications to BHEL
h) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:
Refer "Electrical Scope between BHEL and Vendor".

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/quality assurance requirements stipulated. In line with this two signed and stamped copies of the following shall be furnished by the bidder as technical offer:

a) A copy of this sheet "Electrical equipment Specification " and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.
b) Electrical load requirement

3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 List of enclosures :
a) Specification AC/DC Motors
b) Data sheet of AC/DC Motors.
c) Load data format.

SPECIFIC ELECTRICAL REQUIREMENT

SL.NO.	PARAMETERS	UNIT	NLC
	MOTOR		
1	DESIGN AMBIENT TEMP	DEG. C	50
2	VOLTAGE SUPPLY AND VARIATION	VOLT	415V, ± 10%
3	FREQUENCY WITH VARIATION	Hz	50 (+) 5% to (-) 3%
4	COMBINED VOLTAGE & FREQUENCY VARIATION		10%
5	MAX ACCEPTABLE RATING OF MOTOR AT 415 V	KW	160 KW & below
6	SYSTEM FAULT LEVEL AND ITS DUARTION	KA	50kA, 1sec
7	SUTABILITY OF TERMINAL BOX FOR FAULT LEVEL AND DURATION		50 KA, 0.25 sec
8	CLASS OF INSULATION & TEMP RISE LIMITED TO		Class-F or better and temp rise limited to Class-B
9	MIN. STARTING VOLTAGE		85%
10	MOTOR RATING FOR SINGLE PHASE SUPPLY		0.22 kW & Below
11	MAXIMUM LOCKED ROTOR CURRENT	% OF FLC	As per IS 12615
12	ACCEPTABLE NOISE LEVEL	DB	Noise level for all motors shall be limited to 85dB(A) at 1.5 m (in line with IS 12065)
13	TYPE OF STARTER PROVIDED IN MCC		DOL
14	DOP OF ENCLOSURE		IP-55
15	SPACE HEATER REQUIREMENT	<30kW	30KW & ABOVE
16	PAINT SHADE		DURING DETAIL ENGINEERING.
17	CRANE DUTY MOTOR AS PER IS3177		S4- Duty with 40% cyclic duration factorshall be considered. Motor operating through VFD shall be suitable for inverteer duty.

	TITLE	SPECIFICATION NO.
BHEL	2X500 MW NNTPS (SG), TECHNICAL SPECIFICATION FOR SINGLE GIRDER CRANE MOTOR DATA SHEET - C	VOLUME II B SECTION D REV NO. 00 DATE 29/08/2005 SHEET 1 OF 2

S. No.	Description	Data to be filled by successful bidder
A.	**General**	
1	Manufacturer & country of origin	
2	Motor type	
3	Type of starting	
4	Name of the equipment driven by motor & Quantity	
5	Maximum Power requirement of driven equipment	
6	Rated speed of Driven Equipment	
7	Design ambient temperature	
B.	**Design and Performance Data**	
1	Frame size & type designation	
2	Type of duty	
3	Rated Voltage	
4	Permissible variation for	
5	a Voltage	
6	b Frequency	
7	c) Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)	
9	Synchronous speed & Rated slip	
10	Minimum permissible starting voltage	
11	Starting time in sec with mechanism coupled	
12	a) At rated voltage	
13	b) At min starting voltage	
14	Locked rotor current as percentage of FLC (including IS tolerance)	
15	Torque	
	a) Starting	
	b) Maximum	
16	Permissible temp rise at rated output over ambient temp & method	
17	Noise level at 1.0 m (dB	
18	Amplitude of vibration	
19	Efficiency & P.F. at rated voltage & frequency	
	a) At 100% load	
	c) At 75% load	

NAME OF VENDOR				REV.	
NAME	SIGNATURE	DATE	SEAL		

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	**Constructional Features**	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	**Characteristic curves/ drawings** (To be enclosed for motors of rating ≥ 55KW)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

	QUALITY PLAN		CUSTOMER :			PROJECT			SPECIFICATION :			
						TITLE 2X500 MW NNTPS (SG)			NUMBER : PE-TS-400-501-A002			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION TITLE			
		SHEET 1 OF 2	SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3

BHEL	**PARTICULARS**	**BIDDER/VENDOR**
	NAME	
	SIGNATURE	

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE 2X500 MW NNTPS (SG)			SPECIFICATION : NUMBER : PE-TS-400-501-A002			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION : TITLE :			
		SHEET 2 OF 2	SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	

NOTES:

1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON

2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.

Legends for Inspection agency

1. BHEL/CUSTOMER
2. VENDOR (MOTOR MANUFACTURER)
3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)

P. PERFORM
W. WITNESS
V. VERIFY

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

VOLUME - IIB

SECTION – D

STANDARD TECHNICAL REQUIREMENTS

(MECHANICAL)

SINGLE GIRDER EOT CRANE

1.0.0 **SCOPE**

This specification covers the design, material, manufacture, assembly, inspection and testing at manufacturer works for single girder EOT crane. The equipment shall include all the accessories required for the trouble free operation.

The crane shall be complete with trolley and truck, wheels and axles, Drive mechanisms, Hoisting Drums, Brakes, Creep Speed Arrangement, Lifting tackles, Buffers, Electric Motors, Controls, Switch Board and cabling, horns, warning lights, Limit switches etc. Any item not mentioned herein but required to make the system complete for the satisfactory performance of the crane shall also be included.

2.0.0 **CODES AND STANDARDS**

The equipment to be supplied under this specification shall conform to the following codes and standards (latest revisions) unless otherwise specified hereinafter.

a)	IS 807	Codes of Practice for Design, Manufacture, Erection and Testing (Structural Portion) of cranes and hoists
b)	IS: 3177	Code of Practice for Design of Overhead Travelling Cranes and Gantry Cranes other than steel work cranes
c)	IS: 2266	Specification for steel wire ropes for general Engineering purposes.
d)	IS: 4029	Guide for testing induction motor (for temperature rise)
e)	IS: 15560	Steel hooks for standard shank design
f)	IS: 1554 Part I	PVC insulated (Heavy-duty) electric cables for working voltages up to and including 1100 volts.
g)	IS: 325	Three phase induction motors.
h)	IS: 900	Code of practice for installation and maintenance of induction motors
i)	IS: 694 (Part-I)	Copper conductors PVC insulated cables for voltage up to 1000 V.
k)	IS: 434 (Pt I)	Copper conductors rubber insulated cables for voltage up to 1000V.
m)	IS: 691	Flexible trailing cables rubber insulated.
n)	IS 3043	Code of practice Earthing.
o)	IS: 3938	Electric Wire Rope Hoists.
p)	IS: 2147	Degree of protection provided by enclosures for Low voltage switchgear and control gear.
q)	IS: 1554	Polyethylene insulated PVC sheathed cables.

Indian electricity rules - 1956.

In the event of any conflict between the specification and standards mentioned above, the specification shall govern.

3.0.0 **SINGLE GIRDER EOT CRANE**

3.1.0 **DESIGN REQUIREMENTS**

3.1.1 The crane shall be designed in accordance with the latest edition of IS-3177/IS-807 & hoist block shall be as per IS-3938 and any other standard as referred there in and subject to any modification and requirement as specified herein after.

Class of crane mechanism shall correspond to that of the crane requirement and as specified elsewhere.

3.1.2 Safety devices should be provided with all equipment/parts covered under this specification.

3.1.3 Parts requiring replacement or lubrication shall easily be accessible without dismantling the other equipment or structures. All electrical cables shall be laid to comply with recognized standards and purchaser's requirements.

3.1.4 For welded construction such as bridge girders, end carriages, rope drum, gearboxes etc; steel shall be conforming to IS-2062 quality.

3.1.5 No cast iron part shall be used on the crane.

3.1.6 Guard shall be provided on crane to prevent the hoist ropes coming in contact with down shop leads. Guards of an approved design, which will push forward or off the track any object such as a person foot or arm, placed across it. Guards shall be attached to each end of the end carriages. Suitable guards shall be provided to revolving shafts, coupling etc.

3.1.7 All cables shall be clamped individually. All trailing cables shall be clamped with PVC or non-metallic clamp.

3.1.8 All wheels, couplings, open gear etc. shall be provided with covers.

3.1.9 All bolts except those with locknut shall be provided with grip lock nuts or spring washers.

3.1.10 Fasteners for pedestal blocks, motors, gearboxes etc. shall be easily removable from the top. Studs shall not be used as fasteners for mechanical items except for fixing covers.

3.1.11 Defects in the material like fractures, cracks, blowholes, pitting etc. are not allowed. Rectification of any such flaw is permissible only with the approval of the purchaser.

3.1.12 All parts of the crane shall be thoroughly cleaned of mill scales, rust or foreign matter and then painted as per the specification requirements

3.1.13 The crane shall be manufactured as per the tolerances specified below

a)	Span over LT wheels	± 3mm
b)	Diagonal on wheels	± 3mm
c)	Long travel wheel alignment	± 1mm
d)	Tilt of wheels or balancer axle	±1/1000mm(horizontal and vertical)
e)	Permissible variation in Speeds at full notch with rated load, voltage and frequency shall be as follows.	
	i) Travelling and traversing	±10%
	ii) Hoisting Lowering	±10%

3.1.14 Proper allowance shall be made for impact and wear in the design of the crane and in no case shall the factor of safety in any part be less than six (6), as per IS: 3177 based on the ultimate strength of the materials used at design duty.

3.2.0 **STRUCTURAL DETAILS**

3.2.1 Crane structure shall be designed in accordance with the latest edition of IS-807 after taking the following additions/deviations as applicable.

3.2.1.1 Black bolts shall not be used in the main structure of the crane. The calculated strength of other bolted joints in structural members shall not be less than net strength of member plus 25%.

3.2.1.2 The calculated strength of riveted joint or joints made by friction grip bolts in structure members shall be not less than the calculated net strength of the member.

3.2.1.3 Bolts used in shear shall be fitted in to reamed hole.

3.2.1.4 Transverse filled welding on load carrying member shall be avoided.

3.2.1.5 All butt welds on structural members subjected to tensile stress shall be X - rayed.

3.2.1.6 Fillet welding on load carrying members shall be avoided.

3.2.1.7 Plates, angles and other rolled section used in the load bearing members of the structure shall not be less than 6mm thick.

3.2.1.8 The cranes working out door or in corrosive environment, an allowance of 1.5 mm shall be added to the calculated thickness.

3.2.1.9 Minimum thickness of chequered plates for platform shall be over 5mm over plain. Chequered plates shall not be considered for strength calculations of load carrying member.

3.1.1.10 The material of construction of the major components shall be as specified in the specification/data sheet. Manufacturer are however free to use alternate material which are superior for the intended service. But in all the cases, prior concurrence of the purchaser is must.

3.2.2 **Girder / Beam**

3.2.2.1 The girder / beam shall be fabricated from rolled steel (Box section/ I-section) and shall be of adequate strength to withstand the rolling loads and other stresses it is subjected to. The design of the girder shall be in accordance with latest edition of IS- 807 with the following deletion / addition as applicable.

3.2.2.2 Minimum deflection of the bridge girder with safe working load shall not exceed 1/800 of span. The girder shall be cambered by an amount equal to the maximum deflection due to dead load plus one half the live load and trolley.

3.2.3 **End carriage**

3.2.3.1 End carriages shall be fabricated from rolled steel section or plates or as the case may be. End carriage shall be of ample strength to resist all stresses likely to be imposed on them under service conditions including collision with other cranes or stops.

3.3.0 **MECHANICAL**

3.3.1 Rope drums

Rope drums shall be of mild steel plate fabricated or of cast steel. All fabricated rope drums shall be stress relieved. The drum shall be so designed to take full length of hoisting rope in single layers. The end of the rope shall be anchored to the drum in such a way that the charger in readily accessible. Each rope shall have not less than two (2) full turns on the drum when the hook is at lowest position not taking into consideration the turns covered by the rope in charge. There shall be one spare groove for each rope lead when the hook is at the highest position. Each rope end shall be clamped with minimum two clamping wedges with at least two bolts on each clamping arrangement.

The pitch diameter of the drum shall be as per IS -3177 or as specified elsewhere. The depth of the grove shall not be less than 0.35 times the rope diameter. Each rope shall be clamped to drum with two clamp wedges with at least two numbers of bolts on each clamping arrangement.

3.3.2 Hoist ropes

Ropes of steel core as specified in Data Sheet – A/B shall be of right hand lay, of 6x36 construction of best plough steel having minimum tensile strength as 160-180 kg/mm2. Left hand lay wire ropes shall not be used (Reverse bend ropes shall be avoided as far as possible).

3.3.3 Rope sheaves

Sheaves shall be of cast steel. All sheaves shall be identical, however, exception may be made for equalizer sheave. Sheave groove shall be ground finished for getting increase rope life. Equalizer sheave shall be arranged to turn and swivel in order to maintain rope alignment under all circumstances.

3.3.4 Wheels

LT wheels shall be double flanged with tread to suit the rail. The wheels shall be capable of taking up misalignment in span as specified. Solid wheel shall either be of forged steel or as specified. The wheel shall be with hardness of BHN 300-350. Contact stresses between wheels and rails should be within permissible limits.

3.3.5 Buffer

Each End carriage shall be provided with buffer as per data sheet ‘A’. Buffers should be so located that removal is not required while changing wheels or bogies. Buffers shall have sufficient tension on energy absorption capacity to bring the unloaded crane to rest from the speed of 50% of the rated speed to zero speed.

3.3.6 LT drive

One pair of wheels in each end carriage shall be driven by motor through reduction gear.

3.3.7 CT drive

The CT mechanism of the electric hoist shall consist of 2pairs of wheels which shall be driven by motor through reduction gear.

3.3.8. Gearing

Spur and helical gearing shall normally be used for all motions. Worms and bevel gears shall not be used. First high-speed reduction shall be through helical gears. All gears shall be hardened and tempered and of alloy steel with machine cut teeth. Surface hardening of teeth is not acceptable. Gear teeth shall preferably be cut in metric module system. Gears shall be designed to meet requirement of crane duty as per IS: 3177. The ratings of gears shall be established as per IS: 4660.

3.3.9 Gear Box

3.3.9.1 All gears shall be completely covered and enclosed in oil tight casing & sealed with gasket.

3.3.9.2 The gearboxes shall be of mild steel or cast steel. All fabricated gearboxes shall be stress relieved.

3.3.10 Bearing

3.3.10.1 Ball and roller antifriction bearing of FAG, SKF, NBC, NORMA make shall be used throughout, except where specified otherwise. Rated life of ball and roller bearing shall be not less than total working life as per relevant codes. Life of bearing shall be calculated in accordance with manufacturers recommendations.

3.3.10.2 Provision shall be made for service lubrication of all bearings. Bearing enclosures shall be designed as far as possible to exclude dirt and prevent oil leakage.

3.3.11. Couplings

3.3.11.1 Motor shafts shall be connected to gear box input extension shafts through flexible gear coupling. Solid coupling shall be used for connecting intermediate lengths of long travel shafts, if applicable.

3.3.12 Lifting hook

Standard hooks shall be used unless otherwise specified. These hooks shall conform to the latest edition of IS 15560 as specified in the data sheet “A”.

3.3.13 Brakes

3.3.13.1 Selection and design of brakes shall be such as to meet the requirement. Electro mechanical brakes shall be provided for each motions. Brakes shall be designed to suit 150% FLT of motor for the hoist motion and 125 % FLT of motor for LT/CT motion. Brakes shall be provided as specified in Data Sheet ‘A’

3.4.0 **ELECTRICAL**

3.4.1 The scope of supply shall cover all electrical equipments comprising from Main isolating switch, down shop leads, trolley conductors, current collectors etc.

3.4.1.1 Main isolating Switch fuse unit shall be provided at 1.5M above the operating floor level at one end of bay length or in the middle as specified in the data sheet A. Supply of cable from switch to down shop leads shall be included in the bidder’s scope of work.. The switch shall be provided with Power ON Red indication lamp.

3.4.1.2 Run way conductors (Down shop leads) shrouded conductor as specified in the data sheet A shall have four conductors. One of the conductors shall be connected to earth grid for earthing connections of all electrical equipments on the crane and shall be connected to suitable collecting gear of earth conductor. Voltage drop across the down shop leads shall be less than 2%. Maintenanc

DSL shall be provided on crane if asked in Data Sheet 'A'. Sufficient allowance of min. 10% for wear & tear shall be considered while sizing the conductor. The runway conductors shall be supported on brackets and insulators.

3.4.1.3 The current collectors shall be of adequate current carrying capacity and shall maintain adequate contact pressure. Spacing between current collectors shall be such as to provide sufficient quenching area for sparks coming out of collectors surface. The collector system per conductor shall be top-running type having spring loaded CI/carbon metallic shoes to maintain adequate contact pressure.

3.4.1.4 The cable, supplying power to crane trolley / electric hoist shall be flexible trailing cable as per IS-9968 Part I (latest edition) and mounted on retracting supports (festoon type)

3.4.2 **DRIVE MOTORS**

3.4.2.1 Crane motors shall be totally enclosed, fan cooled and as per data sheet 'A'. The break down torque of the motors shall not be less than 225 percent of the full load torque with rated voltage and frequency applied and pull out torque shall not be less than 250% of the rated full load torque of motor.

3.4.2.2 Ambient correction factors as well as voltage /frequency correction factors depending upon the ambient temperature and voltage /frequency variation shall be applied to derate the motors. The minimum margin of 10% or as specified in the section C of specification shall be considered over the calculated rating of the motor. The protection class of the motors shall be as per data sheet A. Motors shall be tested at manufacturers works in accordance with IS-325/as per agreed Quality plan & Reports shall be submitted for approval. Motors shall comply with the requirement of IS-325-1978 or as per the motor specification if enclosed here with.

3.4.2.3 All the motors shall be provided with lifting lugs, two earth terminals of adequate size to accept the earthing conductors shall be provided at diametrically opposite points unless specifically designed For higher speeds, motors shall be capable of withstanding 2.5 times the rated speed.

3.4.3 **Limit Switch**

The hoist mechanism of the crane shall be provided with rotary type limit switch to open the control circuit and in order to prevent the crane hook from over hoisting and over lowering. One gravity type back-up limit switch of hand-reset type shall be provided. This switch shall operate in the event of failure of main limit switch if called for in data sheet "A".

Lever operated limit switches shall be provided at both ends of longitude travel and cross traverse. These limit switches shall be self reset type.

3.4.8 **Protective Panel / Controls**

3.4.8.1 The electrical protective panel shall be a cubicle fabricated from 2 mm thick sheet steel with lockable-hinged door. It shall be dust and vermin proof with degree of protection as IP-55 or as specified in data sheet A. All the equipment inside the panel shall have permanent identification. The panels shall be front connected type with front-hinged door for access to wiring and terminals. Engraved nameplate shall be furnished for all panels and also for the equipments and devices mounted there on.

The following minimum equipments shall be provided.

a) One triple pole air break type main contactor with thermal overload relay.

b) One triple pole main line connecting/disconnecting switch.

c) Switch fuse unit with D.O.L. starter for each motion.

d) Thermal overload relay for each drive. It shall be ambient temperature compensated and adjustable type.

e) Contactors, timer and auxiliary contactors.

f) Control transformer with fuses.

g) Indicating lamps to indicate the live condition of all three phases.

h) Other equipments as per supplier's standard practice. Air break contactors shall conform to category AC-4 duty. The contactor drop off voltage shall be between 45-50% of rated voltage.

i) All internal wiring shall be identified with numbering ferrules at both ends as per the relevant wiring diagram.

3.4.9 **Pendent Push button station**

It shall be suspended by wire rope to prevent pull on the cables. The following minimum push buttons key operated type.

a) Main" ON", "OFF" push button key operated and lockable in "OFF" position.

This push button will operate the main contactor.

b) Hoist and lower directions. (2Nos.)

c) Trolley travels both directions. (2 Nos.)

d) Bridge travels both directions. (2 Nos.)

e) Inching speed for hoisting & lowering

f) Inching speed for bridge motion.

g) Inching speed for trolley motion.

h) Creep speeds

i) Emergency stop push button (mushroom type).

j) Alarm bell push button.

3.4.10 **Grounding**

3.4.10.1 The crane structure, motor frame and all other electrical equipments shall be grounded in accordance with the Indian Electricity Rules. The connections from Crane Bridge to 4th conductor of down shop leads shall be by means of current collector.

3.4.10.2 The equipment fed by flexible cables shall be grounded by means of fourth core provided in the flexible trailing cable. Pendent push button station shall be earthed separately.

3.4.10.3 Red warning light 3 Nos. shall be provided at both ends of the gantry girder to indicate the aliveness of DSL.

3.4.11 **WIRING SYSTEM**

The supplier shall furnish all power, control and auxiliary circuit wiring of the equipment and the panel located on the trolley or bridge.

The wiring shall be complete in all respect to ensure the proper functioning of the equipment.

Power wiring to any motor shall be done with 1100V grade Cu conductor, PVC insulated / armoured /FRLS cable of suitable sizes as specified in Data Sheet A.

d) For selecting the cable rating, cable for power wiring, consideration shall be given to the motor duty, ambient temperature grouping and disposition of the cables voltage drop etc.

e) All control and auxiliary external circuit wiring shall be done with PVC insulated FRLS type 2.5mm stranded copper conductor.

f) Armoured cables or un-armoured running through the flexible conduits may be used for power wiring / control and auxiliary circuit wiring shall run through flexible conduits.

g) Each motor shall be wired independently. Power and control wiring shall be effectively separated.

h) Each wire shall be identified at both ends with wire designation in accordance with circuit wiring diagram.

i) All wire termination to the panels shall be provided with clamp type connections screw. Type terminals with screw directly impinging on conductors are not acceptable.

j) Multi-way terminal blocks complete with screw nut, washer and marking strips shall be furnished for terminating the panel wiring and outgoing.

k) Not more than two wires shall be connected to any terminal on either side of terminal block. If necessary number of terminals shall be jumped together to provide the wiring points

l) Each terminal block shall be marked with designation in accordance with conductors wiring diagram.

4.0.0 **LOAD INDICATION:**

The crane shall have a permanent inscription of English on each side, readily visible from the ground level, stating the safe working loads in tonnes, year of manufacture, crane serial number and manufacturer's name.

VOLUME III

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

ANNEXURE-II

8T Air compressor house crane		7 kW	S	1	0	D	S	N A	I		Air compressor house							

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)

2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (dc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V

: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

LOAD DATA (ELECTRICAL)	JOB NO.	400	ORIGINATING AGENCY		PEM (ELECTRICAL)	
	PROJECT TITLE	2 X 500MW NNTPS TPP (SG)	NAME		DATA FILLED UP ON	
	SYSTEM	SINGLE GIRDER CRANE	SIGN.		DATA ENTERED ON	
	DEPTT. / SECTION	ELECTRICAL	SHEET 1 OF 2	REV. 00	DE'S SIGN. & DATE	

ANNEXURE-VI

DRAWINGS / DOCUMENTS TO BE SUBMITTED WITH THE BID

Bidder shall submit the following drawings / documents along with their bid

a) Copy of Electrical Scope between BHEL & Vendor duly stamped

b) Electrical Equipment Specification for EOT Crane System duly stamped

c) Electrical load list

d) Deviation schedule with reference to specific clauses of the specification along with reason for such deviation in the format given under Vol-III (if applicable)

e) Un priced copy of price format indicating quoted/ not quoted against each row/column along with cost of withdrawal / price implication format for deviations.

f) Copy of pre-bid clarifications, if any, duly signed & stamped

g) Signed/ Stamped copy of Compliance cum Confirmation Certificate (Vol-III)

OFFER WILL BE CONSIDERED AS INCOMPLETE IN ABSENCE OF ANY OF ABOVE DOCUMENTS. DOCUMENT OTHER THAN ABOVE, IF ANY, SUBMITTED WITH THE OFFER WILL NOT FORM PART OF CONTRACT AND ACCORDINGLY WILL NOT BE CONSIDERED FOR BID EVALUATION.

COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate (every sheet) and furnish same with the offer.

a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions other than those mentioned under "exclusion" in section C and those resolved as per 'Schedule of Deviations', if applicable, with regard to same.

b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'.

c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ CUSTOMER approval & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This shall be within the contracted price with no extra implications to BHEL after award of the contract.

d) All drawings/ data-sheets/ calculations etc. submitted along with the offer shall be considered for reference only, same shall be subject to BHEL/ CUSTOMER approval in the event of order.

e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified/ intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre - bid discussions, otherwise BHEL/ Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.
For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.

g) All sub vendors shall be subject to BHEL/ CUSTOMER approval in the event of order.

h) Guarantee for plant/equipment shall be as per relevant clause of GCC /SCC /Other Commercial Terms & Conditions.

i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities. This clause will apply in case during site commissioning additional requirements emerges due to customer and/ or consultant's comments. No extra claims shall be put on this account.

j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

k) As built drawings shall be submitted as and when required during the project execution.

l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

	TITLE	SPECIFICATION NO. PE-TS-400-524-A001	
BHEL	TECHNICAL SPECIFICATION FOR **SINGLE GIRDER CRANE** **2X500 MW NNTPS (SG)**	VOLUME III	
		SECTION	
		REV 00	DATE DEC 2014
		SHEET 1 OF 1	

PRE-BID CLARIFICATION SCHEDULE

S. No.	Section/Clause /Page No.	Statement of the referred clause	Clarification Required

The bidder hereby certifies that above mentioned are the only clarifications required on the technical specification for the subject package.

SIGNATURE: _____

NAME: _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

COMPANY SEAL

PRICE FORMAT						Rev 00	
2X500 MW NNTPS (SG) (Single Girder Crane)							
						ALL PRICES IN Rs	
No	DESCRIPTION OF EQUIPMENT / ITEM	QTY	Ex-works price	ED with Cess @	CST / VAT	FREIGHT	Total F.O.R PRICE
1	2	3	4	5	6	7	8 =4+5+ 6 + 7
A.0.0	Total lumpsum firm price inclusive of all taxes duties and other levies as applicable for design, engineering, manufacturing, inspection and testing,painting supply/delivery duly packed at FOR site (NNTPS) including mandatory spares, Erection and commissioning spares, maintenance tools and tackles, all accesories (isolating switch and Power Cable from isolating switch to DSL) for 8.0 T capacity Single Girder underslung EOT Crane of 10.3 m span, 4.5 m lift and 26 m baylength for AIR COMPRESSOR BULIDING as per total scope defined in technical specification PE-TS-400-524-A001 taking into account all clarifications, confirmations and agreements till date.	1 no.					
B.0.0	Total lumpsum firm price inclusive of all taxes duties and other levies as applicable for design, engineering, manufacturing, inspection and testing,painting supply/delivery duly packed at FOR site (NNTPS) including mandatory spares, Erection and commissioning spares, maintenance tools and tackles, all accesories for 2.0 T capacity Single Girder underslung HOT Crane of 9.3 m span, 12.0 m lift and 30 m baylength for FOPH as per total scope defined in technical specification PE-TS-400-524-A001 taking into account all clarifications, confirmations and agreements till date.	1 no.					
C.0.0	total (A.0.0 to B.0.0)						
NOTES	**Bidder to note that total price indicated above at A.0.0 & B.0.0 shall be considered for evaluation and hence should be complete in all respect for the full scope defined and considering all terms and conditions agreed.**						
	Total Lumpsum price in column-8 should match with summation of total prices as in [Column (8) of 3.0 of Annexure I + Column (8) of 3.0 of Annexure II]						
	Any item not included in the price quoted above and shown separately will not be taken cognizance of and the offer shall be liable for rejection.						
	Crane & along with all its accessories shall be supplied in a single consignment to site.						
	Any deviation shall be strictly put in Annexure III (Deviation sheet) only.						

PRICE FORMAT (MAIN SUPPLY)							ANNEXURE-I
2X500 MW NNTPS (SG) (Single Girder Crane)							
						ALL PRICES IN Rs	
Sl.No	**DESCRIPTION OF EQUIPMENT / ITEM**	**QTY**	**Ex-works price**	**ED with Cess @**	**CST / VAT**	**FREIGHT**	**Total F.O.R PRICE**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8 =4+5+ 6 + 7**
1.00	**Break - up of Prices given in clause A.0.0 of Main price format**						
1.1	Total lumpsum price of 8T capacity single girder EOT crane of 10.3 M span, 4.5 m lift with all accessories.	1 no					
1.2	Lump sum firm price for PVC Shrouded bus bar type DSL for 26 m baylength complete with all accessories.	for 26 m of bay length					
1.3	Lump sum firm price for one (1) lot power cable from isolating switch to DSL including isolating switch and all accessories	One lot					
1.4	Lump sum price VVVF drive for hoisting motion	One lot					
1.5	Lump sum firm price for Commissioning Spares as per Annexure-A	One Lot					
1.6	Total price for Maintenance tools and tackles as per Annexure B	One set					
2.00	**Break - up of Prices given in clause B.0.0 of Main price format**						
2.1	Total lumpsum price of 2.0 T capacity Single Girder U/S HOT Crane of 9.3 m span, 12.0 m lift with all accessories.	1 no					
2.2	Total price for Maintenance tools and tackles as per Annexure B	One set					
3.0	**TOTAL (1.1 to 2.2)**						
NOTE	1.0 Bidder to note that there shall be no implication for change in lift and/or span upto1000 mm . 2.0 Any variation in length of DSL due to change in bay length will be adjusted based on unit rates arrived from 1.2.0. above						
	Date:_____						
	Bidder's / bidder's representative signature					Company Seal	

ANNEXURE-A

2X500 MW NNTPS (SG) (Single Girder Crane)

LIST OF COMMISSIONING SPARES

S.No.	Item	Quantity	Total ex-works price	ED including CESS	CST/VAT	FREIGHT	Total
1	2	3	4	5	6	7	8=4+5+6+7
A)	**Crane for Air Compressor building crane**						
1.0	Limit Switch	1 set					
2.0	Overload Relay	1 set					
3.0	Fuse Link	1 set					
	Total cost						

2X500 MW NNTPS (SG) (Single Girder Crane) **ANNEXURE-B**

List of Maintenance Tools & Tackles

Sl.no	Description	Unit	Total ex-works price	ED with Cess	CST /VAT	FREIGHT	Total
1	**2**	**3**	**4**	**5**	**6**	**7**	**8=4+5+6+7**
1	Complete set of ring spanners(Indicate sizes)	1 Set					
2	Complete set of screwdrivers (Min 6 nos , indicate size)	1 Set					
3	Adjustable Spanner	1 No.					
4	Insulated plier	1 No.					
5	Wrench spanner	1 No.					
6	Grease Gun	1 No.					
7	Oil Gun.	1 No.					
8	Hand Lamp.	1 No.					
9	Line tester	1 No.					
	TOTAL						
	Note: - The tools shall be supplied in one no. new tool box						
	1 No. = One No. of item for each crane						
	Date: _____						Company Seal

2X500 MW NNTPS (SG) Annexure II

PRICE SCHEDULE FOR MANDATORY SPARES OF SINGLE GIRDER CRANE

S. No	DESCRIPTION OF EQUIPMENT / ITEM	Qty	Total Ex-works price (Rs.)	ED including cess	VAT/CST as applicable (Rs.)	Freight	TOTAL F.O.R. Site Price (Rs.)
1	2	3	4	5	6	7	8
1	**8T CAP UNDER SLUNG CRANES IN COMPRESSOR HOUSE**						
	Mechanical						
i)	First reduction pinion & shaft for hoist, cross-travel & long travel drives	1 no.each for each type					
ii)	Brake drums for hoist, cross-travel & long travel drives	1 no.each for each type					
iii)	Brake lining with rivets for:						
	a) Hoist	6 pairs					
	b) Cross travel	2 pairs					
	c) Long travel	2 pairs					
iv)	Wire rope	1 complete length					
	Electrical						
	Power circuit						
i)	Fixed and moving contacts for stator power contactor	1 set of each type					
ii)	Contactor set for auxi. Contactors	1 set of each type					
iii)	Coils for stator contactors	1 set of each type					
iv)	Coils for auxi. contactors	1 set of each type					
v)	Overload relay	1 set of each type					
vi)	Timers	1 set of each type					
vii)	Auxi. Contactors	1 set of each type					
viii)	Limit switches	1 set of each type					
ix)	Fixed and moving contacts	1 set of each type					
x)	MCCB/ Fuses for:						
	i) Power circuit	1 no. of each rating					
	ii) Power base	1 no. of each rating					
	iii) Control MCBs/ fuses	1 no. of each rating					
	iv) Control fuse base	1 no. of each rating					
	v) Indicating lamp with indicator	6 nos. of each type					
	vi) Contact element set for push button	1 set of each type					
	vii) D.C. rectifier along with control panel and brake	1 no of each type					
	MOTORS (To be repeated for each type & rating)						
i	Bearing (driving end)	1 No. of each type					
ii	Bearing (Non-driving end)	1 No. of each type					
iii	End shield (DE and NDE)	1 set of each type					
iv	Cooling fan of motors	1 No. of each type					
v	Fan cover	1 No. of each type					
vi	Lubrication oil pump motor	1 No. of each type and rating					
vii	Bearing puller	1 Nos. of each type					
viii	Grease gun	2 Nos.					
ix	Special spanners/tools	1 Set					
2	**2T HOT crane in FOPH**						
i)	First reduction pinion & shaft for hoist, cross-travel & long travel drives	1 no.each for each type					
ii)	Grooved pulley	2 sets					
iii)	Pinion	1 set					
iv)	Bearing	1 set					
v)	Shaft pin	1 set					
3	**TOTAL (1 & 2)**						

1	The lists of spares indicated are for the type equipment generally used in thermal power plants. If the design or type of equipment proposed by the bidder is different, then the bidder shall suit the spares list according to the type of equipment. However, the numers or quantity of spares, indicated shall not be reduced.
2	All essential spares shall be supplied as per the requirement of the specifications. In case any spare indicated in the specification is not applicable for particular equipment then suitable applicable alternate spare have been offered / shall be supplied without any financial implication.
3	Any change or variation in equipment or systems during detailed engineering stage which would cause changes / variations in the essential spares quantity, shall be supplied by Vendor without any commercial implications
4	For quantities indicated in percentage, fractions are to be rounded-off to next higher integer.
5	Any item which is “not applicable” in the above list and is found to be “applicable” at a later date shall be supplied by theVendor without any extra cost.
6	If any of the items of spares/tools & tackles ordered is found to be not applicable during detailed engineering stage/execution stage, the contractor will have to supply alternative items of spares/tools & tackles. The alternative items of spares/tools & tackles are to be mutually agreed between the PURCHASER and VENDOR

ANNEXURE-III: DEVIATION SHEET (COST OF WITHDRAWL)

PROJECT:-2X500 MW NNTPS (SG)

PACKAGE:- SINGLE GIRDER EOT CRANE

TENDER ENQUIRY REFERENCE:-

NAME OF VENDOR:-

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
TECHNICAL DEVIATIONS									
COMMERCIAL DEVIATIONS									

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	**DESIGNATIONS**	**SIGN & DATE**	

NOTES:

1. For self manufactured items of bidder, cost of withdrawl of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
2. For directly dispatchable items, cost of withdrawl of deviation will be applicable on the basic price including taxes, duties & freight.
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawl of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.
6. Bidder shall furnish price copy of above format along with price bid.
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawl of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawl of deviation shall be taken as NIL.
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
12. Cost of withdrawl is to be given seperately for each deviation. In no event bidder should club cost of withdrawl of more than one deviation else cost of withdrawl of such deviations which have been clubbed together shall be considered as NIL.
13. In case nature of cost of withdrawl (positive/negative) is not specified it shall be assumed as positive.
14. In case of descrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.