



**SPECIFIC TECHNICAL REQUIREMENT
FOR CIVIL, STRUCTURAL &
ARCHITECTURAL WORKS FOR NCTPP,
DADRI(2X490MW) FLUE GAS
DESULPHURISATION (FGD) SYSTEM
PACKAGE**

SPECIFICATION NO. PE-TS-436-600-001

VOLUME - II B

SECTION - C | SUB-SECTION -

REV.NO. 00 DATE 21.02.2018

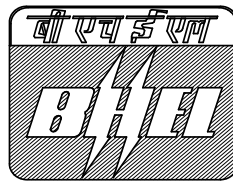
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**SPECIFIC TECHNICAL REQUIREMENTS FOR CIVIL,
STRUCTURAL & ARCHITECTURAL WORKS**

SPECIFICATION NO: PE-TS-436-600-C001



Bharat Heavy Electricals Limited

Power Sector - Project Engineering Management

PPEI Building, Plot No. 25

Sector – 16A, NOIDA (U.P.) - 201301



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PART-I

GENERAL CIVIL REQUIREMENT



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1. GENERAL

Two Volumes-Section C & Section D of this specification cover site development works, design and construction of Civil, Structural and Architectural works. The scope of works covers complete Civil, Structural and Architectural Works including supply of all materials, labour, tools and plants as required for successful execution of the packages. This Part-I of Section-C Lists Codes and Standards to be adopted and the principal structures of the plant, and briefly describes the basic concept, requirements and features pertinent to each.

If there is any ambiguity and/or contradiction between Section C and Section D, the provisions / requirements laid in Section C shall prevail. In case of ambiguity between BOQ and Part C former shall prevail.

(Contractor shall read the parts of the specification relevant to the contract and shall ignore the other parts of the specification. Relevant clauses of this section as applicable for respective package to be followed.)

2. CODES AND STANDARDS

Following is a general listing of Codes and Standards to be used in the design of the Plant. Specific applicable codes and standards will be identified in System Design Descriptions/ Technical Specifications as appropriate. The latest editions/ revision of following codes and standards along with addendums/ amendments, if any, shall be followed:

2.1. Earthwork

- a) IS-1498: Classification and identification of soils for General Engineering purposes.
- b) IS-3764: Safety Code for excavation work.
- c) IS-7293: Safety Code for working with construction machinery.
- d) IS-4701: Code of practice for earth work on canals.
- e) IS-9759: Guide lines for dewatering during construction.
- f) IS-10379: Code of practice for field control of moisture and compaction of soils for embankment and sub-grade.

2.2. Concrete

- a) IS-269: Ordinary and low heat Portland cement.
- b) IS-383: Coarse and fine aggregate from natural sources for concrete.
- c) IS-432: Mild Steel and medium tensile steel bars and hard (Part I & II) drawn steel wire for concrete reinforcement.
- d) IS-455: Portland Slag Cement.
- e) IS-456: Code of Practice for Plain and reinforced concrete.
- f) IS-457: Code of practice for general construction of plain and reinforced concrete for dams and other massive structures.
- g) IS-460: Test Sieves (all parts).
- h) IS-516: Methods of test for strength of concrete.
- i) IS-1199: Methods of sampling and analysis of concrete.
- j) IS-1566: Hard drawn steel wire fabric for concrete Reinforcement.
- k) IS-1786: High strength deformed steel bars and wires for concrete Reinforcement.
- l) IS-1791: General requirement for batch type concrete mixers.
- m) IS-1834: Hot applied sealing compounds for joints in concrete.
- n) IS-1838: Preformed fillers for expansion joints in concrete pavement and structures.



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- o) IS-2386: Methods of test for aggregates for concrete (all parts).(Part I-VIII)
- p) IS-2438: Specification for roller pan mixers.
- q) IS-2502: Code of practice for bending and fixing of bars for concrete Reinforcement.
- r) IS-2505: Concrete vibrators - immersion type.
- s) IS-2506: General requirements for screed board concrete vibrators.
- t) IS-2722: Specification for Portable Swing weigh batchers for concrete (single and double bucket type).
- u) IS-2750: Steel scaffoldings.
- v) IS-2751: Recommended practice for welding of mild steel plain and deformed bars for reinforced construction.
- w) IS-3150: Hexagonal wire netting for general purposes.
- x) IS-3366: Specification for pan vibrators.
- y) IS-3370: Code of practice for concrete structures for storage of liquids (all parts).(Part I-IV)
- z) IS-3414: Code of practice for design and installation of joints in buildings.
- aa) IS-3558: Code of practice for use of immersion vibrators for consolidating concrete.
- bb) IS-4014: Code of practice for steel tubular scaffolding.(Part I & II)
- cc) IS-4656: Form vibrators for concrete.
- dd) IS-4925: Concrete batching and mixing plant.
- ee) IS-4948: Welded steel wire fabrics for general use.
- ff) IS-4990: Plywood for concrete shuttering work.
- gg) IS-5256: Code of practice for sealing expansion joints in concrete lining on canals.
- hh) IS-6452: High Alumina Cement for Structural use.
- ii) IS-6461: Glossary of terms relating to cement concrete.
- jj) IS-6494: Code of practice for water proofing of underground reservoir and swimming pools.
- kk) IS-6509: Code of practice for installation of joints in concrete pavements.
- ll) IS-7320: Concrete slump test apparatus.
- mm) IS-7861: Code of practice for extreme weather concreting.
(Part I & II)
- nn) IS-8041: Rapid Hardening Portland Cement.
- oo) IS-8112: High strength ordinary Portland Cement.
- pp) IS-9012: Recommended practice for shotcreting.
- qq) IS-9103: Admixtures for concrete.
- rr) IS-9417: Recommendations for welding cold worked bars for reinforced concrete construction.
- ss) IS-10262: Recommended guidelines for concrete mix design.
- tt) IS-458: Specification for precast concrete pipes.
- uu) IS-3935: Code of practice for composite construction.
- vv) IS-4995: Criteria for design of reinforced concrete bins for storage of granular (all parts) and powdery materials.
- ww) IS-5525: Recommendation for detailing of reinforced concrete works.
- xx) IS-11384: Code of practice for composite construction in structural steel and concrete.
- yy) IS-11682: Criteria for design of RCC staging for overhead water tanks.
- zz) IS:12118: Two parts polysulphide based sealants.
- aaa) IS:12200: Code of practice for provision of water stops at transverse construction joints in masonry and concrete dams.
- bbb) IS:13311: Non-destructive testing of concrete - methods of test.
Part I - Ultrasonic pulse velocity.
Part II - Rebound hammer.
- ccc) IS-13920: Code of practice for ductile detailing of reinforced concrete structures subjected to seismic forces.
- ddd) SP-16: Design codes for reinforced concrete to IS:456-1978.
- eee) SP-23: Hand book of concrete mixes.
- fff) SP-24: Explanatory handbook on Indian standards code for plain and reinforced concrete.
(IS: 456)
- ggg) SP-34: Hand book on concrete reinforcement and detailing.
- hhh) ACI-318: American Concrete Institute code for structural concrete.
- iii) IS-280: Mild steel wire for general engineering purpose.
- jjj) IS-10297: Code of practice for design and construction of floors and roofs using precast reinforced/prestressed concrete ribbed or cored slab units.
- kkk) IS-10505: Code of practice for construction of floors and roofs using pre-cast reinforced concrete waffle units.
- lll) IS-15658: Pre-cast concrete block for paving.



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2.3. Foundations

- a) IS-1080: Code of practice for Design and Construction of shallow foundations on soils (other than raft, ring and shell)
- b) IS-1904: Code of practice for Design and Construction of foundations in soils: General Requirements
- c) IS-2314: Steel sheet piling sections.
- d) IS-2911: Code of practice for Design and Construction of Pile foundations (all parts).
- e) IS-2950: Code of practice for design and construction of raft foundations.
- f) IS-2974: Code of practice for design and construction of machine foundations.
- g) IS-4091: Code of practice for Design and Construction of foundations for transmission line towers and poles
- h) IS-6403: Code of practice for determination of Bearing capacity of Shallow foundations.
- i) IS-8009: Code of practice for calculation of settlement of foundations: (all parts)
- j) IS-9556: Code of practice for Design and Construction of diaphragm walls.
- k) IS-11089: Code of practice for Design and Construction of ring foundation.
- l) IS-12070: Code of practice for design and construction of shallow foundations on rocks.
- m) IS-13301: Guidelines for vibration isolation for machine foundation.
- n) ISO 10816: Criteria for assessing mechanical vibrations of machines.
- o) ISO 1940: Criteria for assessing the st of balance of rotating rigid bodies.
- p) DIN: EN13906-1: Helical compression spring made of round wire and rod: calculation and design of compression.
- q) DIN: 2096 Helical compression spring out of round wire and rod: Quality requirements for hot formed compression spring.
- r) DIN: 4024 Flexible supporting structures for machine with rotating machines.

2.4. Loading

- a) IS-875: Code of practice for Structural safety of buildings - loading standards.
- b) IS-1911: Schedule of unit weights of building materials.
- c) IRC-6: Standard specifications & Code of practice for road bridges.

2.5. Masonry

- a) IS-712: Building limes.
- b) IS-1077: Common Burnt Clay Building Bricks.
- c) IS-1127: Recommendations for dimensions and workmanship of natural building stones for masonry work.
- d) IS-1528: Methods of sampling and physical tests for refractory materials.
- e) IS-1597: Code of practice for construction of stone masonry (all parts).
- f) IS-2212: Code of practice for brickwork.
- g) IS-2116: Sand for masonry mortars
- h) IS-2185: Concrete masonry units. (all parts - Hollow and Solid concrete blocks).
- i) IS-2250: Code of practice for preparation and use of masonry mortars.
- j) IS-2572: Code of practice for construction of hollow concrete block masonry.
- k) IS-2691: Burnt clay facing bricks.
- l) IS-3414: Code of practice for design and installation of joints in buildings.
- m) IS-3495: Methods of tests of burnt clay building bricks.
- n) IS-4441: Code of practice for use of Silicate type chemical resistant mortars.
- o) IS-4860: Acid Resistant Bricks.
- p) IS-1905: Code of practice for structural use of unreinforced masonry.
- q) IS-10440: Code of practice for construction of reinforced brick and reinforced brick concrete floors and roofs.
- r) SP-20: Hand book on masonry design and construction.
- s) IS-1489: Portland-pozzolana cement.
- t) IS-1542: Sand for Plaster.
- u) IS-12269: 53 grade ordinary Portland cement.
- v) IS-12894: Specification for fly ash lime bricks.
- w) IS-13757: Burnt clay fly ash building bricks.



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2.6. Doors, Windows and Ventilators

- a) IS-399: Classification of commercial timbers and their zonal distribution.
- b) IS-883: Code of practice for design of structural timber in building.
- c) IS-1003: Timber panelled and glazed shutters (all parts).
- d) IS-1038: Steel doors, windows and ventilators.
- e) IS-1081: Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators.
- f) IS-1361: Steel windows for industrial buildings.
- g) IS-2835: Transparent sheet glass for glazing and framing purposes.
- h) IS-1948: Aluminium doors windows and ventilators.
- i) IS-1949: Aluminium windows for industrial building.
- j) IS-2191: Wooden flush door shutters (Cellular and hollow core type).
- k) IS-2202: Wooden flush door shutters (solid core type).
- l) IS-3103: Code of practice for Industrial ventilation.
- m) IS-3548: Code of practice for glazing in buildings.
- n) IS-3614: Fire check doors.
- o) IS-4021: Timber door, windows and ventilator frames.
- p) IS-4351: Steel door frames.
- q) IS-6248: Metal rolling shutters and rolling grills.
- r) IS-208: Door Handles.
- s) IS:281: Mild steel sliding door bolts for use with padlocks.
- t) IS-362: Parliament Hinges.
- u) IS-419: Putty, for use on window frames.
- v) IS-451: Technical supply conditions for wood screws.
- w) IS-733: Wrought aluminium and aluminium alloy bars, rods and sections for general engineering purposes.
- x) IS-1285: Wrought aluminium and aluminium alloy extruded round tube & hollow section (for general engineering purposes).
- y) IS-1341: Steel butt hinges.
- z) IS-1823: Floor door stoppers.
- aa) IS-1868: Anodic coatings on Aluminium and its alloys.
- bb) IS-2209: Mortice locks (vertical type)
- cc) IS-2553: Safety glass.
- dd) IS-3564: Door closers (Hydraulically regulated).
- ee) IS-5187: Flush bolts.
- ff) IS-5437: Figured, rolled and wired glass.
- gg) IS-6315: Specification for floor springs (Hydraulically regulated) for heavy doors.
- hh) IS-7196: Hold fast.
- ii) IS-7452: Hot rolled steel sections for doors, windows and ventilators.
- jj) IS-10019: Mild steel stays and fasteners.
- kk) IS-10451: Steel sliding shutters (top hung type)
- ll) IS-12823: Prelaminated particle boards.

2.7. Roof and Flooring

- a) IS-2204: Code of practice for construction of reinforced concrete shell roof.
- b) IS-3201: Criteria for the design and construction of precast concrete trusses.
- c) IS-2210: Criteria for Design of R.C. shell structures and folded plates.
- d) IS-809: Rubber flooring materials for general purposes.
- e) IS-1195: Bitumen mastic for flooring.
- f) IS-1196: Code of practice for laying bitumen mastic flooring.
- g) IS-1198: Code of practice for laying, fixing and maintenance of linoleum floors.
- h) IS-1237: Cement concrete flooring tiles.
- i) IS-1443: Code of practice for laying and finishing of cement concrete flooring tiles.
- j) IS-2114: Code of practice for laying in situ terrazzo floor finish.
- k) IS-2571: Code of practice for laying in situ cement concrete flooring.
- l) IS-5491: Code of practice for laying in situ granolithic concrete floor topping.
- m) IS-5766: Code of practice for laying burnt clay brick flooring.
- n) IS-1197: Code of practice for laying of rubber floors.



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o) IS-2441: Code of practice for fixing ceiling coverings.

2.8. Waterproofing

- a) IS-1322: Bitumen felts for waterproofing and damp proofing.
- b) IS-1346: Code of practice for waterproofing of roofs with bitumen felts.
- c) IS-1609: Code of practice for laying damp proof treatment using bituminous felts.
- d) IS-3036: Code of practice for laying lime concrete for a waterproofed roof finish.
- e) IS-3037: Bitumen mastic for use in waterproofing of roofs.
- f) IS-3067: Code of practice for general design, details and preparatory work for damp proofing and water proofing of buildings.
- g) IS-3384: Bitumen primer for use in water proofing and damp proofing.
- h) IS-4365: Code of practice for application of bitumen mastic for waterproofing of roofs.
- i) IS-5318: Code of practice for laying of flexible PVC sheet and tile flooring.
- j) IS-8042: White Portland cement.
- k) IS-13755: Dust pressed ceramic tiles with water absorption of 3%, E 6% (Group B11a).
- l) IS-13801: Chequered cement concrete tiles.

2.9. Water Supply, Drainage and Sewerage

- a) IS-404: Lead pipes
- b) IS-458: Concrete pipes
- c) IS-651: Salt glazed stoneware pipes and fittings.
- d) IS-771: Glazed fire-clay sanitary appliances (all parts).
- e) IS-774: Flushing cisterns for water closets and urinals other than plastic cisterns.
- f) IS-783: Code of practice for laying of concrete pipes.
- g) IS-1172: Code of basic requirements for water supply, drainage and sanitation.
- h) IS-1626: Asbestos cement building pipes, gutters and fittings (all parts).
- i) IS-1742: Code of practice for building drainage.
- j) IS-2064: Code of practice for selection, installation and maintenance of sanitary appliances.
- k) IS-2065: Code of practice for water supply in buildings.
- l) IS-2470: Code of practice for installation of septic tanks (all parts).
- m) IS-3114: Code of practice for laying of Cast Iron pipes.
- n) IS-4127: Code of practice for laying of glazed stoneware pipes.
- o) IS-12251: Code of practice for Drainage of Building Basement.
- p) IS-1200: Method of measurement: Laying of water and [Part- XVI] sewer lines including appurtenant items.
- q) IS-1536: Centrifugally cast (spun) iron pressure pipes for water, gas and sewage.
- r) IS-1537: Vertically cast iron pressure pipe for water, gas and sewage.
- s) IS-3486: Cast iron spigot and socket drain pipes.
- t) IS-5329: Code of practice for sanitary pipe work above ground for buildings.
- u) IS-3076: Low density polyethylene pipes for potable water supplies.
- v) IS-1538: Cast iron fittings for pressure pipes for water, gas and sewage.
- w) IS-1230: Cast iron rainwater pipes and fittings.
- x) IS-1729: Sand cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
- y) IS-784: Prestressed concrete pipes.
- z) IS-1726: Cast iron manhole covers and frames.
- aa) IS-5961: Cast iron grating for drainage purposes.
- bb) IS-5219: "P" and "S" traps.
(Part-I)
- cc) IS-772: General requirements for enamelled cast iron sanitary appliances.
- dd) IS-775: Cast iron brackets and supports for wash basins and sinks.
- ee) IS-777: Glazed earthenware wall tiles.
- ff) IS-2548: Plastic water closet seats and covers (all parts).
- gg) IS-2527: Code of practice for fixing rainwater gutters and downpipes for roof drainage.
- hh) IS-554: Pipe threads where pressure tight joints are made on the threads – dimensions, tolerances and designation.
- ii) IS-778: Copper alloy gate, globe and check valves for water works purposes.
- jj) IS-781: Cast copper alloy screw down bib taps & stop valves for water services.



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- kk) IS-782: Caulking lead.
ll) IS-1703: Copper alloy float valve for water supply fitting.
mm) IS-2326: Automatic flushing cisterns for urinals.
nn) IS-2556: Vitreous sanitary appliances (vitreous china).
oo) IS-3311: Waste plug and its accessories for sinks and wash basins.
pp) IS-3438: Silvered glass mirrors for general purposes.
qq) IS-3589: Steel pipe for water and sewage (168.3 to 2540mm outside diameter)
rr) IS-3989: Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
ss) IS-4111: Code of practice for ancillary structure in sewerage system.
(Part I to V)
tt) IS-4733: Methods of sampling and testing sewage effluents.
uu) IS-4764: Tolerance limits for sewage effluents discharged into inland surface waters.
vv) IS-1068: Electroplated coating of nickel plus chromium and copper plus nickel plus chromium.
ww) IS-5382: Rubber sealing rings for gas mains, water mains and sewer
xx) IS-5822: Code of practice for laying of electrically welded steel pipes for water supply.
yy) IS-7740: Code of practice for construction and maintenance of road gullies.
zz) IS-8931: Copper alloy fancy single taps combination tap assembly and stop valves for water services.
aaa) IS-9762: Polyethylene floats for float valves.
bbb) IS-10592: Industrial emergency showers, eye and face fountains and combination units.
ccc) IS-12592: Specification for precast concrete manhole covers and frames.
ddd) IS-12701: Rotational moulded polyethylene water storage tanks.
eee) IS-13983: Stainless steel sinks for domestic purposes.
fff) SP-35: Hand book on water supply and drainage with special emphasis on plumbing.

2.10. Paving and Road works

- a) IS-73: Paving bitumen
b) IS-702: Industrial Bitumen
c) IS-1201: Method of testing tar and bituminous materials. thru' 1220
d) : Practice followed by Indian Road Congress (all parts).

2.11. Earthquake Resistant Design

- a) IS-1893: Criteria for earthquake resistant design of structures.
b) IS-4326: Code of practice for earthquake resistant design and construction of buildings.

2.12. Structural Steelwork

- a) IS-800: Code of practice for general construction in steel.
b) IS-802: Code of practice for use of structural steel in Overhead Transmission Line (All Parts).
c) IS-806: Code of practice for use of steel tubes in general building construction.
d) IS-808: Rolled steel beams, channels and angle sections.
e) IS-813: Scheme of symbols for welding.
f) IS-814: Covered electrodes for manual metal arc welding of carbon and carbon manganese steel.
g) IS-816: Code of practice for use of metal arc welding for general construction in mild steel.
h) IS-817: Code of practice for training and testing of metal arc welders.
i) IS-818: Code of practice for safety and health requirements in electric and gas welding and cutting operation.
j) IS-819: Code of practice for Resistance spot welding for light assemblies in Mild Steel.
k) IS-919: Recommendations for limits and fits for engineering.
l) IS-1024: Code of practice for use of welding in Bridges and Structures subjected to Dynamic loading.
m) IS-1161: Steel tubes for structural purposes.
n) IS-1182: Recommended practice for Radiographic Examination of Fusion Welded Butt joints



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in steel plates.

o) IS-1200: Method of measurement of steelwork and ironwork.

(Part-VIII)

p) IS-1239: Mild steel tubes, tubulars and other wrought steel fittings (all parts).

q) IS-1363: Black hexagonal bolts, nuts and locknuts (Dia. 6 to 39 mm) and black hexagon screws (Dia.6 to 24 mm). [all parts]

r) IS-1364: Precision and semi-precision hexagon bolts, screws, nuts and locknuts (Dia. range 6 to 39 mm). [all parts]

s) IS-1365: Slotted counter sunk head screws (Dia. range 1.6 to 20 mm).

t) IS-1367: Technical supply conditions for threaded steel fasteners. (Part 1 to 18)

u) IS-1443: Code of practice for laying and finishing of cement concrete flooring tiles.

v) IS-1608: Method for tensile testing of steel products.

w) IS-1730: Dimensions for steel plate, sheet and strip for structural and general engineering purpose.

x) IS-1731: Dimensions for steel flats for structural and general engineering purposes.

y) IS-1852: Rolling and cutting tolerances for hot rolled steel products.

z) IS-1977: Structural steel (Ordinary quality)

aa) IS-2016: Plain Washers

bb) IS-2062: Steel for General structural purposes.

cc) IS-2074: Ready mixed paint, air drying, red oxide zinc-chrome, priming.

dd) IS-2633: Methods of testing uniformity of coating of zinc coated articles.

ee) IS-3613: Acceptance tests for wire-flux combinations for submerged-arc welding of structural steels.

ff) IS-3664: Code of practice for Ultrasonic Pulse echo testing by contact and immersions methods.

gg) IS-3757: High strength structural bolts.

hh) IS-4000: High strength bolts in steel structures.

ii) IS-4759: Hot dip zinc coatings on structural steel and other allied products.

jj) IS-5334: Code of practice for Magnetic Particle Flaw detection of welds.

kk) IS-7215: Tolerances for fabrication of steel structures.

ll) IS-7280: Base-wire electrodes for sub-merged arc welding of structural steels.

mm) IS-7318: Approval test for welders when welding procedure approval is not required. (Part-I)

nn) IS-8500: Structural steel - micro alloyed (medium and high strength qualities).

oo) IS-9595: Recommendation for metal arc welding of carbon and carbon manganese steels.

pp) AWS D.1.1 Structural Welding Code.

qq) IS-8640: Recommendations for dimensional parameters for industrial building.

rr) IS-9178: Criteria for design of steel bins for storage of bulk material (all parts).

ss) IS-12843: Tolerances for erection of steel structures.

tt) IS-1181: Qualifying tests for Metal Arc welders (engaged in welding structures other than pipes).

uu) IS-2595: Code of practice for Radiographic testing

vv) IS-2629: Hot dip galvanising of iron and steel

ww) IS-3502: Steel chequered plate.

xx) IS-3658: Code of practice for liquid penetrant flaw detection.

yy) IS-4353: Sub merged arc welding of mild steel and low alloy steel Recommendation.

zz) IS-5369: General requirements for plain washers and lock washer.

aaa) IS-6623: High strength structural nuts.

bbb) IS-6649: Hardened and tampered washers for high strength structural bolts & nuts.

ccc) IS-6911: Stainless steel plate, sheet and strip.

ddd) IS-7205: Safety code for erection of structural steel.

eee) IS-7307: Approved test for welding procedures

(Part I) Fusion welding of Steel

fff) IS-7310: Approval test for welders working to approval welding procedure.

(Part I) Fusion welding of Steel

ggg) SP-6: IS Handbook for structural engineers.



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2.13. Painting

- a) IS-348: Specification for French Polish.
- b) IS-427: Specification for Distemper, dry colour as required.
- c) IS-428: Specification for Distemper, oil emulsion, colour as required.
- d) IS-1477: Code of practice for painting of ferrous metal in buildings.
(Part I & II)
- e) IS-2338: Code of practice for finishing of wood and wood based materials.
(Part I & II)
- f) IS-2339: Specification for Aluminium Paints for general purposes in dual containers.
- g) IS-2395: Code of practice for painting concrete, masonry and plaster surface.
- h) IS-2932: Specification for enamel, synthetic, exterior - a) undercoating, b) finishing.
- i) IS-2933: Specification for enamel, exterior - a) undercoating, b) finishing.
- j) IS-5410: Specification for cement paint.
- k) IS-162: Ready mixed paint, brushing fire resisting, silicate type for use on wood, colour as required.
- l) IS-1650: Specification for colours for building and decorative materials.
- m) IS-2395: Code of practice for painting concrete, masonry and plaster surfaces.
(Part I) Operations and Workmanship.
(Part II) Schedule.
- n) IS-2524: Code of practice for painting of nonferrous metals in buildings.
(Part I) Pre-treatment.
(Part II) Painting.
- o) IS-15489: Plastic emulsion paint.
- p) IS-6278: Code of practice for white washing and Colour washing.
- q) IS-10403: Glossary of term related to building finish.
- r) IS-12027: Silicone based water repellent.
- s) IS-13238: Epoxy based zinc phosphate primer (2 pack).
- t) IS-13239: Epoxy surface (2 pack).
- u) IS-13467: Chlorinated rubber for paints
- v) IS-14209: Epoxy enamel, two component glossy.
- w) BS-5493: Code of practice for protective coating of iron and steel structures against corrosion.

2.14. Sheeting

- a) IS-277: Galvanised steel sheets (Plan & corrugated).
- b) IS-513: Cold-rolled low carbon steel sheets & strips.
- c) IS-730: Hook bolts for corrugated sheet roofing.
- d) IS-801: Code of practice for use of cold formed light gauge steel structural members in general building construction.
- e) IS-7178: Technical supply condition for tapping screw.
- f) IS-8183: Bonded mineral wool.
- g) IS-8869: Washers for corrugated sheet roofing.
- h) IS-12093: Code of practice for laying and fixing of sloped roof covering using plain and corrugated galvanized steel sheets.
- i) IS-12436: Preformed rigid Polyurethane (PUR) and Polyisocyanurate (PIR) foams for thermal insulation.
- j) IS-12866: Plastic translucent sheets made from thermosetting polyester resin (glass fiber reinforced).
- k) IS-14246: Continuously pre-painted galvanized steel sheets and coils.
- l) BS-5950: Code of practice for design of light gauge profiled steel sheeting
(Part VI)

2.15. Plastering

- a) IS-1661: Code of practice for application of cement and cement lime plaster finishes.
- b) IS-2402: Code of practice for external rendered finishes.
- c) IS-2547: Gypsum building plaster.



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2.16. Acid / Alkali Resistant Tiling

- a) IS-158: Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali & heat resisting.
- b) IS-412: Expanded metal steel sheets for general purpose.
- c) IS-4443: Code of practice for use of resin type chemical resistant mortars.
- d) IS-4456: Method of Test for chemical resistant tiles.
(Part I & II)
- e) IS-4457: Ceramic unglazed vitreous acid resisting tiles.
- f) IS-4832: Specification for chemical resistant mortars.
(Part I) Silicon Type
(Part II) Resin Type
(Part III) Sulphur Type
- g) IS-9510: Bitumastic acid resisting grade.

2.17. Safety

- a) IS-1641: Code of practice for fire safety of buildings - General principles of fire grading and classification.
- b) IS-1642: Code of practice for fire safety of buildings - Details of construction.
- c) IS-3696: Safety code for scaffolds and ladders.
(Part I & II)
- d) IS-4081: Safety code for blasting and related drilling operations.
- e) IS-4130: Demolition of buildings - code of safety.
- f) IS-5121: Safety code for piling and other deep foundations.
- g) IS-5916: Safety code for construction involving use of hot bituminous materials.
- h) IS-7205: Safety code for erection of structural steel work.
- i) IS-7969: Safety code for handling and storage of building materials.

2.18. Architectural Design of Buildings

- a) SP-7: National Building Code of India.
- b) SP-41: Hand book on functional requirements of buildings (other than industrial buildings).
- c) ECBC: Energy Conservation Building Code
- d) GRIHA: Green Rating for Integrated Habitat Assessment.

2.19. Other

- a) Indian Road Congress (IRC) Bridge Codes
- b) Indian Railway Standard Bridge Rules

3. GENERAL

All the quality standards, tolerances, welding standards and other technical requirements shall be strictly adhered to. The Bidder shall fully apprise himself of the prevailing conditions at the proposed site, climatic conditions including monsoon pattern, soil conditions, local conditions and site specific parameters and shall include for all such conditions and contingent measures in the bid, including those which may not have been specifically brought out in the specifications. In case of any conflict between stipulations in various portions of the specification, most stringent stipulation would be applicable for implementation by the Bidder without any extra cost to the Employer.

4. LAYOUT

Before starting the work, the Contractor shall carry out the setting out of foundation and structures and provide levels, with reference to general existing grid and bench mark. **If the Contractor uses the grid, bench mark and reference pillar made by other Contractors, he shall coordinate with the Contractor and shall satisfy himself of the accuracy of the reference marks.** If he is required to set out the foundation afresh, he shall do so independently with



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reference to the one existing grid and bench mark which has been followed by other agency at the instruction of the Engineer. In case any discrepancy is found, it shall be immediately brought to the notice of the Engineer for any rectification/modification necessary. No complaint shall be entertained at a later stage. The Contractor shall accurately set out the position for holding down bolts and inserts.

If required, in the opinion of the Engineer, he shall construct and maintain pillars for grid, references and bench marks and maintain them till the completion of the construction. He shall also help the Engineer with instruments, materials and labours for checking the detailed layouts and levels. The Contractor shall be solely responsible for the correctness of the layout and levels, and Engineer's approval shall not be deemed to imply any warranty in carrying out the works correctly. The Tenderer's shall take into account the cost of these in quoting their price.

5. WORKMANSHIP

Workmanship shall be of the best possible quality and all work shall be carried out by skilled workmen except for those which normally require unskilled persons. Welding shall be done by experienced and certified welders in proper sequence using necessary jigs and fixtures. Fabrication shall be done in shops having proper equipment for accurate edge and shaping and dimensioning of anchor bolt assembly, inserts and other misc. items. In addition to the requirement specified above, if the bye laws of the local Govt., Municipal or other authorities require the employment of licensed or registered workmen for various trades, the Contractor shall arrange to have the work done by such registered or licensed personnel. In case of manufactured materials, the Contractor shall have, with no additional cost to the Owner, the services of the supervisors of the manufacturers to ensure that the work is being done according to the manufacturer's specifications.

6. TEMPORARY WORK

All scaffoldings, staging, temporary bracing and other necessary temporary work required for proper execution of the Contract shall be provided by the Contractor at his own cost and inclusive of all materials, labour, supervision and other facilities.

The layout and details of such Temporary work shall have the prior approval of the Engineer, but the Contractor shall be responsible for proper strength and safety of the same. All Temporary work shall be so constructed as not to interfere with any permanent work or with the work by other agencies. If it is necessary to remove any of the temporary work at any time to facilitate execution of the work or with the work of other agencies, such removal and re erection, if required, shall be carried out by the Contractor at the direction of the Engineer without any delay and any extra cost on this account shall be borne by the Contractor.

7. INTERFACE WITH STRUCTURES UNDER OTHER'S SCOPE

Modification in layout of foundation/structure during detail engineering stage may be necessary to avoid fouling with those under other's scope. Necessary changes on this account will be made without any extra cost to Owner.

8. SEQUENCE OF WORK AND PROGRESS REPORT

The sequence in which the works are to be carried out shall be as approved by the Engineer in accordance with the construction method accepted by the Engineer and to be followed by the Contractor. A programme of work is to be submitted for the Engineer's review and approval and this has to be periodically updated and modified as per actual progress to enable timely completion.

The Contractor shall regularly submit to the Engineer progress reports for periods of working as specified by the Engineer showing up to date progress on all important items of work.

9. CONSTRUCTION METHODOLOGY

Construction and erection activities shall be fully mechanized from the start of the work. All excavation and backfilling work shall be done using excavators, loaders, dumpers, dozers, porcelains, excavator mounted rock breakers, rollers, sprinklers, water tankers, etc. Manual excavation can be done only on isolated places with specific approval of engineer.

Dewatering shall be done using the combination of electrical and standby diesel pumps.

For concreting, weigh batching plants, transit mixers, concrete pumps, hoists, etc. shall be used.



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All handling of materials shall be with cranes.
Heavy trailers shall be used for transportation.
Mechanized modular units of scaffolding and shuttering shall be used.
Grouting shall be carried out using hydraulically controlled grouting equipment.
All finishing items shall be installed using appropriate modern mechanical tools. Manual punching etc. shall not be permitted.
Heavy duty hoists for lifting of construction materials shall be deployed.
Compressors for cleaning of foundations and other surfaces shall be used.
Field laboratory shall be provided with all modern equipment for survey, testing of soil, aggregates, concrete, welding, etc.
All persons working at site shall be provided with necessary safety equipment and all safety aspects shall be duly considered for each construction/ erection activity. Moreover, only the persons who are trained in the respective trade shall be employed for executing that particular work.



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PART-II

SPECIFIC TECHNICAL REQUIREMENT

NTPC Limited

(A Government of India Enterprise)



**NCTPP, DADRI, STAGE-II (2X490MW)
~~IGSTPP JHAJJAR (3X500MW)~~**

(PART –B)

SECTION – VI

**TECHNICAL SPECIFICATION
FOR
FLUE GAS DESULPHURISATION (FGD)
SYSTEM PACKAGE**

BIDDING DOCUMENT NO. : CS-6130/0330-109-9

NTPC Limited

(A Government of India Enterprise)



NCTPP, DADRI, STAGE-II (2X490MW)
~~**IGSTPP JHAJJAR (3X500MW)**~~

(PART –B)

SECTION – VI

TECHNICAL SPECIFICATION
FOR
FLUE GAS DESULPHURISATION (FGD)
SYSTEM PACKAGE

BIDDING DOCUMENT NO. : CS-6130/0330-109-9

This document is meant for the exclusive purpose of bidding against this specification and shall not be transferred, reproduced or otherwise used for purposes other than that for which it is specifically issued.

NCTPP DADRI ST-II (2X490MW) & ~~IGSTPP JHAJJAR (3X500MW)~~

SECTION - VI

**TECHNICAL SPECIFICATION
FOR
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE**

THE TECHNICAL SPECIFICATION, SECTION - VI COMPRISE OF THE FOLLOWING PARTS

PART – A

SUB-SECTION-I	INTENT OF SPECIFICATION
SUB-SECTION-IIA	PROJECT INFORMATION – JHAJJAR
SUB-SECTION-IIB	PROJECT INFORMATION - DADRI
SUB-SECTION-III	SCOPE OF SUPPLY & SERVICES
SUB-SECTION-III-A	MECHANICAL EQUIPMENTS & SYSTEMS
SUB-SECTION-III-A1	FLUE GAS DESULPHURISATION SYSTEM
SUB-SECTION-III-A2	AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM
SUB-SECTION-III-A3	FIRE FIGHTING SYSTEM
SUB-SECTION-III-A4	EQUIPMENT COOLING WATER SYSTEM
SUB-SECTION-III- A5	LIME STONE & GYPSUM HANDLING SYSTEM
SUB-SECTION-III-B	ELECTRICAL SYSTEM/EQUIPMENT
SUB-SECTION-III-C	CONTROL AND INSTRUMENTATION SYSTEM
SUB-SECTION-III-D	CIVIL WORKS
SUB-SECTION-IV	TERMINAL POINTS & EXCLUSIONS
SUB-SECTION-V	SALIENT DESIGN DATA & SIZING
SUB-SECTION-VI	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES

PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION-I-M (MECHANICAL SYSTEM)

SUB-SECTION-I-M1	FLUE GAS DESULPHURISATION SYSTEM
SUB-SECTION-I-M2	AIR CONDITIONING & VENTILATION SYSTEM
SUB-SECTION-I-M3	COMPRESSED AIR SYSTEM
SUB-SECTION-I-M4	FIRE DETECTION & PROTECTION SYSTEM
SUB-SECTION-I-M5	EQUIPMENT COOLING WATER SYSTEM
SUB-SECTION-I-M6	LIME STONE & GYPSUM HANDLING SYSTEM
SUB-SECTION-I-M7	PIPING
SUB-SECTION-I-M8	OPERATION & MAINTENANCE PHILOSOPHY

PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION-II-E (ELECTRICAL SYSTEM)

SUB-SECTION-II-E1	GENERAL ELECTRICAL SPECIFICATION
SUB-SECTION-II-E2	MOTORS
SUB-SECTION-II-E3	MEDIUM VOLTAGE BUS DUCTS
SUB-SECTION-II-E4	LT POWER CABLES
SUB-SECTION-II-E5	LT CONTROL CABLES
SUB-SECTION-II-E6	CABLING EARTHING & LIGHTNING PROTECTION
SUB-SECTION-II-E7	HT CABLES
SUB-SECTION-II-E8	ELECTRIC ACTUATORS WITH INTEGRAL STARTERS
SUB-SECTION-II-E9	HT SWITCHGEAR
SUB-SECTION-II-E10	LT SWITCHGEAR & LT BUSDUCT
SUB-SECTION-II-E11	DIESEL GENERATORS
SUB-SECTION-II-E12	OUTDOOR TRANSFORMERS
SUB-SECTION-II-E13	ELEVATOR ELECTRICAL
SUB-SECTION-II-E14	FIRE PROOF CABLE PENETRATION SEALING SYSTEM

SUB-SECTION-II-E15	LIGHTING
SUB-SECTION-II-E16	BATTERY
SUB-SECTION-II-E17	BATTERY CHARGER

PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION-III-C (CONTROL & INSTRUMENTATION SYSTEM)

SUB-SECTION-III-C1	BASIC DESIGN CRITERIA
SUB-SECTION-III-C2	MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)
SUB-SECTION-III-C3	PROCESS CONNECTION AND PIPING
SUB-SECTION-III-C4	INSTRUMENTATION CABLES
SUB-SECTION-III-C5	PLC BASED CONTROL SYSTEM
SUB-SECTION-III-C6	TYPE TEST REQUIREMENTS
SUB-SECTION-III-C7	CONTROL VALVES, ACTUATORS & ACCESSORIES

PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION-IV-D (CIVIL WORKS)

SUB-SECTION-IV-D	CIVIL WORKS
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PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION- V-Q (QUALITY ASSURANCE)

(MECHANICAL)

SUB-SECTION-V-QM1	FLUE GAS DESULPHURISATION SYSTEM
SUB-SECTION-V-QM2	LIME & GYPSUM HANDLING
SUB-SECTION-V-QM3	EQUIPMENT COOLING WATER SYSTEM
SUB-SECTION-V-QM4	AIR CONDITIONING & VENTILATION
SUB-SECTION-V-QM5	LP PIPING

SUB-SECTION-V-QM6 COMPRESSOR AIR SYSTEM

(ELECTRICAL)

SUB-SECTION-V-QE1 MOTORS
 SUB-SECTION-V-QE2 MEDIUM VOLTAGE BUS DUCTS
 SUB-SECTION-V-QE3 LT POWER CABLES
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 SUB-SECTION-V-QE6 HT CABLES
 SUB-SECTION-V-QE7 ELECTRIC ACTUATORS WITH INTEGRAL STARTERS
 SUB-SECTION-V-QE8 HT SWTIGCHGEAR
 SUB-SECTION-V-QE9 LT SWTIGCHGEAR
 SUB-SECTION-V-QE10 DIESEL GENERATORS
 SUB-SECTION-V-QE11 AUXILIARY TRANSFORMERS
 SUB-SECTION-V-QE12 ELEVATOR
 SUB-SECTION-V-QE13 VFD MODULE
 SUB-SECTION-V-QE14 STATION LIGHTING

(CONTROL & INSTRUMENTATION SYSTEM)

SUB-SECTION-V-QC1 MEASURING INSTRUMENTS
 (PRIMARY & SECONDARY
 SUB-SECTION-V-QC2 INSTRUMENTATION CABLES
 SUB-SECTION-V-QC3 POWER SUPPLY SYSTEM
 SUB-SECTION-V-QC4 DDCMIS
 SUB-SECTION-V-QC4 CONTROL VALVE
 SUB-SECTION-V-QC5 ELECTRICAL ACTUATOR WITH INTEGRAL STARTERS

(CIVIL WORKS)

SUB-SECTION-V-QD1

SUB-SECTION- VI

(PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND
INITIAL OPERATIONS)

PART - C

GENERAL CONDITIONS OF CONTRACT

PART - D

ERECTION CONDITIONS OF CONTRACTS

PART - E

LIST OF TENDER DRAWINGS

PART - F


ATTACHMENT-12 TO SECTION-VII (TECHNICAL DATA SHEETS)


PART – B (DETAILED TECHNICAL SPECIFICATION)


SUB-SECTION-IV-D (CIVIL WORKS)

SUB-SECTION-IV-D

CIVIL WORKS

CLAUSE NO.	TECHNICAL REQUIREMENTS		
1.00.00	GENERAL		
1.01.00	<p>This section of the bidding document deals mainly with the technical specification for the design and preparation of detailed drawings, getting the design and drawings approved by the Employer, fabrication, erection and construction of the necessary civil, structural and architectural works associated with the Flue Gas Desulphurization system package for NCTPP-Dadri Stage-II (2x490MW) and IGSTPP-Jhajjar (3x500MW). The work shall have to be carried out both below and above ground level and shall be involving, basements, equipment foundations, slabs, beams, columns, footings, rafts, walls, steel frames, brick walls, stairs, trenches, pits, access roads, culverts, trestles, silos, sumps, Limestone storage hopper & shed, Crusher House, Transfer points, Conveyor Galleries, Tunnels, Gypsum storage shed, Chimney, Gypsum dewatering building, Ball Mill building, FGD control room building, Tank Foundations, absorber tower foundation, transformer foundation, MCC Building, finishes, complete architectural aspects, drainage, sanitation, water supply (from terminal points to various buildings/facilities) and all other civil, structural and architectural works associated with the complete FGD package.</p>		
1.02.00	<p>The specifications are intended for the general description of the work, quality and workmanship. The specifications are not, however, intended to cover minutest details and the work shall be executed according to the relevant latest Indian Standard Codes / I. R. S. / I. R. C. specifications. Where provisions are not covered in Indian Standards, reference shall be made to ACI, AISC, ASCE, EN, CICIND and other international standards or to the best prevailing local Public Works Department practices or to the instructions of the Engineer. Some of the relevant I. S. Codes to be followed are mentioned in the Technical Specifications. The Contractor is expected to get clarified on any doubts about the specifications, etc. before bidding, in writing with the Employer in respect of interpretation of any portions of this document.</p>		
1.03.00	<p>Bidder or his agencies engaged as detailer for fabrication drawings should have the experience of detailing for power plant structures or steel plant or Industrial structures like Petro/ Chemical/ Refinery/ Cement/FGD Plant/Coal Handling Plant/Ash Handling Plant etc.</p> <p>The designer responsible for preparation of scope drawings shall review and approve the fabrication drawings prepared by the detailer before releasing them for fabrication.</p>		
2.00.00	CLAUSE DELETED		
3.00.00	Work Description		
3.01.00	<p>Truck Hopper, Limestone Storage hopper and Underground Tunnel</p> <p>Truck Hopper shall consist of underground portion, which shall be of R. C. C. with structural steel shed covered with permanently Colour coated profiled steel sheets.</p>		
<p>NCTPP DADRI ST—II(2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6130/0330-109-9</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 1 OF 67</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS				
	<p>Limestone storage hopper shall be of RCC with structural steel shed covered with permanently Colour coated profiled steel sheets.</p> <p>The structural arrangement to be adopted for the design and construction of Limestone Storage hopper shall essentially consist of R. C. C. frames spaced at approx. 3.0M centers with R. C. C. wall panels on the sides and R. C. C. raft at the bottom, fixed to the frames. Minimum thickness of R. C. C. raft at bottom shall be 600 mm. Minimum thickness of RCC side walls shall be 600 mm at bottom and 300 mm at top.</p> <p>The vertical and inclined portion of hopper shall be provided with 50 mm thick guniting (shotcreting). Details of shotcreting have been given elsewhere in this specification.</p> <p>Expansion joints shall be provided at a maximum distance of 40m. 600 mm wide water stop fabricated with 22G copper plate with bitumen board fillers and polysulphide sealing compound as specified elsewhere shall be used as expansion joint material.</p> <p>Floor shall be provided with cross slope not flatter than 1 in 50 towards side drains. Side drains shall be sloped towards sump where sump pumps as specified elsewhere, shall be provided. The slope of side drains shall not be flatter than 1 in 400. Side drains and sump shall have removable type steel grating cover.</p> <p>Water proofing / Damp proofing of under ground Truck hopper, Limestone Storage hopper, tunnels and underground (i. e. basement) portion of transfer houses shall be done by providing the following treatments:</p> <p>Chemical injection grouting for inner faces (details as specified elsewhere).</p> <p>Polymer modified cementitious coating on earth side face as per the following :</p> <ol style="list-style-type: none"> (1) On the outer surface of walls, frames and roof slabs coming in contact with earth, polymer modified cementitious coating in two layers as specified and as per manufacturer's specifications shall be provided directly on the concrete surface. (2) 50 mm thick P. C. C. (1 : 2 : 4 with 10 mm nominal size stone aggregates) shall be provided under the raft i.e. over the lean concrete, followed by polymer modified cementitious coating in two layers (slurry mix application) as per manufacturer's specification. 50 mm thick P. C. C. (1 : 2 : 4) with 10 mm nominal size stone aggregates shall then be laid over the polymer modified cementitious coating before laying the raft. <p>Truck hopper and its gratings shall be designed for movement of front end loader/ bulldozer over them. Bull dozer weight shall be considered as about 35T. The gratings shall be built of min. 200x28mm thick flats in main direction and min.100mm x 20mm thick in secondary direction. No painting/galvanization shall be provided in gratings. However, two coats of Red oxide Primer to be provided immediately after fabrication.</p>	<p>NCTPP DADRI ST—II(2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6130/0330-109-9</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 2 OF 67</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
<p>3.02.00</p> <p>In conveyor galleries tubular sections may be used for roof truss only as clearly stipulated in specifications clause no. 3.02.00, Subsection IVD-Civil Works, Part B, section VI. Tubular sections for beam members in steel structures is not allowed.</p>	<p>Plinth protection along with drains shall be provided along the Hopper complex. However, 5m wide paving shall also be provided around machinery hatches and Truck hopper.</p> <p>Earth pressure to be considered for design shall be due to earth pressure at rest (Ko) condition only. Earth pressure due to surcharge intensity of Uniformly Distributed Load (U. D. L) of intensity 2 T / Sq. M. shall be considered in the design.</p> <p>A minimum safety factor of 1.2 against uplift due to ground water shall be ensured during execution and after execution, considering dead weight of the structure to be 0.9 times only, ground water table to be taken at adjoining formation level and soil wedge angle of not more than 15 degrees.</p> <p>Also, FOS against uplift, to be taken as 1.0, considering the dead wt. of structure and soil resting on side projections if any in the vertical plane. Inclined wedge action of soil shall not be considered in this case.</p> <p>Wherever, slope of tunnel exceeds 10°, R. C. C. steps shall be provided for the entire width of each walkway.</p> <p>3.01A.00 Limestone Storage Silo The supporting structure for silo shall be of structural steel. Independent supporting structure shall be provided for each silo.</p> <p>Overhead / Ground Conveyor Galleries and Trestles</p> <p>Overhead conveyors shall be located in a suitably enclosed gallery of structural steel. The overhead gallery shall consist of two vertical latticed girders having rigid jointed portal frame at both ends. Cross beams at floor level supporting conveyor stringer beams shall be made of single rolled steel beam or single channel section (ISMB or ISMC) or plate girder. Horizontal bracings are to be provided at top & bottom plan of the gallery (latticed girders shall be braced together in plan at the top and bottom). Common end portal frame shall not be used for adjacent conveyor spans. Roof truss shall be provided at upper node points of latticed girders to form an enclosure. Contractor can also use tubular steel sections for roof truss only of conveyor galleries. The tubular steel section shall be of circular/rectangular/square shape. The circular steel tube shall conform to IS 1161 and rectangular/square steel sections shall conform to IS 4923. The steel structures using tubular sections shall be designed and fabricated as per IS 806 – “Code of Practice for use of steel tubes in general building construction.” and EN 1993-1-8:2005. The maximum span of overhead gallery shall be limited to 25 meters unless higher span is required due to site conditions, which shall be subject to approval of the Engineer. The gallery should as far as possible be erected as a box section keeping all the vertical and horizontal bracing tied in proper position. The gallery should be checked for all erection stresses that are likely to develop during handling and erection and if required, temporary strengthening of gallery members during erection shall be made.</p> <p>Seal plates under the conveyor galleries shall be provided in such a way that complete gallery bottom shall form a leak proof floor.</p> <p>The ground conveyors shall be located in suitably enclosed gallery of structural steel consisting of rigid portal frames spaced at regular intervals and suitably braced. Plinth protection along with drains shall be routed along the ground conveyors.</p>		
<p>NCTPP DADRI ST-II(2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6130/0330-109-9</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 3 OF 67</p>

For double stream conveyor gallery, two side and one central walkway of width 800 mm and 1100 mm respectively shall be provided. The width of two side walkways for single stream conveyor gallery shall be 800 mm and 1100 mm respectively. Both sides of central and side walkways shall be provided with pipe handrails all along the conveyor gallery. Hand railing should not be supported on conveyor supporting stringers. The walkways shall be chequered plate construction with anti - skid arrangement. The anti - skid arrangement will consist of welding of 10 mm square steel bars at a maximum spacing of 500 mm along the length of the gallery. Where the slope of walkway is more than 10°, chequered plate steps with nosing and toe guard shall be provided. The floor of conveyor gallery all along the gallery length, shall be provided with minimum 12 gauge thick seal plates and other drainage arrangements as specified elsewhere

Conveyor gallery shall have permanently colour coated steel sheet covers on roof and both sides. However in roof, a panel of minimum 1.5 m x 1.5 m area at about 6.0 m center shall be provided with translucent sheets of polycarbonate material for natural lighting. A continuous slit opening of 500 mm shall be provided on both sides just below the roof sheeting. Adequate provision of windows shall be kept on both sides of conveyor gallery as appended in Mechanical Section (Belt conveyor system). Windows shall be provided with wire mesh as specified elsewhere in this specification.

Cross-over with chequered plate platform and ladder for crossing over the conveyors shall be provided at approximately every 100 M intervals of conveyor. Crossover shall preferably be located over four-legged rigid trestle location.

For railway tracks passing below overhead conveyor gallery and along conveyors, the railway clearances both underground as well as over ground shall have to be adhered to for design, execution and erection of foundations, trestles, galleries etc., so that movement of locomotives and wagons is not hampered in any way during execution and afterwards. However at the location where the overhead conveyor gallery crosses road / rail line, minimum clearance of 8.5 m above the road crest / rail top shall be provided.


For calculation of material load on moving conveyor, a multiplication factor 1.6 shall be used to take care of inertia force, casual over burden and impact factor etc.


Thus material load per unit length of each moving conveyor shall be


$$1.6 \quad \times \quad \frac{\text{Rated capacity of conveyor system}}{\text{Conveyor Belt Speed}} \quad \times \quad F$$


Where, F = 1700/1400 for lime & 1250/900 for gypsum


It should be noted that for structural design, unit weight of lime shall be assumed as 1700 Kgs. / Cu. M. instead of 1400 Kgs. / Cu. M., unit weight of gypsum shall be assumed as 1250 Kgs. / Cu. M. instead of 900 Kgs. / Cu. M. considered for system sizing purpose. Conveyor Gallery structure shall be designed considering both conveyors operating simultaneously.


CLAUSE NO.	TECHNICAL REQUIREMENTS	
<p>3.03.00</p> <p>Use of tubular sections in transfer houses is not allowed as per technical specification.</p> <p>Use of cold formed sections for purlins and side runners is not allowed.</p>	<p>Conveyor gallery and supporting trestles located between transfer houses / buildings shall be arranged in any one of the following ways.</p> <p>a) All gallery supporting trestles shall be four legged type only. One end of each gallery span shall be hinged to the supporting trestle and the other end shall be slide type. Slide type support shall be with P. T. F. E. bearings to allow both rotation & longitudinal movements.</p> <p>b) In between transfer houses / buildings, four legged trestles shall be placed at a maximum interval of 90 metres. The arrangement shall be such so as to ensure that force in the longitudinal direction (i. e. along the conveyor length) of conveyor gallery of length not more than 90 m is transferred to any four legged trestle. In the space between each successive four legged trestles, two legged trestles shall be provided at regular intervals. The end supports resting on the four-legged trestle can have either ends hinged or one hinge and the other on slide type depending on the arrangements. Slide type support shall be with P. T. F. E. bearings to allow both rotation & longitudinal movements.</p> <p>End of conveyor gallery which will be supported over transfer house, shall be so detailed that only vertical reaction is transferred from conveyor gallery and no horizontal force in longitudinal direction is transferred from conveyor gallery to transfer house structure and vice - versa.</p> <p>For trestles and trestle foundations for conveyor galleries located adjacent to existing structures, over ground and under ground facilities, location and details of these trestles and foundations shall have to be decided such that there is no interference both underground as well as over ground with existing structures and facilities. Trestle columns / ground conveyor portal column base shall be kept 300 mm higher than the existing ground level.</p> <p>Transfer Houses</p> <p>The over ground portion of the transfer house shall be framed structure of structural steel work with permanently colour coated profiled steel sheet side cladding (from lowest working floor level till top) and R. C. C. floors comprising of RCC slab over profiled metal deck sheets (to be used as permanent shuttering) over structural beams. Shear anchor studs shall be provided through metal deck at regular interval on all top flange/flange plate of structural beams. However, the lower portion of side cladding, at ground, for a minimum height of 0.9 m above the finished floor level shall be one brick thick wall plastered on both side. In some areas like MCC floors etc., one brick thick wall cladding shall be provided. Brick wall cladding shall be supported on encased wall beams and suitably anchored to adjoining columns and beams. Vertical bracings shall be provided only on four sides along the periphery. Grade slab with 0.9m height one brick thick wall plastered on both side at periphery shall be provided for all transfer houses.</p> <p>Adequate steel doors and windows for proper natural lighting and ventilation shall be provided. In addition to steel windows, panels of suitable size to suit the architectural treatment and made of translucent sheets of polycarbonate material shall also be provided on the side cladding for natural lighting.</p>	
<p>NCTPP DADRI ST-II(2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6130/0330-109-9</p>	<p>SUB-SECTION-IV-D CIVIL WORKS PAGE 5 OF 67</p>


CLAUSE NO.	TECHNICAL REQUIREMENTS			
<p>3.04.00</p>	<p>The roof of Transfer points shall be provided with pre-fabricated insulated metal sandwich panels. Composition of Insulated Metal Sandwich Panels shall be as described elsewhere in the Technical Specification. Adequate slope shall be provided for quick drainage of rain water.</p> <p>Crusher House</p> <p>The crusher house shall be framed structure of structural steel work with permanently colour coated profiled steel sheet side cladding. However, panels of suitable size to suit the architectural treatment and made of translucent sheets of polycarbonate material shall also be provided on the side cladding for natural lighting. The lower portion of side cladding, at ground, for a height of minimum 0.9m above the finished floor level shall be of one brick thick wall plastered on both faces. Floors shall be of R. C. C. slab over profiled metal deck sheets (to be used as permanent shuttering) over structural beams. Shear anchor studs shall be provided through metal deck at regular interval on all top flange/flange plate of structural beams. Within this building cubicles are to be provided for resting room of operators and these shall be constructed with one brick thick brickwork having both sides plastered and roof slab. Adequate steel doors and windows for natural lighting and ventilation shall be provided. Vertical bracings shall be provided only on four sides along the periphery.</p> <p>The roof of Crusher house shall be provided with pre-fabricated insulated metal sandwich panels. Composition of Insulated Metal Sandwich Panels shall be as described elsewhere in the Technical Specification. Adequate slope shall be provided for quick drainage of rain water.</p> <p>Crushers shall be supported on R. C. C. deck, which in turn will rest on suitable vibration isolation system consisting of springs and dampers. This R. C. C. deck shall be isolated from the floor. However, the vibration isolation system consisting of springs and dampers may rest on main building framework. Detailed specification of vibration isolation system including the unbalanced force, frequency and amplitude criteria and other design requirements are appended elsewhere in this specification.</p>			
<p>3.05.00</p>	<p>Control building, M. C. C. Buildings</p> <p>These shall be steel framed building with R. C. C. roof and floor. For steel framed building roof /floor shall comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only) over structural beams. Cladding shall be of brickwork/concrete block work with plastering on both sides. Roof shall be provided with roof water proofing treatment, as specified elsewhere in the Technical specification. Suitable arrangement shall be provided so as to prevent ingress of water into the cable trenches inside the building from cable entry locations.</p> <p>All air - conditioned areas, shall be provided with the suspended permanently colour coated aluminium false ceiling system (details specified elsewhere) with under deck insulation.</p>			
<p>NCTPP DADRI ST—II(2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6130/0330-109-9</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 6 OF 67</p>	


CLAUSE NO.	TECHNICAL REQUIREMENTS				
<p>3.06.00</p> <p>Pent House</p> <p>3.07.00</p> <p>Gypsum Storage Shed</p> <p>3.08.00</p> <p>Toilets</p> <p>3.09.00</p> <p>Staircases, Gratings, Handrails</p>	<p>Adequate aluminium doors and windows shall be provided for natural lighting, ventilation and view. All windows in air conditioned rooms shall have hermetically sealed double glazing.</p> <p>These shall be of R. C. C. framed structures with columns, beams, slabs and foundations etc. Cladding shall be of brickwork with plastering on both sides. Roof shall be provided with roof water proofing treatment as specified elsewhere. Adequate nos. of steel doors and windows shall be provided for natural lighting and ventilation.</p> <p>The Gypsum storage shed shall be RCC framed structure with RCC/ Brick infill wall (upto Tripper floor) and structural steel shed with permanently colour coated profiled steel sheet roof and side cladding (above tripper floor). Roof shall be provided with troughed profile permanently colour coated sheet with slope of 1 in 5 for quick drainage of rain water. At grade level Heavy duty paving as detailed elsewhere in the specification shall be provided inside the shed.</p> <p>Toilet with potable water line facilities shall be provided in each of the following locations:</p> <p>(a.) In all M. C. C./ Control buildings</p> <p>All floors of transfer points/crusher houses and other facility buildings shall be accessible through staircase. All staircases of Transfer points and crusher house shall be of steel. Cage ladders (min. 450mm wide) shall be provided for access to roof of penthouses, single storey mcc rooms & mumty. All Stairs shall be minimum 1200 mm wide, maximum rise should not be more than 180 mm and minimum tread with 250 mm. Numbers and arrangement (including enclosures etc.) of stair cases shall be such as to meet the fire safety requirement as per guide lines of statutory regulatory bodies. For steel staircases, Stringers shall be of rolled steel channel (minimum ISMC 250) and tread shall be of steel gratings. Outside stairs to transfer points/crusher house shall be open type. However sheeting shall be provided at the top. Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection for treads of stairs in underground TP's</p> <p>All gratings shall be electro forged types. Minimum thickness of the grating shall be 40 mm for indoor installation and 32 mm for outdoor installation. However, at entry or road crossing point's minimum thickness of grating shall be 40 mm The opening size shall not be more than 30mmx100mm. The minimum thickness of the main bearing bar shall be 6 mm or as per design requirement whichever is higher. All gratings shall be designed for minimum imposed load of 500Kgs. / Sq. M. If actual expected load is more than the specified load, then actual load is to be considered. All gratings shall</p>	<p>NCTPP DADRI ST—II(2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6130/0330-109-9</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 7 OF 67</p>


CLAUSE NO.	TECHNICAL REQUIREMENTS		
<p>3.10.00</p>	<p>be hot dip galvanized at the rate of 610 g. per sq.m. after surface preparation by means of blast cleaning/ acid pickling.</p> <p>Minimum 1000 mm high hand railing shall be provided around all openings, projections / balconies, walkways, platforms, Stairs, etc. All handrails and ladder Pipes shall be 32 mm nominal bore MS Pipes (medium class) as per IS:1161. Handrails shall have top and middle rails at a height of 1000 mm and 500 mm and the vertical post spacing shall not exceed 1.50 M, with provision of kick Plates (100 mm high and 6 mm thick). All handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. M as per IS:4736.</p> <p>Trenches</p> <p>All trenches for cables or any other underground facility as detailed out elsewhere shall be of R. C. C. Cable trenches shall be provided with pre - cast R. C. C. covers / chequered plate cover. Cable trenches as well as pre - cast covers shall be provided with edge protection angles and lifting hooks. All embedments / block outs as required and specified elsewhere in these specifications shall be provided. Proper drainage arrangement shall be provided. Trench pre - cast cover weight shall not be more than 65 Kgs. Trench covers near entry or at road crossings shall be designed for 10 T wheel load at centre. Pre - cast covers shall be designed for central point load of 75 Kgs. R. C. C. cable trenches shall be filled with sand after erection of cables, up to top level and covered with pre - cast R. C. C. covers. For cable trenches outside buildings, top level shall be 200 mm above G. L and sand filling shall be overlaid with 50 thk. PCC.</p> <p>Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection all around cut outs / openings in floor slabs, edges of drains supporting grating/precast RCC covers, edges of R. C. C. trenches supporting pre - cast covers, supported edges of pre - cast cover</p>		
<p>3.11.00</p>	<p>Cable gallery/trestles</p> <p>Cable galleries/trestles shall be made of structural steel. The contractor can use either rolled sections or tubular steel sections. The tubular steel section shall be of circular/rectangular/square shape. The circular steel tube shall conform to IS:1161 and rectangular/square steel sections shall confirm to IS:4923. The steel structures using tubular sections shall be designed and fabricated as per IS:806 – “Code of Practice for use of steel tubes in general building construction.” and EN 1993-1-8:2005.</p>		
<p>3.12.00</p>	<p>Transformer Foundation</p>		
<p>3.12.01</p>	<p>Foundations of transformers shall be designed for seismic and wind loads in addition to other applicable loads. Block foundations shall be provided for the main transformer block.</p> <p>The oil soak pit, if provided, shall be filled with gravel of size 40mm. The volume of the soak pit shall be sufficient to store complete oil of the transformer/reactor along with 10 minutes of fire water considering only 40% of the volume as available voids between gravel filling. However, in case a separate oil collection tank is provided for</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
<p>3.12.02</p>	<p>the transformer/reactor, oil soak pit of volume equivalent to one-third (1/3) the oil volume of transformer/reactor shall be provided around transformer/reactor. The oil collection tank, in such cases, shall be designed for an effective capacity of complete oil of the transformer along with 10 minutes of fire water. The oil soak pit shall also be provided with a sump at the corner to allow drainage of water/oil from the soak pit.</p> <p>Arrangement for moving the transformer into place using rail cum road, jacking pads and pulling blocks including inserts, as required, shall be provided along with the transformer/ reactor foundations.</p> <p>RCC Firewall shall also be provided between the transformers wherever required.</p> <p>300 mm thick PCC M20 encasement all around the Pylon supports inside soak pit for fire fighting system shall be provided up to top of gravel filling. Coarse aggregate filling inside the transformer oil soak pit shall be carried out only after construction/erection of Pylon supports and PCC encasement.</p> <p>Fencing</p> <p>Fencing with toe wall and steel gates shall be provided around the transformers. Fencing shall comprise of PVC coated GI chain link fencing of minimum 8G (including PVC coating) of mesh size 75 mm and of height 2.4 m above the toe wall. The diameter of the steel wire for chain link fence (excluding PVC coating) shall not be less than 12G. Fence posts shall be of pre – cast R. C. C. of minimum M20 grade. All corner posts will have two stay posts and every tenth post will have transverse stay post. Suitable R. C. C. foundation for the post and stays shall be provided based on prevailing soil conditions. Gates shall be sturdy with locking provisions.</p> <p>Toe walls of brick masonry shall be provided between fence posts all along the run of the fence with suitable foundation. Toe wall shall be minimum 200 mm above the formation level with 50 mm thick P. C. C. coping (1: 1. 5: 3) and shall extend minimum 300 mm below the formation level. Toe wall shall be plastered on both sides and painted with two coats of cement paint of approved colour and shade. Toe wall shall be provided with weep holes at suitable spacing</p>		
<p>3.13.00</p>	<p>Booster Fan Foundation</p> <p>Booster Fan foundations shall be RCC block foundation directly resting on virgin soil/ pile below Ground level. The vertical faces of this block foundation shall be isolated from adjacent footings by providing minimum 100mm thick polystyrene board of type-1 conforming to IS: 4671 with density 20 Kg/cum sandwiched between the vertical face of block foundation and 230 thick brick wall all round.</p>		
<p>3.14.00</p>	<p>CHIMNEY</p>		
<p>3.14.01</p>	<p>Salient Features</p>		
	<p>Single flue chimney(s) shall be provided. Chimney shall be of reinforced concrete construction. There shall be one flue (liner) for each unit. The flue gas emission point</p>		
<p>NCTPP DADRI ST-II(2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6130/0330-109-9</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 9 OF 67</p>


CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<p>shall be minimum 115 meters above the plant grade level. The centre to centre distance between the proposed chimney(s) and the existing chimney(s) in any direction shall not be less than 150 metres.</p> <p>The chimney shell (windshield) shall be constructed using slip form shuttering. Internal platforms of steel structure shall be provided for enabling access to various elevations of the chimney and to provide support to the flue liners. Spacing of internal platforms shall not exceed 45.0 M. The platform beams shall be supported on concrete shell using suitable load bearing arrangement in the recesses provided for the purpose. The platform beams getting supported in the chimney shell shall have complete bearing support within the thickness of shell at that location and shall in no case be supported completely/partially on corbels/ brackets from the shell. "Through openings" in shell if provided to facilitate erection of platform beams shall be closed with cast-in-situ RCC closure wall on the external face of the shell. Necessary dowel bars shall be provided in the shell during construction for this purpose. Openings in the concrete shell for flue duct entry, access door & truck entry door at ground level, air ventilation etc shall be provided. Hand railing shall be provided all around internal staircase & around the ventilation voids in the internal platform using min. 32 mm nominal bore MS pipes of medium class conforming to IS:1161. Spacing of railing posts shall not be more than 1500 mm centre to centre with a minimum height of 1200 mm. The handrail shall have three rows of horizontal members between the railing posts including the top member. Kick plate of min. size 100x6 thick shall be provided in the hand railing.</p> <p>The flue duct outside the chimney shall be suitably connected to the flue liner inside the chimney through a transition duct. The transition duct shall be bottom supported and shall be profiled into a circular shape to connect to the flue liner. The flue duct shall be so designed that no load is transferred on the chimney shell due to the duct. The interface between the flue liner and the transition ducting shall be provided with non-metallic fluoroelastomeric fabric expansion joint.</p> <p>The expansion joint in the flue liner shall comprise of non-metallic fluoroelastomeric material suitable to withstand a temperature of 300 Deg C, shall be acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification and shall also prevent dust accumulation. The space between the expansion joint material and the liner shall be packed and sealed by providing a bolster made up of light weight compressible material suitable to withstand a temperature of 300 Deg C and acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification. The bolster shall be confined in texturized glass fabric having a final covering of stainless steel wire mesh.</p> <p>Chimney roof shall be of RCC slab over a grid of structural steel beams and provided with rainwater drainage system. An internal structural steel staircase supported from chimney shell with chequered plate floor panels and pipe handrails, shall be provided for full height of the chimney and an internal cage ladder for a small height, over last staircase landing to access the chimney roof through a roof access hatch.</p> <p>The other components of the chimney include liner test ports (for continuous pollution monitoring), liner hatches, grade level slab of RCC with metallic hardener floor finish, acid resistant treatment on roof slab, a large electrically operated grill type roll-up door and personnel access metallic door at grade level, roof drain basin, rain water down comer pipe (150 mm diameter galvanized pipe), connection to plant drains, louvers with bird screens for ventilation and all other openings in the wind</p>			
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<p>3.14.02</p>	<p>shield, mild steel wind strakes (if required), all finishing works, electrical power distribution boards, lighting panels, power & control cabling and wiring systems, stair and platforms lighting, socket outlet, lightning protection and grounding system, aviation obstruction lighting with photoelectric controller etc, communication system, a rack and pinion elevator and other items, though not specifically mentioned but reasonably implied and necessary to complete the job in all respects.</p> <p>Aviation Warning Lights (AWL) shall be mounted on door panel of required size (open able from interior of chimney shell) fixed to openings in the chimney shell at locations and levels specified elsewhere. Suitable provision for approach to the AWL shall be provided at the platform level. AWL shall be located at about 1-1.5 metre above the top of platform to enable easy handling for maintenance.</p> <p>The size of roll-up door shall be determined based on minimum requirement for ventilation and transportation & erection of flue segments.</p> <p>Design Concept</p> <p>Design and construction of various components and systems of the chimney shall be in accordance with relevant Indian Standard and where provisions are not covered in Indian Standard, reference shall be made to ACI, EN, CICIND and other international standards.</p> <p>In case of any conflict between this document and the Indian and International Standards, the stipulations of this document shall prevail.</p> <p>Imposed loading for design of all chimney components shall not be less than 5 kN/Sq.m. An additional 25% of liner load shall be taken as impact loading for liner erection in addition to the liner load.</p> <p>The min. thickness of web for plate girders shall be kept as 12 mm.</p> <p>Seismic forces on the chimney system shall be determined based on site specific seismic information provided elsewhere in this document.</p> <p>Wind forces on the chimney system shall be determined based on site specific wind design criteria provided elsewhere in this document.</p> <p>The chimney and its components shall be designed to resist the most onerous forces resulting from all the possible combinations of the various loadings. Design of all chimney components shall be based on working stress method.</p>		<p>NCTPP DADRI ST—II(2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6130/0330-109-9</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 11 OF 67</p>
<p>3.14.03</p>	<p>Wind Shield</p> <p>The wind shield shall be designed for vertical loading, cross wind loading, seismic loading, circumferential wind loading, thermal gradients etc. The load calculation and load combinations shall be as detailed in IS 4998 (Part 1) : 1992. The wind shield shall be analysed for cases with and without flue liner loads.</p> <p>Forces/stresses in the wind shield due to eccentricity effects of local (e.g. corbel) loadings, insulations effects, rotation of chimney foundations, construction tolerances and moments of second order shall also be considered.</p> <p>Seismic response of the chimney shall be computed by the response spectrum method. At least, the first five modes of vibrations shall be used for this analysis.</p>					


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<p>3.14.04</p>	<p>The cross wind analysis of the chimney shall be carried out irrespective of the value of the Scruton Number for the chimney and other empirical considerations which suggest structural immunity to cross wind oscillations.</p> <p>The effect of the openings/cut-outs in the chimney shell shall be duly considered in the design of the windshield. The minimum thickness of shell shall not be less than 500mm.</p> <p>The stresses for the shell design shall not exceed the limits given in Cl. 7.0 of IS:4998 (PART-I) 1975 for various combinations of loads, excepting the stress in concrete for the case of dead load + wind load which shall not exceed $0.30f_{ck}$ where f_{ck} is the characteristic compressive strength of concrete.</p> <p>The minimum vertical reinforcement shall be 0.3% of the concrete area. The maximum spacing of the reinforcement bars shall not be more than 250 mm on each face. The minimum circumferential reinforcement shall be 0.2% of the concrete area. The maximum spacing of the reinforcement bars shall not be more than 200 mm on each face. The circumferential reinforcement in the top 3 meters of the windshield shall be twice that required from design forces. The clear cover to reinforcement shall be 50 mm.</p> <p>There shall be a continuous ring of concrete shell without any opening for a height of atleast 5m below the soffit of flue duct openings.</p> <p>There shall not be any reverse (outward) slope in the inside face of chimney shell. Where there is a sudden change in slope/ profile of the shell, the circumferential reinforcement shall be increased to twice the requirement as per the design in a circumferential band extending atleast 3m above and below such slope/profile change level.</p> <p>The diameter of the reinforcing bar for the main vertical reinforcement of shell shall not be less than 25mm for a shell height upto the top level of flue duct opening.</p> <p>Shell thickness between any two 10m reference levels shall not vary more than 150mm.</p> <p>The minimum thickness of shell/closure wall at beam support recess/ opening locations shall be 100mm.</p> <p>Grade of concrete for chimney shell, and other super structure shall be minimum M 30. Only OPC cement shall be used for Chimney shell and other super structure.</p> <p>The final design shall be checked & verified by 'Wind Tunnel Test' and shall be conducted at a reputed institution. Dynamic interference effects due to additional chimney(s)/NDCTS's and other tall structures located in the area or in the future expansion stage of the project shall be determined along with the other topographical features of the local area through model test.</p> <p>Flue Liners</p> <p>The flue gas parameters & various operating conditions for selection of flue liner material, material specification for flue liner and the criteria of flue gas exit velocity for sizing the flue liner shall be as specified elsewhere in the specification.</p> <p>For flue liner with base metal as mild steel, the thickness of the base metal shall be determined from structural considerations. The thickness of any clad metal/coating/block lining etc. provided on the base metal shall not be considered for computing the structural strength of flue liner. The minimum thickness of the mild</p>		
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<p>3.14.05</p>	<p>steel base metal shall, however, not be less than that specified elsewhere in the specification.</p> <p>Two manholes placed diametrically opposite shall also be provided in each flue at all internal platform levels.</p> <p>The supporting/restraining arrangements of the liners should be such that expansion of the liners longitudinally or circumferentially is not restrained.</p> <p>Clean-out door shall be provided below the flue for the removal of ash.</p> <p>Internal Platforms</p> <p>The platforms shall be designed for dead, imposed (live), erection work and other possible loadings and temperatures effects. These platforms shall provide support and lateral restraint to the steel liners and provide access for inspections and maintenance. Forces imposed on the floors due to lateral restraint of flues shall be enhanced aptly for impact effects. These platforms shall also be designed suitably for the liner erection works. The platform shall be made up of chequered floor panels supported on grid of structural steel beams. All beams shall have bolted connections. The maximum permissible deflection in main steel girders supporting flue liner shall be span/1000.</p>		
<p>3.14.06</p>	<p>Internal Staircase</p> <p>The staircase shall have a clear passage way width of not less than 800 mm and a clear headroom of not less than 2100 mm. The riser height shall not be more than 175 mm and tread width shall not be less than 225 mm.</p>		
<p>3.14.07</p>	<p>Foundation</p> <p>The chimney foundation shall be designed for the most critical combination of forces and moments, resulting from all possible combinations of the various loadings from the chimney system during all stages of constructions. The effect of water table shall be considered and the foundation shall be checked for overturning for minimum and maximum vertical loads. There should be no uplift under any portion of the foundation for any loading condition. Since chimney is a wind sensitive structure no allowance shall be made in the load carrying capacity of the bearing strata / piles under any load case/combination with wind. No allowance shall be made in the stresses for design of foundation for wind loading. The foundation diameter to depth ratio shall be maintained to around 10 and should preferably not exceed 12. The diameter of the reinforcing bar for the main radial and tangential reinforcement for the foundation shall not be less than 25mm. The spacing of radial steel at the outer edge of the foundation shall not be more than 250mm. Grade of concrete for foundation shall be minimum M 25.</p>		
<p>3.14.08</p>	<p>Thermal insulation (Applicable in case of Titanium / C-276 Flue Liner)</p> <p>The insulation shall be semi-rigid, resin bonded type, in the form of slabs and shall conform to IS: 8183. Blanket type insulation shall not be used. The density of insulation shall not be less than 64 kg/cu.m for resin bonded glass wool insulation and 100 kg/cu.m for resin bonded rock wool. The coefficient of thermal conductivity</p>		
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3.14.09	<p>of insulation shall not be more than 0.52mW/cm/oC at a mean temperature of 100oC.</p> <p>The insulation thickness shall be determined based on the maximum/minimum ambient temperature, surface air velocity worked out based on the draught of ventilation air in the annular space between the flue liner and chimney shell, insulation surface emissivity of 0.3 and the insulation cold face maximum temperature not exceeding 55 degree Celsius. The draught of air in the annular space shall be the natural draught created by the heating of air by the flue liner and the air being vented out through the openings in the chimney shell. The increase in the annulus air temperature due to the rising heated air shall be taken into account while calculating the insulation thickness.</p> <p>The insulation thickness shall not be less than 100 mm, in any case, and shall be provided in two layers with the second layer of insulation covering the joints of the first layer. The insulation shall be wrapped on the outer-most surface with galvanised wire mesh using MS galvanised pins and speed washer.</p> <p>Chimney Painting</p> <p>(i) All exposed steel surfaces (including exterior surface of mild steel flue liner in case the design does not envisage provision of thermal insulation on the exterior surface of flue liner) except surfaces of steel wind strakes shall be painted as specified in corrosion protection clause of this specification.</p> <p>(ii) All exposed surfaces of steel wind strakes shall be painted with epoxy phenolic coating system having total 240 microns DFT.</p> <p>a) All steel surfaces shall be provided with two component epoxy primer coat (having solid by volume minimum 51% ±2%) of minimum 70 micron DFT to be applied over blast cleaned surface conforming to Sa 2½ finish of ISO 8501-1 with surface profile 40-60 Micron. The primer coat shall be applied in shop immediately after blast cleaning by airless spray technique.</p> <p>b) Primer coat shall be followed with the application of Intermediate coat of epoxy phenolic coating (solid by volume minimum 63%) of minimum 100 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.</p> <p>c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied in shop after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer.</p> <p>(iii) All steel parts embedded in concrete like Strake embedment assembly including bolts, nuts, washers, pipe sleeves and insert plate shall be galvanized as per IS:4736. The minimum weight for galvanizing shall be 610 g/sq.m and shall comply with relevant IS Codes.</p>		
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3.14.10	<p>(iv) The inside surface of chimney shell above roof, horizontal surface of shell at top, underside of concrete roof slab etc. shall be painted with epoxy phenolic coating system having total 220 microns DFT.</p> <p>a) All concrete surfaces shall be provided with two component transparent polyamide cured epoxy sealer coating (having solid by volume minimum 40% ±2%) of minimum 50 micron DFT to be applied over cleaned surface in multiple coats. Surface to be coated shall be absolutely dry, clean and dust free.</p> <p>b) Sealer coat shall be followed with the application of Intermediate coat of epoxy phenolic coating (solid by volume minimum 63%) of minimum 100 micron DFT. This coat shall be applied after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.</p> <p>c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat). Colour and shade of the coat shall be as approved by the Employer.</p> <p>d) The entire external surface of chimney shell shall be painted with epoxy phenolic coating as specified in (iv) above in alternate bands of 'signal red' and 'bright white' colours.</p> <p>Electrical System</p> <p>415V, normal and emergency AC power supply for chimney shall be derived from main plant power supply system. Emergency supply shall feed 20% of platform lighting, 50% of staircase lighting, aviation obstruction lighting and elevator load. All other loads shall be connected on normal power supply.</p> <p>Ambient temperature for design of all equipment shall be considered as 55 deg. C which is likely to be encountered inside the chimney. The equipment shall be suitable for installation and render trouble free operation at higher ambient temperature and rigorous weather conditions prevailing at chimney.</p> <p>All equipment supplied shall comply with relevant IS Standards.</p> <p>The distribution boards of chimney shall comprise switch fuse units of appropriate ratings. Emergency board shall have two incomers, one from emergency supply and other from normal AC distribution board itself. Auto changeover scheme shall be provided in emergency board to enable changeover to healthy source on failure of any source.</p> <p>Dry type isolating transformer of Dyn connection shall be provided in emergency board to obtain neutral lead, in case 3 phase 3 wire emergency supply is derived from main plant.</p> <p>Various platforms shall be illuminated by dust tight HPSV well glass lighting fixtures. Average illuminations level of 150 lux shall be maintained on equipment and 70 lux on platforms & 100 lux on staircases (minimum 1 lighting fixture at each landing).Any</p>	<p>NCTPP DADRI ST-II(2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6130/0330-109-9</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 15 OF 67</p>


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	<p>additional fixture to take care of dark patches/shadows shall also be provided. Lighting system shall be controlled through MCB provided in lighting panel.</p> <p>A lighting and power panel each shall be located at grade level and at other in between levels as required. All distribution boards, aviation lighting controls, etc. shall be located at grade level only. At each platform, 1 No. 63A, 415V welding receptacle and 1 No. 20A, 240V receptacle shall be provided and shall be fed from power panel. Wiring installation for lighting fixture shall be of PVC insulated copper/aluminium wires through galvanised steel conduits.</p> <p>Aviation obstruction lighting system shall conform to the requirements of the latest rules and regulations of the International Civil Aviation Organization (ICAO), National Airports Authority (NAA) and Directorate of Air Routes and Aerodromes (DARA). The type of aviation obstruction lighting system shall be of medium intensity aviation obstruction lights having an effective intensity of 2000 to 20,000 cd depending upon back ground illuminance. Obstacle lights shall have a day time effective intensity of minimum 20000 cd. The intensity of lights shall be 20000 cd \pm 25% at twilight and shall reduce automatically to a night time intensity of 2000 cd \pm 25% through the use of photo-cell. The obstacle lights shall flash simultaneously at a rate between 20 to 60 per minute. A minimum of three levels will be provided with aviation obstruction lights and there will be four light units per level. The lowest level should not be lower than 45 meters above the ground and vertical spacing of the intermediate levels could vary between 45 and 105 meters. The intermediate lights shall be spaced as equally as possible. Aviation obstruction lighting shall be complete with lights, photo cell, controller, special cables, etc..</p> <p>A temporary aviation obstruction lighting system shall be provided during construction of the chimney.</p> <p>Cables from distribution board to lighting panels/power panels/receptacles shall be 1100V grade, multicore FRLS HR-PVC insulated, PVC inner sheathed, armoured, PVC outer sheathed stranded copper/ Aluminium laid on galvanised sheet steel cable trays. Cables shall be terminated using double compression type cable glands and solder less crimping type tinned copper cable lugs. Minimum size of the power cable shall not be less than 2.5 sq.mm copper or 4 sq.mm Aluminium. Minimum size of control cable shall not be less than 1.5 sq.mm.</p> <p>Lightning protection system shall comprise minimum 3 vertical air terminations for each flue liner, horizontal air terminations and minimum 4 Nos. of down conductors spaced 90 degrees apart routed all along chimney height on external surface and connected to the earthing system. Down conductors shall be of minimum 50x6 mm galvanized steel strip. Each down conductor shall be provided with a test link at 1 metre above ground level. Each test link shall be enclosed in a galvanised sheet steel enclosure. Above ground level earthing and lightning protection system shall comprise galvanised steel strips. These materials provided at top 12 meters shall have additional coating of 2 mm thick seamless lead cover and the accessories like nuts, bolts, washers etc. shall be of stainless steel to take care of corrosion. Chimney earthing system shall be interconnected to main plant earthing system.</p> <p>A temporary lightning protection & earthing system shall be provided during construction of the chimney till a permanent lightning protection & earthing system is installed. In no case reinforcement bars of Shell should be used as earthing Down Conductors</p> <p>Communication system comprising of telephone socket at every internal platform level and at grade level, necessary wiring installation, a telephone hand set, junction</p>		


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<p>3.14.11</p>	<p>boxes etc. shall also be provided. Telephone cables shall be of minimum 0.6 mm diameter annealed high conductivity electro copper conductor, PVC insulated, twisted, PVC tape wrapped, screened, rip corded, PVC sheathed, conforming to relevant ITD (Indian Telephones Department) specifications.</p> <p>All equipment to be supplied shall be of type tested quality. The Contractor shall submit for Owner's approval the reports of all type tests as listed below:</p> <p>(A) Distribution boards/panels-Degree of protection tests</p> <p>(B) Aviation lights:</p> <p>(1) Intensity Test</p> <p>(2) Degree of protection test</p> <p>For various equipment, the technical requirements and practices shall conform to the relevant clauses of the main plant electrical specification.</p> <p>Rack and Pinion Elevator</p> <p>A rack and pinion elevator, with a load carrying capacity of 400 kg (min) (passenger cum goods), cabin floor size of 1100 mm x 1000 mm (min.) and an operating speed of 40 m/min. (approx.), shall be provided for travel from the grade level to the top of the chimney. A landing platform shall be provided at all access/ platform levels. The elevator shall be of a proven and approved make. Enclosure shall be fabricated from tubular steel and expanded metal or wire mesh, 2.1 m high (Approx.). A Safety device comprising of an over speed governor in constant mesh with the rack by means of a flame hardened steel pinion shall be provided to protect the cab against over speed during the cab downward motion and the same shall actuate the brake mechanism and stop the down ward motion gradually. The lift shall be installed using anchor fasteners. The electrical requirement of the system shall conform to the main electrical specification. Drive motor shall be of S3 duty class with CDF of 25% and maximum number of 120 starts per hour in 55 degree Celsius ambient temperature. The motor shall be provided with internal 220V AC single phase space heaters or an alternate heating system. The elevator shall be supplied, installed, painted, tested, commissioned etc. complete with all mandatory spares (as specified in Part-F of this specification) and operation maintenance manual.</p>			
<p>3.15.00</p>	<p>Limestone Grinding System building</p> <p>This shall be steel framed building with R. C. C. roof and floor. The building roof /floors shall comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only over structural beams). Cladding shall be of single skin metal sheeting or brickwork/concrete block work with plastering on both sides. Roof shall be provided with roof water proofing treatment, as specified elsewhere in the Technical specification.</p>			
<p>3.16.00</p>	<p>Gypsum Dewatering Building</p> <p>This shall be steel framed building with R. C. C. roof and floor. The building roof /floors shall comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only over structural beams). Cladding shall be of single skin metal sheeting or brickwork/concrete block work with plastering on both sides. Roof</p>			
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<p>4.00.00</p> <p>4.01.00</p> <p>4.02.00</p>	<p>shall be provided with roof water proofing treatment, as specified elsewhere in the Technical specification.</p> <p>Drainage & Water Supply Works</p> <p>Drainage System:</p> <p>The drainage arrangements shall be so planned so as to ensure quick disposal of drainage water without stagnation and / or overflow. It is envisaged to clean the facility buildings etc. with water periodically.</p> <p>Minimum 4 nos. down comers shall be provided in each building at corners.</p> <p>For Conveyors, each down comer shall lead the water / slurry to pit (of 2 Cu.M capacity) to allow settling of lime/gypsum. The water from the pit shall overflow into contractor's R.C.C drain, which will lead the discharge finally into owner's drain routed alongside the nearby road.</p> <p>For Ball Mill building, Gypsum dewatering building, FGD control room building, peripheral drains (Brick drains with steel gratings provided around the building) shall lead the water / slurry to a local pit (of 2 Cu. M. capacity) near each facility to allow settling. The water from the pit shall overflow into contractor's R.C.C drain, and finally into owner's drain routed alongside the nearby road.</p> <p>In case of Control rooms and M. C. C. buildings Pump houses, etc, water / slurry coming from down comers shall discharge into peripheral drains (Brick drains with steel gratings provided around the building) which will lead the water / slurry into contractor's R.C.C drain, which will lead the discharge finally into owner's drain routed alongside the nearby road.</p> <p>Contractor's scope shall also include construction of necessary culverts under the rail lines / roads as per railway / I. R. C. standards and approval of Railway culverts from concern Railway authorities.</p> <p>Internal and external water supply, drainage etc.</p> <p>The scope for potable water supply includes all distribution systems, tanks, pipes, fittings etc. as required and as described here or elsewhere in the specifications.</p> <p>The scope for service water supply and dust control water supply shall be as described elsewhere in the specifications.</p> <p>For water supply, medium class galvanized mild steel pipes conforming to IS: 1239 shall be used.</p> <p>All facility buildings shall be provided with open surface brick drains of minimum size of 300 mm width and 300 mm depth all around the periphery. All drains excepting the peripheral drains around facility building shall be of R. C. C. construction. Drains shall have removable steel grating cover and shall be provided with edge protection angles.</p>		
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	<p>The scope for foul water from toilets shall include layout and laying of sewers up to the Employer's main sewer line for sewerage system together with all fittings and fixtures and inclusive of ancillary works such as connections, manholes and inspection chambers within the building and from the building to the Employer's sewer line.</p> <p>For rain water down comer and those to be used for conveying water / slurry generated from cleaning of buildings floors, Galvanised MS pipes conforming to IS: 1239 (for 150 mm NB Medium grade pipes) with welded joints shall be used for MCC buildings, penthouse, control rooms, ball mill building, gypsum dewatering building, storage sheds.</p> <p>Galvanising shall be as per IS: 4736. The minimum mass of zinc coating shall not be less than 400 gms/sq.m. as per IS:6745. The zinc coating shall be smooth and shall be subjected to testing as per IS: 2633, for uniformity of coating. The zinc coating shall be free from all defects as per IS: 2629.</p> <p>All rain water down comers shall be provided with roof drain heads and complete with shoes bends, junctions, sockets, adapters, brackets and finished with anti-corrosive painting over a coat or primer.</p> <p>For design of building drainage system IS: 1742 shall be followed.</p> <p>For sanitary / sewerage pipes above ground, sand cast iron pipes conforming to IS : 1729 with leak proof lead joints.</p> <p>For underground drain pipes, minimum class NP - 2 pipes conforming to IS: 458. At road crossings, concrete pipes of class NP 3 conforming to IS: 458 and at rail crossing R.C.C. box culvert to be provided.</p>			
5.00.00	COLOUR COATED AND OTHER SHEETING WORK			
5.01.00	<p>Material</p> <p>a) Wall Cladding & Roofing Material</p> <p>Troughed permanently colour coated sheet of approved shade and colour shall be</p> <ul style="list-style-type: none"> i) either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 ii) or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 iii) or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 			
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<p>5.02.00</p> <p>5.03.00</p>	<p>10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150.</p> <p>Alternatively aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254.</p> <p>b) Metal Deck Roof Material</p> <p>Troughed permanently colour coated metal decking sheets shall be</p> <ul style="list-style-type: none"> i) either of steel with minimum 0.8mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 ii) or of minimum 0.6mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 iii) or of steel of minimum 0.6mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275. <p>Alternatively aluminium feed material of minimum bare metal thickness of 0.9 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254 can also be used for metal decking.</p> <p>Thickness tolerance of (+/-) 0.04mm is permissible. However, all design calculations shall be carried out on the basis of lowest value of sheet thickness provided.</p> <p>5.02.00 Colour Coating</p> <p>Steel shall be colour coated with total coating thickness of at least 40 microns (nominal) comprising of silicon modified polyester (SMP with silicon content of 30% to 50%) paint or Super Polyester paint, of minimum 20 microns (nominal) dry film thickness (DFT) on external face over primer coat of minimum 5 microns (nominal) and minimum 10 microns (nominal) SMP or super polyester paint over primer coat of minimum 5 microns (nominal) on internal face. SMP and Super polyester paint systems shall be of industrial finish of product type 4 of AS/NZ2728.</p> <p>5.03.00 Design Criteria</p> <p>For wall cladding insulated / uninsulated sides and roof, permanently colour coated sheet of troughed profile shall be used. The nominal depth of trough shall be 30 mm.</p> <p>For profiled metal decking sheets (to be used for RCC floor slab or roof slab) the sectional modulus and moment of inertia of troughed profile per meter width shall be so as to limit the deflection of sheets to span/250 under total super imposed loading (DL +LL) comprising the self-weight of metal deck sheet, dead weight of green concrete and an additional construction load 100kg per sq.m for two span condition. The section modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS 801 for satisfying the deflection and strength requirements.</p> <p>For metal deck sheets used for roofing (with or without RCC) and side cladding, the sectional modulus and moment of inertia of troughed profile per metre width shall be such that the deflection of sheets is limited to span/250 under design wind pressure for two span condition. The sectional modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS 801 for satisfying the deflection</p>	<p>NCTPP DADRI ST-II(2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6130/0330-109-9</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 20 OF 67</p>


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<p>5.04.00</p>	<p>and strength requirements. No increase in allowable stress is permissible under wind load condition.</p> <p>Fasteners</p> <p>Side cladding/roofing/decking sheets shall be fixed to the runner/purlins using self-drilling special coated fasteners confirming to corrosion resistant class 3 of AS3566 and tested for 1000 hours salt spray test. Spacing of Self-drilling fasteners in transverse direction (along runners/purlin) shall be equal to the pitch of trough or 250(+/-100) mm, whichever is lesser and in longitudinal direction at every runner/purlin location.</p> <p>Shear anchor studs shall also be provided through troughed permanently colour coated metal decking sheets metal deck, which are to be used as permanent shuttering, at regular interval on all top flange / flange plate of structural beams.</p> <p>The shear anchor studs for fixing metal deck sheet to floor structural beams shall conform to Type-B studs specified in AWS D1.1/D1.1M or equivalent as shear connector of 19mm diameter and 100mm length manufactured from cold drawn round steel bars conforming to the requirement of ASTM A 29, of grade designation 1010 through 1020, of standard quality with either semi-killed or killed, welded by Drawn Arc Stud Welding through metal deck sheet.</p> <p>The shear anchor studs for fixing metal deck sheet to roof structural purlins shall conform to Type-B studs specified in AWS D1.1/D1.1M or equivalent as shear connector of 16mm diameter and 65mm length manufactured from cold drawn round steel bars conforming to the requirement of ASTM A 29, of grade designation 1010 through 1020, of standard quality with either semi-killed or killed, welded by Drawn Arc Stud Welding through metal deck sheet.</p> <p>Alternatively, J/U type hooks shall be used in roofing which shall be provided in transverse direction (along runners/purlin) at a spacing equal to the pitch of trough or 250(+/-100) mm, whichever is lesser and in longitudinal direction at every runner/purlin location.</p>		
<p>5.05.00</p>	<p>Miscellaneous Details</p> <p>To minimize the number of joints, the length of the sheet shall preferably be not less than 4.5m, cut pieces shall not be used, unless specifically approved by the Engineer. However, the actual length shall be such so as to suit the purlin / runner spacing.</p> <p>Lap between the sheets shall be at least 150mm in the longitudinal direction and at least one crest wide in the transverse direction which shall be properly anchored / fixed with fasteners.</p> <p>Z spacers if required shall be made of at least 2 mm thick galvanised steel sheet of grade 350 as per IS 277</p> <p>Sealant used for cladding shall be butyl based, two parts poly sulphide or equivalent approved, non stainless material and be flexible enough not to interface with fit of the sheets</p> <p>Filler blocks as a trough filler shall be used to seal cavities formed between the profiled sheet and the support or flashing. The filler blocks shall be manufactured from black synthetic rubber or any other material approved by the Engineer.</p>		
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<p>5.06.00</p>	<p>All flashings, trim closures, caps etc. required for the metal cladding system shall be made out of plain sheets having same material and any weather/moisture sealants with appropriate material and coating specification as mentioned above for the outer face of the metal cladding. Overlap shall be min. 150 mm or as specified by manufacturer.</p> <p>Pre-Fabricated Insulated Metal Sandwich Panels</p> <p>For structures where Pre-Fabricated Insulated Metal Sandwich Panels shall be used for Roofing, the sandwich panels shall comprise top sheet as troughed permanently colour coated sheet & bottom sheet as plain permanently colour coated with 50mm thick insulation sandwiched between the two sheets. Each sheet shall be</p> <ul style="list-style-type: none"> i) either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 ii) or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 iii) or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150. <p>Alternatively aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254.</p> <p>Metal sheets (steel or aluminium) shall be colour coated with total coating thickness of at least 40 microns (nominal) dry film thickness (DFT) comprising of Silicon Modified Polyester (SMP with silicon content of 30% to 50%) paint or Polyester paint, of minimum 20 microns (nominal) SMP or polyester paint on one side (exposed face), over minimum 5 micron (nominal) primer coat and minimum 10 micron (nominal) SMP or Polyester paint over minimum 5 micron (nominal) primer coat on other side. SMP and Super Polyester paint shall conform to product type 4 of AS/NZS 2728. Troughed sheet shall be of approved profile, sectional properties, (suitable for the specified loading / deflection and purlins / runners spacing), colour and shade.</p> <p>Special coated fastener conforming to corrosion resistant Class 3 of AS3566 and tested for 1000 hours salt spray test shall be used for fixing Pre-Fabricated Insulated Metal Sandwich Panels with the structural members below.</p> <p>The contractor shall prepare working drawings of sheeting system including end and side laps, fixing details etc. before starting sheeting work at site.</p>		
<p>5.07.00</p>	<p>Polycarbonate Sheets</p> <p>The polycarbonate sheet to be used for cladding and glazing purpose in conveyor galleries, Transfer points & pump houses shall have toughed profile to match with the metal cladding profile. Minimum 3.0mm thick fire retardant and UV resistant polycarbonate clean sheet of approved make shall be used. The polycarbonate sheet shall be installed along with the metal cladding so as to have a watertight</p>		
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	<p>lapping arrangement. Suitable detailing shall be made to cater for the thermal expansion. IS 14434 to be referred for other details</p> <p>6.00.00 Roof Details</p> <p>6.01.00 Roof slab shall be minimum 150 mm thick(above the top surface (crest) of the metal deck sheet) and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom.</p> <p>6.02.00 900 mm high and minimum 100 mm thick R. C. C. parapet wall shall be provided over roofs of all buildings. Parapet wall shall have suitable coping. External face of parapet wall of the buildings provided with metal cladding shall also be finished with metal cladding of design and colour as per approved architectural drawings.</p> <p>6.03.00 Junction of roof and parapet shall be provided with 150 x 150 mm size concrete fillet.</p> <p>6.04.00 Drain level shall be provided with 45 x 45 cm size khurras having minimum thickness of 30 mm of M-15 concrete over PVC sheet of 1 m x 1m x 400 micron and finished with 12 mm 1 : 3 cement : sand plaster.</p> <p>6.05.00 Roofs of all control rooms, M. C. C. rooms, penthouse etc., shall have roof water proofing treatment. Roof water proofing treatment shall be as follows:</p> <ol style="list-style-type: none"> 1) Application of polymerised mastic over the RCC roof to achieve smooth surface as primer coat. 2) Application of high solid content liquid applied urethane based elastomeric water proofing membrane, over the primer coat, to give uniform joint less dry film thickness of minimum 1.5 mm (as per ASTM C 836 and C 898). 3) For efficient disposal of rain water, the run off gradient for the roof shall not be less than 1: 100. This gradient shall be provided by screed concrete M-15 (using 12.5 mm coarse aggregate) and / or cement mortar (1: 4) over the elastomeric water proofing membrane with 25mm thick cement mortar (1:4) topping. 4) Wearing course at top, shall consist of 25 mm thick P. C. C. (M-15) cast in panels of maximum 1.2 x 1.2 m size and reinforced with 0.56 mm diameter galvanized chicken wire mesh and sealing of joints using sealing compound / elastomeric water proofing membrane. Pathways for handling of materials and movement of personnel shall be provided with 22 mm thick chequered cement concrete tiles as per IS : 13801 for a width of 1000 mm in place of P. C. C. <p>6.06.00 For efficient disposal of rain water, the run off gradient for the roof shall not be less than 1:100. This gradient can be provided either in structure or subsequently by screed concrete M-15 (using 12.5 mm coarse aggregate) and/ or cement mortar (1:4). However, minimum 25 mm thick cement mortar (1:4) shall be provided on top to achieve smooth surface.</p> <p>6.07.00 Medium class galvanised mild steel pipes conforming to IS: 1239/ IS: 3589 with welded joints shall be provided for rain water down comers to drain off rain water from the roof. These shall be suitably concealed with masonry work, to match with the exterior finish. The number and size of down comers shall be governed by IS: 1742 and IS: 2527. RCC roof shall be provided with 45 x 45 cm size Khurras having minimum thickness of 30 mm with M-15 concrete over PVC sheet of 1mx1mx400micron and finished with 12 mm thick cement sand plaster 1:3.</p>			
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	<p>Cage ladder to be provided for access to roof of single storey MCC room. For multi storey MCC room RCC stair case to be provided.</p>
6.08.00	<p>Access to RCC roof of Gypsum dewatering building, FGD Control room building, MCC building, Ball mill building shall be through RCC staircase, and roof access to all other buildings all shall be through cage ladder as per requirement.</p>
6.09.00	<p>Fillets at junction of roof and vertical walls shall be provided with cast - in - situ cement concrete (M-15) nominal mix followed by 12 mm thick 1:4 cement sand plaster.</p>
6.10.00	<p>The rainwater down comers shall be provided with suitable C.I. grating at inlet point.</p>
7.00.00	<p>RCC Floors, Paving & Grade Slab details</p> <p>The floor slabs shall be minimum 150 mm thick (above the top surface (crest) of the metal deck sheet) and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom.</p> <p>In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.6mm as permanent shuttering. The detailed material property requirement of metal deck sheet is specified elsewhere in the specification. These profiled metal deck sheets shall be fixed to the structural steel beams/ purlins using headed shear anchor studs specified elsewhere in the specification.</p> <p>Chequered plates (used for floors, walkways etc.) shall be minimum 6 mm thick. Mild steel flats/angles of suitable size shall be welded to the bottom portion of chequered plates at a designed spacing to stiffen chequered plates suitably. Chequered plates shall be fixed by staggered welding of suitable size. Floors of trenches shall have integral finish to concrete base.</p> <p>Toe guard of size 100 x 6 mm shall be provided at various openings provided in floors e.g. around stair case openings, chute openings and other similar cutouts. For conveyor walkways, angle runner to act as toe guard shall be provided.</p> <p>R. C. C. floors (where no brick masonry walls are provided) shall be provided with handrails all along the periphery.</p> <p>RCC paving of minimum 150 mm thick with M25 grade concrete, over an under bed as specified herein shall be provided for areas mentioned below. RCC paving shall be designed as rigid reinforced concrete pavement for the crane/ vehicular/ equipment movement loads which the paving has to bear. The under bed for paving shall consist of preparation and consolidation of sub-grade to the required level, laying of stone soling of 200mm compacted thick for normal duty paving and 400mm compacted thick for heavy duty paving with 63 mm and down aggregate with interstices filled with selected moorum/ non-expansive soil followed by 75 mm thick 1:4:8 PCC (1 part cement, 4 parts sand and 8 parts stone aggregate) with 40 mm nominal size aggregate. For normal duty paving, reinforcement of the RCC paving shall consist of minimum 8mm dia bars @ 200 mm c / c in both directions at the centre of the slab. For heavy duty paving/ passage, reinforcement of the RCC paving shall consist of minimum 10mm dia bars @ 200 mm c / c in both directions at the centre of the slab.</p> <p>Paving areas shall be provided with the metallic hardener floor finish as specified elsewhere in the specification.</p>
NCTPP DADRI JHA FLUE GAS DESULPH	<p>Extent of paving for FGD facilities shall be in accordance with Technical specification. However, any functional requirement of paving for FGD facilities not specifically mentioned in technical specification is also in the scope of bidder.</p>
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8.00.00	<p>Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings. These passage areas shall be provided with heavy duty paving for movement of heavy vehicles. The top surface of the passages shall be finished with 50 mm thick metallic hardener topping. Heavy duty paving shall also be provided for the areas in the equipment lay down area, unloading & maintenance area with 50 mm thick metallic hardener topping.</p> <p>Lightly loaded areas such where no heavy traffic movement is envisaged shall be provided with Normal Duty paving.</p> <p>All facility buildings shall be provided with 750 mm wide plinth protection all around. It consists of 50 mm thick P.C.C. M-20 grade with 12 mm maximum size aggregate over 200 mm thick stone soling using 40 mm nominal size rammed, consolidated and grouted with fine sand</p> <p>An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection. Further, heavy duty paving shall be provided for passages connecting the outer periphery road to have access to the various facilities/buildings.</p> <p>Plinth level of all buildings shall be kept at least 500 mm above the finished grade / formation level.</p> <p>Suitable open RCC drains shall be provided to dispose off storm water drain. The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain.</p> <p>Sewer lines (Cast Iron), interconnected by sewer manholes (RCC) at regular intervals (not exceeding 30 meter centre to centre) shall be provided to dispose off sewage from FGD block to sewage pump house.</p> <p>GRADE SLAB OF BUILDINGS AT GROUND FLOOR</p> <p>In buildings, the grade slab shall consist of 150mm thick RCC M25 grade base slab over an under bed as specified below. The under bed for ground floor slab shall consist of 75mm thick 1:4:8 PCC on stone soling of 200mm compacted thick with 63 mm and down aggregate with interstices filled with well graded selected sand/ moorum/ non-expansive soil on compacted and dressed sub - grade. Reinforcement for the slab shall consist of minimum 8mm dia. bars @ 200 mm c/c at top & bottom of the slab in both directions. However, at unloading & maintenance area, stone soiling of minimum 400mm thick and grade slab with minimum 10mm dia bars @ 200 mm c/c at top and bottom in both directions shall be provided.</p> <p>Further, top surface of grade slabs shall be finished with 50mm thick metallic hardener topping.</p> <p>Brickwork and allied masonry works</p> <p>All brick walls shall be non - load bearing in-filled panel walls.</p> <p>All brickwork shall be designed as per Indian Standards and shall be plastered on both faces. All external walls shall be minimum one brick thick in 1: 6 cement: sand mortar. Brick walls shall be provided with 12 mm and 18 mm thick 1: 6 cement: sand plaster on smooth and rough face of the brick work respectively.</p>	<p>NCTPP DADRI ST—II(2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6130/0330-109-9</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 25 OF 67</p>

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	<p>Only fly ash bricks shall be used in all construction. Bricks shall be table moulded/ machine made of uniform size, shape and sharp edges and shall have minimum compressive strength of 75kg/cm². Burnt clay fly ash bricks and fly ash lime bricks shall conform to IS 13757 and IS 12894 respectively. Minimum fly ash content in fly ash based bricks shall be 25%.</p> <p>Brickwork cladding for various structures shall be so provided that there is a clear gap of 40 mm between inside face of external brick wall and outside face of column flange. Structural steel wall beams supporting brickwork shall be suitably encased with plaster or 1: 2: 4 concrete as the case may be. In case of box type steel beam, encasement shall be done with cement sand plaster in specified thickness and proportions over G. I. wire netting of 0.9 mm thickness.</p> <p>Parapets, chajjas, windows and door heads, architectural faces, fins etc. shall be provided with drip course in 1 : 4 cement sand mortar.</p> <p>50 mm thick Damp proof course shall be provided at plinth level for all brick wall.</p> <p>All R. C. C. ceilings shall be rendered smooth and finished with whitewash unless otherwise specified. Ceiling of control rooms, M. C. C. rooms (except areas provided with false ceiling) shall be provided with 6 mm thick plaster.</p> <p>9.00.00 Earthing Mat</p> <p>40 mm Dia MS Rods as earthing mat, placed at a distance of 1.0M away and at depths between 0.60M and 1.00M shall be supplied and laid all around the periphery of buildings, structures, and outdoor equipment, as per the approved drawings. Risers of 40 mm Dia MS Rods and connecting to the above Earthing mat shall also be supplied and laid in position by the Contractor, as per the approved drawings. Risers shall be laid up to a height of 300 mm above the local Ground level, at each of the columns of the buildings on outside of the buildings, and minimum 2 (Two) numbers for structures and outdoor equipment. The contractor also supply and lay necessary number of 3.0 M deep vertical 40 mm Dia MS Rods Earthing electrodes and connecting them to the Earthing mat, as per the approved drawings and the supplying and laying of 40 mm Dia MS Rods for connecting the Contractor's earthing mat with the Employer's earthing mat separately at two locations.</p> <p>10.00.00 CLAUSE DELETED</p> <p>11.00.00 CLAUSE DELETED</p> <p>12.00.00 ROADS</p> <p>All roads shall be of rigid pavements unless otherwise specified. The design of rigid pavement shall be carried out as per IRC: 58. The effects of design wheel load, maximum tyre inflation pressures, tyre contact area for the vehicle, traffic loads, environmental factors such as temperature changes in the pavement, other factors, like impact, load repetitions, etc., are to be taken. Detailed plate load tests to</p>		
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	<p>determine the modulus of sub grade reaction “K” shall be carried out as per the procedure outlined in IS: 1888. The design traffic load shall be a minimum value of 4 million standard axles. The road shall be designed for 30 years of life and considering a minimum traffic growth rate of 1 per cent per annum. The concrete pavement for roads shall be minimum 250 mm thick slab.</p> <p>The road construction including its shoulders, base, sub base and concrete pavement shall be as per IRC standards. IRC: 58 shall be followed for the pavement design and IRC: 15 shall be followed for the construction of the concrete pavement.</p> <p>The road base shall be with minimum 150 mm thick dry lean concrete over granular sub base. Dry lean concrete shall be laid by a mechanical paver and compacted by vibratory rollers. Concrete pavement of the road shall be done with fully mechanized paver fitted with electronic sensors for construction techniques. Dry lean concrete shall be minimum M10 grade and concrete pavement slab shall be minimum M35 grade concrete.</p> <p>The finished top (crest) of all roads shall be 350 mm above the surrounding finished ground level.</p> <p>The sub grade under all roads and its shoulders shall be compacted to achieve 95 per cent or more of Standard Proctor’s Density MDD using mechanical means.</p> <p>Cutting / extending / rerouting / remaking of existing roads including associated works to maintain continuity of road system / network shall also be carried out.</p> <p>All culverts and RCC bridges at crossings of all roads / rail tracks / facilities with drains / nallahs / channels / roads / rail tracks / pipes / other facilities, etc. are to be designed and constructed.</p> <p>Unless otherwise specified, all roads shall be double lane roads.</p>		
13.00.00	CLAUSE DELETED		
14.00.00	<p>LIME & GYPSUM HANDLING AND ASSOCIATED BUILDINGS STORM WATER DRAINAGE SYSTEM</p> <p>Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc with a return period of 50 years. These values shall be based on rainfall intensity of 75mm/hr. All RCC drains shall be either RCC Cast-in-Situ or RCC Pre-cast drains. The minimum grade of concrete shall be M25 for RCC Cast-In-Situ drains and M30 for RCC Pre-cast drains. The maximum velocity for RCC open drains shall be limited to 1.8 metre per second. However, minimum velocity of 0.6 metre per second for self - cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be provided.</p> <p>Open RCC rectangular section, unless required otherwise due to functioned requirement, shall be provided for all drains. The thickness of side walls and bottom slab of RCC drains shall be minimum 150mm or as per design considerations whichever is higher for drains upto depth of 1m from formation level. For depth of</p>		
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15.00.00	<p>drain more than 1m from formation level, the thickness of side walls and bottom slab of RCC drains shall be minimum 200mm or as per design considerations whichever is higher. The drains shall be provided on both sides of roads .These shall be designed to drain the road surface as well as all the free and covered areas, etc. Box culverts shall be provided at all rail, road and other crossings.</p> <p>All drains inside the building shall have minimum 40 mm thick grating covers. In areas where heavy equipment loads would be coming, precast RCC covers shall be provided in place of steel grating.</p> <p>The invert levels of the in-plant and plant peripheral drains shall be kept such that water can be discharged by gravity to the main / trunk drains under all conditions.</p> <p>The invert levels of the drains shall be decided in such a way that the water can easily be discharged to the natural water bodies above the high flood.</p> <p>SEWERAGE SYSTEM</p> <p>The connection of sewer pipe line for the associated buildings of FGD and Lime and gypsum handling area to nearest owner's sewage network is in bidder's scope.</p> <p>Cement concrete pipes of class NP-3 as per IS:458 shall be used below ground level for sewage disposal in all areas . However, for pressure pipes and under roads spun C.I. pipes conforming to IS:1536 of required class shall be used.</p> <p>RCC manholes with CI cover shall be provided at every 30m along the length, at connection points, and at every change of alignment, gradient or diameter of a sewer pipeline. This shall be as per IS:4111.</p> <p>Sewage pumping stations shall be provided as per IS:4111.</p>		
16.00.00	<p>LOADING</p>		
16.01.00	<p>For consideration of loads on structures IS : 875 - 'Code of practice for structural safety of buildings' shall be followed. In addition to the dead load, live load, equipment load (including impact / vibration). Temperature loads etc. various loading conditions arising due to operation and maintenance of equipment shall be considered in the design. The structure and equipment shall also be designed for seismic loads as per the "Criteria for Earthquake Resistant Design of Structures and equipment" and the "Criteria for Wind Resistant Design of Structures and equipment" specified in the "Project Information section" of technical specification. Wind and seismic forces shall not be considered to act simultaneously. The following minimum live loads shall be adopted for the design of various</p>		
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	<p>structures. If actual expected load is more than the specified load, then actual load is to be considered.</p> <p>a) Roofs 150 Kgs. / Sq. M. for accessible roofs and 75 Kgs. / Sq. M. for non - accessible roofs. In addition to this dust load (Dead load) of 150 Kgs. / sq. m. on flat roofs & 75 Kgs. / sq. m. on inclined roofs shall also be considered.</p> <p>b) R. C. C. floors 500 Kgs. / Sq. M.</p> <p>c) Stair and balconies 500 Kgs. / Sq. M.</p> <p>d) Toilet rooms 200 Kgs. / Sq. M.</p> <p>e) Chequered plate floors 400 Kgs. / Sq. M.</p> <p>f) Walkways (including walkways in conveyor galleries) 300 Kgs. / Sq. M.</p> <p>g) Conveyor galleries In addition to the live loads, loads due to cable trays, fire fighting / service water pipes shall also be considered @ 125 Kgs. / m (minimum) on each of the longitudinal girder. Roof-truss members are to be checked for supporting fire fighting pipes/ Service water pipes.</p> <p>h) Road Culverts and its allied structures including R. C. C. pipe crossing & road crossing of trenches. For class 'AA' loading and checked for class A loading as per IRC standard.</p> <p>i) Channels / trenches In addition to earth pressure and water pressure, etc. additional earth pressure due to surcharge of 2T / Sq. M. shall also be considered for design.</p> <p>j) Covers for trenches / channels Covers for channels & trenches, shall be designed for a live load of 0.4T Sq. M. and loading as mentioned under clause in trenches, whichever is critical.</p> <p>k) Sumps and tanks and other underground basement type structures In addition to earth pressure with a surcharge of 2T / Sq. M. (or surcharge due to Railway loading whichever is critical for Railway load bearing structures etc.) and sub - soil water</p>			
<p>NCTPP DADRI ST—II(2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6130/0330-109-9</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 29 OF 67</p>	


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<p>16.02.00</p> <p>16.03.00</p> <p>17.00.00</p> <p>17.01.00</p>	<p>pressure etc. These are also to be designed for the following conditions :</p> <p>i) Water / liquid inside and no earth outside (applicable only to such structures which are liable to be filled up with water or any liquid).</p> <p>ii) Earth with surcharge outside and no water / liquid inside</p> <p>iii) For underground (basement) structures protection against buoyancy during execution and after execution shall be ensured without superimposed loadings with minimum factor of safety of 1.2 against buoyancy.</p> <p>If the erection load is higher than the specified live loads on any floor or part thereof, then the erection loads are to be considered for the design.</p> <p>Permissible increase in stresses of materials and bearing pressure of soil due to wind load or seismic load shall be as per relevant I. R. S. and I. S. code.</p> <p>Crane load</p> <p>For crane loads, an impact factor of 25% and lateral crane surge of 10% (of lifted weight + trolley weight) shall be considered in the analysis of frame according to the provisions of IS:875. The longitudinal crane surge shall be 5% of the static wheel load. Longitudinal surge and lateral surge shall not be considered to act simultaneously.</p> <p>Temperature load</p> <p>For temperature loading, the total temperature variation shall be considered as 2/3 of the average maximum annual variation in temperature. The average maximum annual variation in temperature for this purpose shall be taken as the difference between the mean of the daily minimum ambient temperature during the coldest month of the year and mean of daily maximum ambient temperature during the hottest month of the year. The structure shall be designed to withstand stresses due to 50% of the total temperature variation.</p> <p>Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns. The maximum distance of the expansion joint shall be as per the provisions of IS: 800 and IS: 456 for steel and concrete structures respectively.</p> <p>DESIGN CRITERIA</p> <p>The design of all R. C. C. structures shall be carried out as per 'code of practice for plain and reinforced concrete for general building construction', IS: 456.</p>		
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17.11A.00 The loads for all railway load bearing structures e. g. tunnel, culverts and underground transfer houses etc. and the analysis and the design of these structures shall be made strictly in accordance with the provisions of Indian Railway Bridge rules (latest edition), and Indian Railway Codes of practice (latest edition) with all amendments up to the date of opening of bids. The analysis, design and detailed drawing for tunnel, underground transfer houses, culverts etc. coming directly below the railway track shall be got approved by the contractor from the concerned railway authorities. All necessary payment for the above work shall be made by the bidder to the railway authority.


17.02.00	Design of steel structures shall be done as per provisions of IS:800: 2007 (Limit state design) and other relevant IS standards.
17.03.00	For industrial structures, analysis for verification of mechanism shall be carried out as per IS:1893 (Part 4):2015 for Earthquake loads.
17.04.00	Minimum size of the angle section to be used as structural members shall be 50 X 50 X 6. Minimum weld size shall be 6 mm. Connections shall be designed for 70 % of shear capacity of the member or the actual shear force, whichever is higher. The steel structures using tubular sections shall be designed and fabricated as per IS:806 – “Code of Practice for use of steel tubes in general building construction.” and EN 1993-1-8:2005. Minimum grade of steel & thickness of Tubular/Hollow sections shall be Yst 240 Mpa & 4.0mm respectively
17.05.00	The building shall conform to local bye - laws, rules and regulations for industrial buildings and also B. I. S. publications, SP 32 and 41.
17.06.00	Slotted holes shall not be assumed to act as expansion joint for relieving of stresses and suitable bearings shall be provided at the supports.
17.07.00	Stresses for all structures shall be checked for the higher of the forces obtained from gust factor method and the peak wind speed method.
17.08.00	Horizontal bracing system shall be provided at floor levels around the openings.
17.09.00	Shear force in steel columns shall be transferred to the pedestals / foundations exclusively either through foundation bolts or the shear key arrangement.
17.10.00	For design of liquid retaining structures, IS : 3370 (Part - I to IV) (latest) shall be followed. Face of the structure in contact with liquid shall be designed as un - cracked section. For design of R. C. C. pipes for culverts, latest editions of IS : 458, IS : 783 should be followed.
17.11.00	For design of all underground structures / foundations, ground water table shall be assumed at the formation level (i. e. the adjoining ground level). For all underground structures like tunnel, underground transfer point and underground hopper etc. crack width shall be limited to 0.2mm.
17.12.00	Design of masonry walls shall be made as per IS : 1905.
17.13.00	Civil task drawing indicating various equipment loading and supporting arrangement and floor loads to be submitted along with the design calculation.
17.14.00	Minimum 0.12% of reinforcement shall be provided on the top face of the foundation concrete on either direction and minimum percentage of reinforcement at bottom face of foundation shall be same as that stipulated for beam as per IS:456.
17.15.00	Foundations for all tanks shall be designed for as per IS: 803.
17.16.00	Footings shall be so proportioned to as to minimise the differential settlement.

17.11B.00. Minimum clearance of 8.5m above the road crest / rail top shall be maintained at the location where the overhead conveyor gallery/cable gallery crosses road / rail line. The horizontal distance between Centre line of rail track and edge of any nearby building/structure shall not be less than 3.0m

CLAUSE NO.	TECHNICAL REQUIREMENTS											
17.17.00	All gallery supporting trestles shall be so proportioned that the transverse deflection of gallery due to wind / seismic load should not exceed trestle height / 1000 as stipulated in IS: 11592. This deflection condition shall be strictly followed. Peak wind speed method shall be considered for checking the transverse deflection.											
17.18.00	The crusher and transfer house structures shall be so designed that transverse deflection at places where conveyor galleries meet, should be equal to the respective transverse deflection of conveyor supporting trestles.											
17.19.00	<p>Deflection criteria</p> <p>The maximum Horizontal Deflection for various structures shall not exceed and be limited to the following:</p> <table border="1"> <thead> <tr> <th>Sl. No.</th> <th>Description</th> <th>Maximum value of</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)</td> <td>Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)</td> </tr> <tr> <td>2.</td> <td>For other Buildings</td> <td>Height/325</td> </tr> </tbody> </table>			Sl. No.	Description	Maximum value of	1.	For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)	Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)	2.	For other Buildings	Height/325
Sl. No.	Description	Maximum value of										
1.	For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)	Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)										
2.	For other Buildings	Height/325										
17.20.00	<p>a) Permissible deflection (unless specified otherwise in this specification) for latticed framework and beams of floors other than drive floor shall be span/325.</p> <p>b) The allowable deflection for beams directly supporting drive machinery shall be restricted to span/500 unless specified otherwise in this specification.</p> <p>c) The deflection for manually operated cranes & monorail supporting beams shall not exceed span/500.</p> <p>For electric overhead cranes :</p> <p>1) upto 50 t capacity : span/750</p> <p>2) over 50 t capacity : span/1000</p> <p>d) The vertical deflection of metal deck sheet for roofing and side cladding shall be limited to span/250</p> <p>e) The permissible vertical deflection for beams supporting drive machinery shall be restricted to span / 500 and for other beams it shall be within span / 325.</p>											
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
17.21.00	<p>f) Permissible deflection for all purlins, cladding runners, roofing/cladding sheets and grating / chequered plates shall be span/250. However, the maximum vertical deflection of Grating/ Chequered plate shall be limited to 6 mm.</p> <p>a) Dispersion of load in any direction through soil shall be as per IS: 8009 (relevant part).</p> <p>b) Dispersion of load through concrete shall be considered at an angle of 45 degrees with horizontal from the edge of contact area.</p>		
17.22.00	<p>a) The design and construction of RCC structures shall be carried out as per IS: 456. Working stress method shall be adopted for the design wherever specifically mentioned in this specification.</p> <p>b) For design and construction of steel-concrete composite members, IS: 11384 shall be followed.</p> <p>c) For reinforcement detailing, IS: 5525 and SP: 34 shall be followed.</p> <p>d) Two layers of reinforcement (on both inner and outer faces) shall be provided for RCC wall sections having thickness 150 mm or more.</p>		
17.23.00	<p>a) All RCC liquid retaining/conveying shall be designed by working stress method as outlined in clause no. 4.5 of IS 3370 (Part-2) 2009 unless specified other wise.</p> <p>b) Water proofing treatment shall be provided for liquid retaining/ carrying structures and basement type structures (requiring dry working condition). Dense and durable concrete with water cement ratio not more than 0.45 shall be used. Plasticiser /super-plasticiser cum water proofing compound shall be added to the concrete. All the construction/expansion joints shall be provided with PVC water bar and/or chemical injection grouting as per IS:6494. As applicable internal/external surface of such structures shall be provided with acrylic based polymer modified cementitious composite coating system for critical structures. For liquid carrying/retaining structures, minimum two coats of such coating shall be applied. For external application wherever the surface is in contact with the earth, fine silica/quartz sand of 0.6 mm nominal size shall be added in the coating mix for better abrasion resistance and total nominal thickness of such coating shall be minimum 1.5 mm. For non critical structures minimum two coats of bitumen grade 85/25 as per IS:702, mixed with 1% of anti-stripping compound meeting the requirement of IS:6241, shall be applied. The total application of bitumen shall not be less than 1.7 kg/sq.m.</p> <p>Bidder shall submit a comprehensive scheme for water proofing treatment based on above or any other alternative scheme, internationally accepted for Employer's approval prior to commencement of work.</p> <p>c) All liquid retaining/carrying structures shall be tested for water tightness as per the provisions of IS: 3370 and IS: 6494 and in case of leakage, the same shall be rectified by chemical injection grouting through nozzles.</p>		
17.24.00	<p>For design of all underground structures, foundations, etc. ground water table shall be assumed at the finished ground level unless specified otherwise.</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
17.25.00	<p>Earth pressure for all underground structures shall be calculated using coefficient of earth pressure at rest or co-efficient of active earth pressure, whichever is applicable, depending upon the structural configuration. However, for the design of substructure of pump houses, earth pressure at rest shall be considered. Co-efficient of passive earth pressure shall be used only in design of shear keys for stability against sliding.</p>			
17.26.00	<p>a) Following loading conditions shall be considered in addition to the loading from super structure for the design of substructure of pump house, channels, sumps, tanks, trenches and other underground structures containing liquid</p> <p>i) Water pressure from inside and no outside pressure, like earth pressure, ground water and surcharge pressure (applicable only to structures, which are liable to be filled up with water or any other liquid.)</p> <p>ii) Earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.</p> <p>iii) Design shall also be checked against buoyancy due to the ground water during construction as well as after construction stages. Minimum factor of safety of 1.2 against buoyancy shall be ensured considering empty condition inside and ignoring the superimposed loadings. Provision of pressure relief valves/flap valves, etc., shall not be permitted to counter the buoyancy unless specified otherwise.</p> <p>iv) Base slab and piers of the pump houses shall also be designed for the condition of different combination of pump sumps being empty during maintenance stages with maximum ground water level.</p> <p>b) Intermediate dividing pier of pump sumps and partition wall (if applicable) in channel shall be designed considering water on one side only and other side being empty for maintenance.</p> <p>c) All pump houses and other substructures (wherever applicable) shall be checked for stability against sliding and overturning during construction as well as operating conditions for various combinations of loads.</p>			
17.27.00	<p>Design of Block Foundation</p> <p>a) Block foundation resting on soil shall be analyzed using elastic half space theory. In case the foundation is supported over piles, Novak's approximation shall be used for determining the spring constant and damping ratio of pile groups. The mass of the RCC block shall be at least three times the mass of machine. Free vibration analysis of the foundation shall be carried out to evaluate the natural frequencies. The fundamental natural frequency shall be kept at least 20% away from the operating frequency (speed). Forced vibration analysis shall be carried out if the dynamic forces are made available by the machine supplier in which case the amplitude limits stipulated by the machine supplier and ISO 10816, whichever is lower, shall be satisfied.</p> <p>Reinforcement design shall be done by working stress method as per IS:456-2000 and IS:2974 (Part-IV).</p> <p>b) For the foundations supporting minor rotating equipment weighing less than one ton or if the mass of the rotating parts is less than one hundredth of the mass of the foundation, no dynamic analysis is necessary. However, if such</p>			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
17.28.00	<p>minor equipment is to be supported on building structure, floors, etc., suitable vibration isolation shall be provided by means of springs, neoprene pads, etc., and such vibration isolation system shall be designed suitably.</p> <p>Design drawings of steel structures shall include the connection, joint & fastener details for Main columns, Beams & Bracings.</p>			
18.00.00	<p>Coating on RCC water retaining structures (other than drinking water)</p> <p>Epoxy phenolic coating shall be applied on internal surfaces of the RCC water retaining structures, as per details specified below:</p> <p>All concrete surfaces shall be provided with two component transparent polyamide cured epoxy sealer coating (having solid by volume minimum 40% ±2%) of minimum 50 micron DFT. Surface to be coated shall be absolutely dry, clean and dust free.</p> <p>Sealer coat shall be followed with the application of epoxy phenolic coating (solid by volume minimum 63%) of minimum 400 micron DFT. This coat shall be applied after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.</p> <p>Coating on RCC water retaining structures (drinking water)</p> <p>Internal surfaces of RCC water retaining structures shall be provided with minimum 400 micron Food grade epoxy coating complying to FDA Title 21, Part 175.300. Surface to be coated shall be absolutely dry, clean and dust free.</p>			
19.00.00	<p>Fabrication</p> <p>All steel structures shall be fabricated in factory, transported and erected at site. All factory fabricated structures shall have bolted field connections.</p> <p>Silo with hopper & Chimney flue liners can either be fabricated at factory in segments, transported and welded at site before erection or fabricated at site. For Chimney flue liners, to prevent flue gas leakages, the applicable field joints shall necessarily be welded.</p>			
20.00.00	<p>Electrodes</p>			
20.01.00	<p>The electrodes used for welding shall be of suitable type and size depending upon specifications of the parent material, the method of welding, the position of welding and quality of welds desired. Only low hydrogen electrodes shall be used for welding of medium / high tensile steel and for mild steel plate thickness above 20 mm.</p>			
20.02.00	<p>All low hydrogen electrodes shall be baked and stored before use as per manufacturer's recommendation. The electrodes shall be re-baked at 250°C - 300°C for one hour and later on cooled in the same oven to 100° C. It shall be transferred to a holding oven maintained at 60°C - 70°C. The electrodes shall be drawn from this oven for use.</p>			
20.03.00	<p>Where coated electrodes are used they shall meet the requirements of IS: 814 and relevant ASME - Sec. II. Covering shall be heavy to withstand normal conditions of handling and storage.</p>			
20.04.00	<p>Only those electrodes that give radiographic quality welds shall be used for welds, which are subjected to radiographic testing.</p>			
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20.05.00	Where bare electrodes are used these shall correspond to specification of the parent material. The type of flux-wire combination for submerged arc welding shall conform to the requirements of F-60 class of AWSA-5-17-69 and IS: 3613. The electrodes shall be stored properly and the flux shall be baked before use in an oven in accordance with the manufacturer's requirements as stipulated.
20.06.00	The contractor shall take specific approval of the weld for the various electrodes proposed to be used on the works before any welding is started.
20.07.00	Edge Preparation for Welding Suitable edge as per weld joint detail shall be prepared either by machines or by automatic gas cutting. All edges cut by flame shall be ground before they are welded.
20.08.00	Pre Heating and Post Heating Mild steel and medium / high tensile steel plates thicker than 20mm, will require Pre-Heating of the parent plate prior to welding as mentioned in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, however, higher pre heat temperature may be required as per approved welding procedure and it shall be followed. In welding materials of unequal thickness, the thicker part shall be taken for this purpose. Base metal shall be preheated, notwithstanding provisions of IS: 9595 to the temperature given in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, prior to welding or tack welding. When base metal not otherwise required to be pre heated is at a temperature below 0°C it shall be pre heated to atleast 20°C., prior to tack welding or welding. Pre heating shall bring the surface of the base metal to the specified pre heat and this temperature shall be maintained as minimum inter-pass temperature welding is in progress.

**TABLE - 1
MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR
WELDING MILD STEEL**

Thickness of thicker part at Point of welding	Welding Using	
	Low hydrogen electrode or submerged arc welding	Other than low hydrogen electrode
Upto and including 20mm	None	None
Over 20mm and up to and including 40mm	20°C	Not allowed
Over 40mm and up to and including 63mm	66°C	Not allowed
Over 63mm	110°C	Not allowed

Note: Type of electrode and the preheating requirements for welding shall be as per approved welding procedure.



**TABLE - 2
MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR
WELDING MEDIUM / HIGH TENSILE STEEL**

Thickness of thicker part at Point of welding	Welding Using	
	Low hydrogen electrode or submerged arc welding	Other than low hydrogen electrode
Upto and including 20mm	None	Not Allowed
Over 20mm	120oC - 140°C	Not Allowed

Note : Type of electrode and the preheating requirements for welding of medium and high tensile steel shall be as per approved welding procedure.

20.09.00 Pre heating may be applied by external flame which is non-carbonizing like LPG, by electric resistance or electric induction process such that uniform heating of the surface extending up to a distance of four times the thickness of the plate on either side of the welded joint is obtained.

20.10.00 Thermo-chalk, thermo-couple or other approved methods shall be used for measuring the plate temperature.

20.11.00 All butt welds with plates thicker than 50mm and all site butt welds of main framing beam supporting the bunker shall require post weld heat treatment as per procedure given in AWS D-1.1. Post heating shall be done up to 600oC and rate of application shall be 200oC per hour.


20.12.00 The post heat temperature shall be maintained for 60 minutes per 2.5cm thickness. For maintaining slow and uniform cooling, asbestos pads shall be used for covering the heated areas.


21.00.00 Paving, Drainage and Sewage


RCC paving of minimum 150 mm thick with M25 grade concrete, over an underbed as specified herein shall be provided. RCC paving shall be designed as rigid reinforced concrete pavement for the crane/ vehicular/ equipment movement loads which the paving has to bear. The under bed for paving shall consist of preparation and consolidation of sub-grade to the required level, laying of stone soling of 200mm compacted thick for normal duty paving with 63 mm and down aggregate with interstices filled with selected moorum followed by 75 mm thick 1:4:8 PCC (1 part cement, 4 parts sand and 8 parts stone aggregate) with 40 mm nominal size aggregate. Paving areas shall be provided with the metallic hardener floor finish as specified elsewhere in the specification.


2.5 m wide paving with metallic hardener around periphery of all sumps and underground tanks shall be provided.


Suitable drains shall be provided to dispose off storm water as well as floor wash of the FGD area block. The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain.


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<p>22.00.00</p>	<p>Sewer lines (Cast Iron), interconnected by sewer manholes (RCC) at regular intervals (not exceeding 30 meter centre to centre) shall be provided to dispose off sewage from FGD area to the nearest available manhole of the owner.</p> <p>The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr. The maximum velocity for pipe drains and open drains shall be limited to 2.4m/sec and 1.8 m/sec. respectively. However, minimum velocity of 0.6m/sec. for self-cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be provided. The open drains shall be open rectangular drains of RCC unless required otherwise due to functional requirement. RC box culverts shall be provided at rail, road or other crossings.</p> <p>Sewers shall be designed for a minimum self-cleansing velocity of 0.75m/sec and the maximum velocity shall not exceed 2.4m/sec.</p> <p>Statutory Requirements</p> <p>Bidder shall comply with all the applicable statutory rules pertaining to Factories Act, Fire Safety Rules at Tariff Advisory Committee. Water Act for pollution control, Explosives Act, etc.</p> <p>Provisions of safety, health and welfare according to Factories Act shall be complied with. These shall include provision of continuous walkways along the crane - girder level on both sides of building, comfortable approach to EOT crane cabin, railing, fire escape, locker room for workmen, pantry, toilets, rest room etc.</p> <p>Provisions for fire proof doors, number of staircases, fire separation wall, lath plastering/encasing the structural members (in fire prone areas), type of glazing etc. shall be made according to the recommendations of Tarrif Advisory Committee.</p> <p>Statutory clearances and norms of State Pollution Control Board shall be followed.</p> <p>Bidder shall obtain approval of Civil/Architectural drawings from concerned authorities before taking up the construction work.</p>								
<p>23.00.00</p>	<p>INSPECTION, TESTING AND QUALITY CONTROL</p> <p>Sampling and testing of major items of civil works viz. earthwork, concreting, structural steel work (including welding), piling, sheeting, etc. shall be carried out in accordance with the requirements of this specification. Wherever nothing is specified relevant Indian Standards shall be followed. In absence of Indian Standard equivalent International Standards may be used.</p> <p>The Bidder shall submit and finalise a detailed field Quality Assurance Programme before starting of the construction work according to the requirement of this specification. This shall include frequency of sampling and testing, nature/type of test, method of test, setting of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/experienced manpower, preparation of format for record, Field Quality Plan, etc. Tests shall be done in the field and/or at a laboratory approved by the Engineer. The Bidder shall furnish the test certificate from the manufacturer's of various materials to be used in the construction.</p>								
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
24.00.00	<p>CONCRETE</p> <p>All R. C. C. works to be done under this specification, unless specified otherwise shall be design mix concrete. Minimum grade of concrete for various structures shall be as follows:</p> <p>a) M25 - For all underground / sub-structural/ super-structure R. C. C. work.</p> <p>b) M30- For Block Foundation</p> <p>c) M35- For spring supported RCC deck and rail load bearing structure (if applicable)</p> <p>Minimum 75 mm thick P.C.C M-7.5 shall be provided as mud mat below all foundations.</p> <p>For concreting of underground structures requiring water tightness, plasticizer cum water proofing admixture shall be added to the concrete mix.</p> <p>Both coarse and fine aggregates shall conform to IS: 383 for concrete, shotcreting etc. unless otherwise mentioned.</p>		
25.00.00	Excavation, Backfilling, Disposal and Stacking of materials Details		
25.01.00	<p>Excavation in Soil</p> <p>Excavation for foundation shall be to the bottom of lean concrete and as shown on drawing or as directed by the Engineer. The bottom of all excavations shall be trimmed to required levels and when excavation is carried below such levels by error, it shall be brought back to the specified level by filling with concrete of nominal mix 1 : 3 : 6 (cement: coarse sand: 40 mm down aggregates), as directed by the Engineer.</p> <p>The Contractor shall ascertain for himself the nature of materials to be excavated and the difficulties, if any, likely to be encountered in executing this work. Cofferdams, sheet piling, shoring, bracing to maintain suitable slopes, draining etc. shall be provided and installed by the contractor, to the satisfaction of the Engineer.</p> <p>Surplus excavated materials shall be disposed off by the contractor at locations up to a lead of 5 kms from the plant boundary wall as directed by the engineer.</p> <p>The Contractor shall have to constantly pump out any water collected in excavated pits and other areas due to rain water, springs etc. and maintain dry working conditions at all times until the excavation, placement of reinforcement, shuttering,</p>		
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<p>25.02.00</p>	<p>concreting, Backfilling is completed. The Contractor shall remove all slush/muck from the excavated areas to keep the work area dry. The Contractor, if required, shall employ sludge pumps, for this purpose.</p> <p>For other details, excavation clauses as given at “Foundation system and Geotechnical Data Chapter” given at “Project Information section” of technical specification, are to be referred.</p> <p>Excavation in Rock</p> <p>For the work of excavation in rock, Contractor shall engage specialised agency having experience of excavation in rock involving wedging and blasting. The agency shall be subject to approval of Engineer and the Contractor shall furnish details of relevant experience in support while seeking approval for the agency.</p> <p>Blasting shall be resorted to only with the written permission of the Engineer. All the statutory laws, (Explosives Act etc.) rules, regulations, Indian Standards etc. pertaining to the acquisition, transport, storage, handling and use of explosives etc. shall be strictly followed.</p> <p>The contractor shall obtain Licenses from Competent Authorities for undertaking blasting work as well as for procuring, transporting to site and storing the explosives as per Explosives Act. The Contractor shall be responsible for the safe transport, use, custody and proper accounting of the explosive materials.</p> <p>Surplus excavated materials shall be disposed off by the contractor at locations up to a lead of 5 kms from the plant boundary wall as directed by the engineer.</p> <p>The Contractor shall have to constantly pump out any water collected in excavated pits and other areas due to rain water, springs etc. and maintain dry working conditions at all times until the excavation, placement of reinforcement, shuttering, concreting, backfilling is completed. For other details for excavation in rock, clauses as given at “Foundation system and Geotechnical Data Chapter” given at “Project Information section” of Technical specification, are to be referred.</p>		
<p>25.03.00</p>	<p>Backfilling, Disposal and Stacking of materials</p> <p>Backfilled earth shall be compacted as per “Foundation system and Geotechnical Data Chapter” given at “Project Information section” of technical specification.</p> <p>However, the backfill under the rail lines and roads shall be compacted to minimum 95 % of the standard proctor density at OMC unless otherwise stated by rail Authorities.</p>		
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<p>26.00.00</p>	<p>The contractor is required to excavate upto any depth as shown on the drawings or as directed by the Engineer. Lifting of excavated materials shall be done either by manual or mechanical or both means if called for by the Engineer.</p> <p>The disposal / stacking areas for excavated materials shall be indicated by the Engineer. The carriage of excavated materials shall be done by the methods mentioned below:</p> <p>The excavated materials shall be carried beyond the initial lead of 50 m but upto 500 m by manual / animal labour or by mechanical means. If directed by the Engineer this material shall be used directly for filling purposes.</p> <p>For leads exceeding 500 m the Contractor shall transport the excavated materials by mechanical means only and as directed by the Engineer. The Contractor may be allowed to carry materials through Kuccha roads. Providing and maintaining of the Kuccha roads shall be the responsibility of the Contractor. The transported material shall be neatly stacked as directed by the Engineer.</p> <p>Some excavated materials required for filling purposes, may have to be carried upto a lead of 500 m and stacked as per instructions of the Engineer. Excavated materials carried beyond 500 m shall normally be for disposal purpose only. Double handling of materials shall be avoided as far as possible. However, depending on site condition excavated materials carried beyond a lead of 500 m may also be required to be brought back for filling purpose.</p> <p>Materials to be used for filling purpose shall be stone, sand or other inorganic materials and they shall be clean and free from shingle, salts, organic matter, large roots and excessive amount of sod, lumps, concrete or any other foreign substances which could harm or impair the strength of the substances in any manner. All clods shall be suitably broken to small pieces. When the material is mostly rock boulders, these shall be broken into pieces not larger than 150 mm size before backfilling and shall be backfilled in layers of 300mm interstices filled with sand. In case of broken rock boulders used for back filling, the top cover shall be with 1.0m thick soil. The layers of rock boulders, interstices filled with sand shall be compacted by plate vibrators. Sand used for filling shall be clean, medium grained and free from impurities. Fines less than 75 microns shall not be more than 20%. In any case, the materials to be used for filling purposes shall have the prior written approval of the Engineer.</p> <p>In case the materials have to be brought from pits / quarries, then it shall be the Contractor's responsibility for identification of such quarry areas, obtaining approval from their use from concerned authorities, excavation / quarrying loading and carriage of such material, unloading and filling at specified locations. The Contractor shall pay any fees, royalties etc. that may have to be paid for utilisation of borrow areas.</p> <p>GALVANISING</p> <p>All burrs and irregular edges of the structural steel members to be galvanised shall be ground smooth before galvanising.</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
<p>27.00.00</p>	<p>Purity of Zinc to be used for galvanising shall be 99.5 % as per IS : 209 (latest edition).</p> <p>The weight of the zinc coating shall be at least 610 Gms. / m² unless noted otherwise.</p> <p>CHEMICAL INJECTION GROUTING</p> <p>Minimum, 12 mm dia (NB) threaded nozzle of suitable length, shall be provided over the surface and along the construction joint line in a grid pattern at a spacing not exceeding 1.5 m c / c before concreting operation. Adequate precaution shall be taken to keep the nozzles plugged at both ends to prevent them from getting closed by concrete.</p> <p>For fixing of any nozzle in set concrete suitable size hole shall be drilled, preferably by using repercussive hammer drill electrically operated, in grid pattern and grouting nozzle shall be fixed in these holes.</p> <p>After the nozzles are fully set, neat cement slurry admixed with water soluble non - shrink polymer / monomer based chemical shall be injected through the net - work of nozzles with low pressure grout pumps at a pressure of about 2.0 Kgs. / cm². Cement slurry shall be prepared by mixing cement with non-shrink polymer/monomer @ 500 gm/50 kg bag of cement and water, ensuring that Water: Cement ratio does not exceed 2 (by weight). Wetter the structure, lesser should be the water cement ratio. The property of the polymer/monomer should be such that when it is mixed with water @0.5% by weight of water, the viscosity of the resultant solution (water and polymer/monomer) should not be more than 1.2 centipoises. Plasticizing agent shall be added wherever required. The grouting shall be started at very low pressure and increased gradually to a required pressure. The grouting shall continue, till the hole refuses to take any further grout, even at an increased pressure. Applied pressure shall not be more than the designed strength of the concrete. After completion of grouting operation, the nozzles shall be sealed properly to the satisfaction of the Engineer.</p>		
<p>28.00.00</p>	<p>POLYMER MODIFIED CEMENTITIOUS COATING</p>		
<p>28.01.00</p>	<p>Materials</p> <p>Modified liquid polymer blend shall be a dispersion containing 100 % acrylic based polymer solids. Polymer shall be mixed in the ratio of 1 cement: 0.5 polymer (for minimum solid content of polymer 30%).</p> <p>Portland cement based dry powder.</p> <p>Clean, fine specially prepared quartz sand approximately 0.6 mm size.</p>		
<p>28.02.00</p>	<p>Mixing</p> <p>The liquid polymer shall be stirred well and cement based powder shall then be added slowly to make a Slurry Mix. For preparation of Brush Topping Mix, quartz</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
<p>28.03.00</p>	<p>sand shall be added slowly and mixed well till a homogeneous mixture is obtained. The mix shall be used within half an hour of the preparation. Addition of quartz sand may not be necessary, in case dry power contains the same.</p> <p>Properties of Coating</p> <p>It must adhere to wet surface.</p> <p>It should develop adequate bond strength, with the concrete surface, not less than 2 N / Sq. mm.</p> <p>Co - efficient of permeability shall be about 5×10^{-10} Cm / Sec.</p> <p>Water absorption after continuous soaking shall not be more than 1 %.</p> <p>The materials shall be permeable under water vapour.</p> <p>The material shall be resistant to acids and alkalies present in the soil and underground water with normal pH value between 4 and 14.</p> <p>The co - efficient of thermal expansion of the material shall be close to that of concrete.</p>		
<p>28.04.00</p>	<p>Application</p> <p>The concrete surface shall be cleaned and made free from grease, oils or loosely adhered particles. The surface shall be damp without any free water. For exterior underground part, application (b) pertaining to Brush topping Mix shall be followed.</p> <p>(a) For Slurry Mix</p> <p>A minimum of 2 coats shall be applied on the surface. The first coat being applied, when the surface is still damp and left to harden for 4 to 6 hours. After 4 to 6 hours of the application of second coat, it shall be finished by rubbing down with a soft dry sponge. The coverage shall not be less than 1 : 1 Kgs. / m² in the 2 coats. A lap of 75 mm shall be provided at the joints.</p> <p>The coating shall be air dried for 4 to 6 hours and, thereafter, cured for 7 days after the application of last coat.</p> <p>(b) For Brush Topping Mix</p> <p>This shall be applied in two coats. A primary coat of slurry mix can also be first applied on the surface as first coat. After the coating has dried up, a coat of Brush Topping Mix shall be applied over it with a push broom or any other similar brush. It shall be left in broom finished condition. The nominal thickness shall be 1.5 mm and minimum thickness shall be 1.0 mm. A lap of 75 mm shall be provided at the joints. It shall be ensured that no pinhole exists and rebrushing shall be done to cover the pinholes, if any.</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
<p>29.00.00</p> <p>29.01.00</p> <p>29.01.01</p> <p>29.01.02</p> <p>29.02.00</p>	<p>The Coating shall be air dried for 4 to 6 hours and thereafter cured for 7 days after the application of last coat.</p> <p>Rate of application of coating shall be established to achieve the required thickness.</p> <p>Architectural Concepts</p> <p>Buildings shall be architecturally treated in such a way that it presents a pleasing composition of mass and void with suitable and functionally designed projections and recesses. The overall impact of the building shall be one of aesthetically unified architectural composition having a comprehensive scale, blending with the surroundings and taking full consideration of the climatic conditions and the building orientation. All the buildings shall be architecturally treated in such a way so as to be in harmony with the surroundings. The over all composition may have straight or curvilinear profiles.</p> <p>Necessary projections, fins, parapets, chajjas etc. in addition to the minimum area specified elsewhere in this specification shall be provided as required.</p> <p>Nothing extra shall be payable for any changes required while getting the drawings / scheme approved and for executing the same.</p> <p>All structures, buildings and facilities shall be designed as per provisions of National Building Code 2005 and Local building by - laws as applicable including provisions of the Factories Act of the State concerned, with regard to requirement of free access, stairs, minimum head room, walkways, ventilation, toilets etc. and safety requirements like railings, fire escapes etc. Further all layouts and detailed drawings shall meet the relevant statutory requirements specified in recommendations of Petroleum act, Explosives act and Indian Electricity rules' as applicable.</p> <p>FINISHING SCHEDULE</p> <p>Flooring</p> <p>The nominal total thickness of floor finish shall be 50mm i.e. underbed & topping. The floor shall be laid on an already laid and matured concrete base. Flooring of tiles / stone shall be fixed with 18 mm thk cement sand mortar 1:4, above PCC under bed (M 20 (with graded aggregate of nominal size 12.5mm) design mix)</p> <p>Flooring of Concrete hardener topping shall be provided above the PCC underbed (M 20 (with graded aggregate of nominal size 12.5mm) design mix).</p> <p>Wherever specified Heavy duty ceramic tiles of size 300x300x7 mm thick (minimum) of reputed manufacturer (Kajaria, Orient, Johnson or equivalent) of approved finish shade and colour to be used. Vitrified ceramic tiles wherever specified shall be 600x600 mm with minimum 9.5 mm thickness and of reputed manufacturer (Kajaria, Johnson, Orient or equivalent).</p> <p>Floor finish & skirting:</p> <p>The nominal thickness of floor finish shall be 50 mm.</p> <p>Floors of toilets, pantries / kitchen shall be finished with Heavy duty (grade-5) dust pressed ceramic tiles 300mmx300mm x7 mm thick as per IS:15622, including</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
<p>29.03.00</p>	<p>pointing the joints with white cement mixed with matching pigment, of approved make, size & colour shade.</p> <ol style="list-style-type: none"> (1) Floors of Office Room, Labs, Control Rooms, RIO Rooms and all other A/c Room shall be finished with Mirror polished Vitrified ceramic tiles (minimum 9.5 mm thk) with 3 mm groove joints as per approved pattern, pointed neatly with 3X4mm stainless epoxy grout SP- 100 of Laticrete or approved equivalent in approved colour to match colour of tile. (2) Suitable supporting arrangement shall be provided with M.S. angles / channels on cable trenches in MCC and Control rooms for mounting Control panels / MCC. (3) In rest of the areas, IPS (Cement concrete flooring) with Concrete hardener topping shall be 12mm thick with ordinary grey cement using uniformly graded, properly treated iron particles shall be provided. (4) Floors and sides of under ground RCC structures like valve pits, trenches and tanks shall have simultaneous (integral) neat cement finish at the time of concreting. (5) The interconnecting walkway between various structures, buildings and facilities shall be finished with 22 mm chequered concrete tiles at top. 1000 mm wide walkway of 22mm thick chequered concrete tiles shall be provided on terrace for maintenance purpose, in all RCC /Metal deck roof buildings. (6) Skirting in general shall be 150mm high, Dado in toilet, kitchen & pantry shall be up to specified height (up to 2200 mm for toilets, up to 600 mm high above counter top in kitchen and pantry area). The dado height shall be measured from finished floor level. Skirting and Dado shall match with the floor finish. (7) Battery Room shall be provided with Acid resistant tile on horizontal and vertical surfaces, at all levels for all type of works, including One coat of bitumen primer followed by 12 mm thick bituminastic layer, 20 mm thick Acid Resistant tiles, 6 mm thick under-bed by potassium silicate mortar, 6 mm thick pointing of joints of tiles with acid/alkali resistant epoxy/furane mortar up to a depth of 20 mm and bituminastic end sealing. 1200 mm high dado on wall shall be with 12 mm thk Acid resistant tiles of the similar finish and the joints to be finished as per flooring tiles, with the rest of wall height and ceiling finished in chemical resistant paint (chlorinated rubber based). (8) Well polished 18 mm thick Kota stone jointed with neat cement slurry mixed with pigment to match the shade of the stone including rubbing and cleaning, complete, to be provided in entrance area, entrance steps, Entrance area, staircases (tread, riser, landings, skirting). <p>Sunken RCC slab shall be provided in false flooring area and toilet, Kitchen and pantry, so as to keep the finished floor level of these areas same as that of the surrounding area.</p>	<p>NCTPP DADRI ST-II(2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6130/0330-109-9</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 45 OF 67</p>


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<p>29.04.00</p>	<p>Water proofing treatment to be provided on sunken portion of all vertical and horizontal surfaces of depressed portions of all toilets, W.C., kitchen, Pantry and the like consisting of :</p> <p>(i) Ist course of applying cement slurry @ 4.4 kg/sq.m mixed with water proofing compound conforming to IS 2645 in recommended proportions including rounding off junction of vertical and horizontal surface.</p> <p>(ii) IInd course of 20 mm cement plaster 1:3 (1 cement: 3 coarse sand) mixed with water proofing compound in recommended proportion including rounding off junction of vertical and horizontal surface.</p> <p>(iii) IIIrd course of applying blown or residual bitumen applied hot at 1.7 kg. per sq.m of area.</p> <p>(iv) IVth course of 400 micron thick PVC sheet. (Overlaps at joints of PVC sheet should be 100 mm wide and pasted to each other with bitumen @ 1.7 kg/sq.m).</p>		
<p>29.05.00</p>	<p>Acid / Alkali Resistant Treatment:</p> <p>Acid / alkali resistant lining treatment shall be provided in different areas as follows:</p> <p>Neutralization Pit: The walls shall be provided with one coat of bitumen primer, followed by 18 mm thick bitumastic layer, 115 mm thick A.R. bricks, 6 mm thick under bed of potassium silicate mortar, pointing the joints of bricks with acid / alkali resistant epoxy / furane mortar upto a depth of 20 mm and bitumastic end sealing. Suitable plasters shall be provided with A.R. bricks at regular intervals depending upon the height of lining, as per the specification.</p> <p>The floor of neutralization pit shall be provided with acid / alkali resistant lining treatment as given in the above para, except that the 115 mm thick A.R.tile layer shall be replaced by 75 mm thick A.R. tile layer and pilasters shall be omitted.</p> <p>The ceiling of neutralization pit shall be provided with one coat of epoxy primer followed by 2 coats of epoxy paint (150 micron).</p> <p>Acid / Alkali storage area / projections above the floor, pedestals projecting from the floor / saddles. : The floor shall be provided with one coat of bitumen primer followed by 12 mm thick bitumastic layer, 20 mm thick A.R. tiles, 6 mm thick under - bed by potassium silicate mortar, 6mm thick pointing of joints of tiles with acid / alkali resistant epoxy / furane mortar up to a depth of 20 mm and bitumastic end sealing. Dado of 12 mm thk Acid Resistant tiles up to 1.0M high shall also be provided if applicable in case of walls nearby.</p> <p>Alum/Lime Storage area and first floor of Chemical House : One coat of bitumen primer followed by 12mm thick bitumastic layer, 20 mm thick A.R. tiles, 6 mm thick underbed of potassium silicate mortar, 6mm thick pointing of joints of tiles with acid /alkali resistant epoxy /furane mortar up to a depth of 20 mm and bitumastic end sealing.</p> <p>Alum solution preparation tank:</p> <p>The wall shall be provided with one coat of bitumen primer followed by 12 mm thick bitumastic layer, 75 mm thick A.R. tiles, 6 mm thick underbed by potassium silicate</p>		
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	<p>mortar, pointing of joints of tiles with acid / alkali resistant epoxy / furane mortar upto a depth of 20 mm and bitumastic end sealing.</p> <p>The floor shall be provided with acid / alkali resistant lining treatment as given in the above para except that the 75 mm thick A.R. tile layer shall be replaced by 12 mm thick A.R. tile layer.</p> <p>Basket of Alum solution preparation tank: 5 mm thick epoxy lining over a coat of epoxy primer.</p> <p>Curved surfaces of saddles shall have minimum 12 MM thick bitumastic layer to support the vessel / tanks.</p> <p>Effluent Drains: Acid Resistant lining treatment indicated for the storage area shall be provided on the bed as well as walls of the drains with 38 MM AR tiles. The underside of the pre-cast slab cover shall be applied with one coat of epoxy primer and two coats of epoxy coating, total DFT 150 microns.</p> <p>Lime tank: Two coats of bitumen paint conforming to IS: 9862, with total DFT 150 microns.</p> <p>29.06.00 Walls</p> <p>29.06.01 All walls shall be non-load bearing infilled panel walls. All external walls shall be minimum one brick thick masonry wall.</p> <p>29.06.02 All external and internal walls shall be with minimum one brick masonry (230 or 250 mm) including toilet walls. Toilet partition low height walls shall be minimum half brick masonry.</p> <p>29.06.03 For all air conditioned areas/ rooms, wherever metal cladding is envisaged as cladding material, additional brick masonry wall (230m thick) shall also be provided in addition to metal cladding for effective air conditioning. This brick wall shall be plastered & painted as specified elsewhere in the specification.</p> <p>29.06.04 RCC transoms and mullions of size 115x115mm with suitable reinforcement shall be provided wherever necessary to reinforce the brickwork.</p> <p>29.06.05 50 mm thick DPC in Cement concrete (M-20) with water proofing compound followed by two layers of bitumen coating 85/ 25 grade as per IS: 702 @ 1.7 kg/ sq.m. shall be provided at plinth level before starting the masonry work.</p> <p>29.06.06 The bricks shall be laid with cement mortar (1:6) for one brick thick walls and (1:4) for half brick thick walls IS: 1905, IS: 2212 and SP -- 20 shall be followed for brick work design and construction.</p> <p>29.07.00 Plastering</p> <p>29.07.01 External (rough) surface of walls shall be plastered with 18 mm thick cement plaster, consisting first (base) layer of 12 mm thick plaster in cement sand mortar (1:6) and second (finishing) layer of 6 mm thick plaster in cement sand mortar (1:4).</p> <p>The internal (smooth) surface of walls shall have 12 mm thick plaster in cement sand mortar (1:6).</p> <p>All external / internal RCC surfaces including RCC parapet walls shall be provided with minimum 12mm thick plaster in cement sand mortar (1:4) except walls of underground structures like cable trenches / valve pits etc.</p>			
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29.07.02	All exposed faces of R.C.C. walls of structures, buildings and facilities shall have minimum 12 mm thick cement sand plaster 1:6.		
29.07.03	All RCC ceilings (except areas provided with false ceilings and cable vault ceiling) shall be provided with 6 mm thick cement sand plaster 1:4.		
29.07.04	All plastering work shall conform to IS: 1661.		
29.08.00	Painting		
29.08.01	All painting on masonry or concrete surface shall preferably be applied by roller. If Applied by brush then same shall be finished off with roller.		
29.08.02	All paints shall be of approved make including chemical resistant chlorinated rubber paint.		
29.08.03	Minimum two finishing coats of paint shall be applied over a coat of primer.		
29.08.04	The thinner shall not be used with textured paint (Sandtex Matt or equivalent) finish.		
29.09.00	Internal Finish		
29.09.01	All Air conditioned areas shall have 2mm of polymer based water resistant putty (wall putty) to given an even and smooth surface.		
29.09.02	Acrylic emulsion paint shall be as per IS: 5411 (Part - 1). Acrylic distemper shall be as per IS: 428. Air - conditioned areas shall be applied with minimum 2 coats of acrylic emulsion paint. All other areas shall be applied with minimum 2 coats of Acrylic distemper.		
29.09.03	Toilet, Pantry / Kitchen areas shall have dado with Designer ceramic tiles, 300x200mw (matt finish) upto 2.2 m height and shall match with floor finish. Above dado, Acrylic distemper shall be applied.		
29.09.04	Areas coming in contact with chlorine fumes or acid / alkali shall have two coats of acid / alkali resistant chlorinated rubber paint over suitable primer on walls above dado & ceiling.		
29.09.05	The paint shall be of approved colour shade and make.		
29.10.00	External Wall Finish		
29.10.01	One pack, ready mix and ready to use, resin / polymer bonded granular textured coating finish of 2.5 mm (natural coloured graded stone chips), of approved colour, and shade for all types of plastered and / or exposed concrete surface, in all kinds of works, at all levels, including preparation of surface, preparation of working drawing, labour, material, equipment, handling, transportation, mixing, laying, applying finishing, testing, curing, making grooves, scaffolding, staging, etc., all complete, as per specifications, drawings and instructions of the Engineer-in-charge.		
29.10.02	Toe wall of chain link fencing shall be provided with two coats of Acrylic Smooth Exterior Paint		
29.10.03	The finish shall be of approved colour shade and make.		
29.11.00	Ceiling Finish		
29.11.01	Ceiling shall have min. two (2) coats of Acrylic distemper except AC areas & Battery room.		
29.11.02	For painting on concrete, masonry and plastered & surface, IS: 2395 shall be followed. For painting on steel work and ferrous metals, IS: 1477 shall be followed.		
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29.11.02	Fire resistant transparent paint (confirming to IS: 162) shall be provided on all wood work, over French police or flat oil paint. French polish shall confirm to IS : 348. Flat oil paint shall confirm to IS: 1237.			
29.12.00	Doors, Windows, Ventilators, Louvers, Rolling Shutters & Glazing			
29.12.01	Adequate Doors, Windows, Louvers and Ventilators shall be provided for proper lighting and ventilation of all buildings. The area of windows shall be at least 10% of the floor area of the respective building. In addition to the above, wherever room height is more than 3.5 m, a band of ventilators of 600 mm height (minimum) shall be provided at the top.			
29.12.02	Unless specified all doors, of air conditioned areas, entrance lobby of all buildings shall have electro colour coated (anodised) aluminium frame work with glazing. Windows, ventilators & partitions of all buildings shall have electro colour coated (anodised) aluminium frame work with glazing. All doors of toilet, kitchen, pantry & store areas shall be of factory made pre - laminated solid core flush door shutters, as per IS: 2202 (Part-II) with pressed steel door frame. Control room shall have Aluminium glazed door & partitions. All other doors (unless otherwise specified) shall be of steel.			
29.12.03	All steel doors shall consist of double plate flush door shutters. The door shutter shall be 45 mm thick with two outer sheets of 18 G rigidly connected with continuous vertical 20 G stiffeners at the rate of 150 mm centre to centre. Side, top and bottom edges of shutters shall be reinforced by continuous pressed steel channel with minimum 18 G. The door shall be sound deadened by filling the inside void with mineral wool. Doors shall be complete with all hardware and fixtures like door closer, tower bolts, handles, stoppers, aldrops, etc.			
29.12.04	Wherever functionally required, rolling shutters of suitable size approved by the Owner, with suitable operating arrangement manual/ electric shall be provided to facilitate smooth operations. Rolling shutters shall conform to IS: 6248.			
29.12.05	All windows and ventilators at ground floor level shall be provided with suitable anodised aluminum grill.			
29.12.06	Fire proof doors with panic devices shall be provided at all fire exit points as per the requirements. However minimum Fire rating shall be 2 hours. These doors shall be double cover plated type with mineral wool insulation.			
29.12.07	Hollow excluded Section of minimum 2 mm wall thickness as manufactured by INDAL, Jindal, Hindalco or equivalent shall be used for all Aluminium doors, windows, ventilators and Partitions.			
29.12.08	The doors, Windows & ventilators frame shall be of suitable size & thickness for fixing the glazing. The Glazing thickness shall be minimum 6 mm thk clear toughened glass for all glazed doors, windows, ventilators & partitions. Windows in air conditioned areas shall be provided with 24mm thick hermetically sealed composite double glazing.			
29.12.09	Doors and windows on external walls shall be provided with sunshade over the openings with width 600 mm more than the opening width. The projection from the finished face of the wall for sunshade shall generally be 450 mm over window openings, 750 mm over door openings and 900 over Rolling shutters, or as decided and approved by the Engineer.			
29.12.10	Float glass or flat transparent sheet glass shall conform to IS: 2835.			
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29.12.11	All glazing work shall conform to IS: 3548.																									
29.12.12	Windows in conveyor gallery shall be provided with welded wire fabric of 1.6mm thick wire as per IS: 4948 and 12mm x 30mm mesh size.																									
30.00.00	WATER SUPPLY, DRAINAGE AND SANITATION																									
30.01.00	Polyethylene water storage tank conforming to IS: 12701 shall be provided (for the use of toilet, pantry and kitchen) over the roof, with adequate capacity depending on the number of users and 8 hours requirement complete with all fittings including float valve, stop cock etc. The capacity of tank shall be calculated minimum 500 liters, per toilet, pantry and kitchen																									
30.02.00	Galvanised MS pipe of medium class conforming to IS: 1239 shall be used for internal piping works for potable water supply.																									
30.03.00	Sand C.I. pipes with lead joints conforming to IS: 1729 shall be used for sanitary works above ground level.																									
30.04.00	The facilities provided in the toilet block shall depend on the number of users. However, minimum facilities to be provided shall be as stipulated below. IS: 1172 shall be followed for working out the basic requirements for water supply, drainage and sanitation. In addition, IS: 2064 and IS: 2065 shall be also be followed.																									
30.05.00	<p>Each toilet block shall have the following minimum facilities. Unless specified all the fittings shall be of chromium plated brass (fancy type).</p> <p>The common toilet area shall have finished floor level at 15 mm below the finished floor level of surrounding area.</p> <p>Following minimum fittings & fixtures together with associated plumbing works shall be provided as specified below.</p> <table border="1"> <thead> <tr> <th>Sl. No.</th> <th>Type of Fitting / Fixtures</th> <th>Gents Toilet</th> </tr> </thead> <tbody> <tr> <td>i)</td> <td>1 no wall mounted coloured glazed vitreous china European water closet with flush valve.</td> <td>1 No.</td> </tr> <tr> <td>ii)</td> <td>Coloured glazed vitreous china flat back lipped urinals with photo voltaic controlled automatic flushing system including all requisite fittings and fixtures</td> <td>1</td> </tr> <tr> <td>iii)</td> <td>Wash Basin (oval shape) with photo voltaic control system and all requisite fittings and fixtures to be fixed on concrete platform finished with 18mm thick first grade polished granite stone</td> <td>1 No.</td> </tr> <tr> <td>iv)</td> <td>Wall to wall mirror minimum 450 mm high (minimum 6mm thick float glass) including all fittings</td> <td>1 No.</td> </tr> <tr> <td>v)</td> <td>Stainless steel Towel Rail 600mm Long x 20 mm dia.</td> <td>1 No.</td> </tr> <tr> <td>vi)</td> <td>Stainless steel Liquid soap holder cum dispenser with requisite fittings.</td> <td>1 No.</td> </tr> <tr> <td>vii)</td> <td>Overhead Drinking water storage tank (Minimum 500 Litres capacity)- High density polyethylene (cylindrical/vertical) molded seamless type.</td> <td>1</td> </tr> </tbody> </table>		Sl. No.	Type of Fitting / Fixtures	Gents Toilet	i)	1 no wall mounted coloured glazed vitreous china European water closet with flush valve.	1 No.	ii)	Coloured glazed vitreous china flat back lipped urinals with photo voltaic controlled automatic flushing system including all requisite fittings and fixtures	1	iii)	Wash Basin (oval shape) with photo voltaic control system and all requisite fittings and fixtures to be fixed on concrete platform finished with 18mm thick first grade polished granite stone	1 No.	iv)	Wall to wall mirror minimum 450 mm high (minimum 6mm thick float glass) including all fittings	1 No.	v)	Stainless steel Towel Rail 600mm Long x 20 mm dia.	1 No.	vi)	Stainless steel Liquid soap holder cum dispenser with requisite fittings.	1 No.	vii)	Overhead Drinking water storage tank (Minimum 500 Litres capacity)- High density polyethylene (cylindrical/vertical) molded seamless type.	1
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<p>30.06.00</p> <p>30.07.00</p> <p>30.08.00</p>	viii)	Overhead Service water storage tank (Minimum 500 Litres capacity)- High density polyethylene (cylindrical/vertical) molded seamless type	1 No.
	<p>One No. drinking water connection with C.P. brass valve for fixing water cooler by Owner.</p> <p>Required plumbing work from Owner's service water terminal point to the service water tank and from tank to the toilet accessories mentioned above.</p> <p>Required plumbing work from Owner's potable water terminal point to the drinking water tank and from tank up to the water coolers.</p> <p>Janitor room. Adequate space shall be provided.</p> <p>Provision for installation of water cooler.</p> <p>All structures, buildings, facilities, liquid storage tanks shall be provided with peripheral surface brick drains of all around periphery and suitably connected to nearest Owner's drain. Overflow and drains from storage tanks shall be laid to and suitably connected to Owner's open surface drains.</p> <p>The sewerage and waste water disposal system shall consist of providing all associated plumbing and underground pipe works together with all fittings and fixtures and inclusive of ancillary works such as connections, manholes and inspection chambers, including connection to Owner's nearest main sewer line or as directed by Engineer. If required, R.C.C. septic tank and soak pit of required capacity shall be provided by the Bidder.</p> <p>Miscellaneous Architectural Items</p> <p>(a.) In all buildings suitable arrangement with provision of floor traps for draining the water collected from leakage, floor washing, fire fighting etc. shall be provided on all floors which shall be connected to rain water down comers.</p> <p>(b.) Wherever required minimum 1000 high hand railing with 32 NB M.S. pipes medium class as per IS : 1239 shall be provided, with toe & knee rail and toe guard plate, around all floor / roof openings, around periphery of Neutralisation Pit, projections of balconies, walkways, platforms, steel staircase etc.</p> <p>(c.) However for RCC staircases in structures, buildings and facilities, railings with 20 mm square MS bar balustrades with suitable anti corrosive paint of approved colour MS flats for knee & toe guard with 50mm Ø NB MS pipe hand rail at top shall be provided.</p> <p>(d.) All air conditioned areas / common corridors shall be provided with false ceiling constructed from 15 mm mineral Fibre Board in tile form of 600x600mm with supporting system as per manufacture guidelines. 50 mm thick mineral wool insulation (conforming to IS : 8183) shall be provided with as under deck insulation). Additional hangers and height adjustment clips shall be provided for return air grills, light fixtures, Air conditioning ducts etc. Minimum headroom below false ceiling shall be 3.0 m.</p> <p>(e.) Under - deck insulation shall be provided on the ceiling (underside of roof slab) and underside of floor slab of air - conditioned areas depending upon the functional / air - conditioning requirements. The under - deck insulation shall consist of 50 mm thick mineral wool insulation conforming to IS : 8183 backed with 0.05 mm thick aluminium foil & 24 G x 25 mm mesh wire netting</p>		
<p>NCTPP DADRI ST-II(2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6130/0330-109-9</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 51 OF 67</p>


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	<p>and shall be fixed to ceiling with 24 G wire ties and suitable fixing arrangements.</p> <p>(f.) Parapets, chajjas, window / door heads, architectural facias, fins etc., shall be provided with drip course in cement mortar (1 : 3).</p> <p>(g.) 150mm thick fillets at junction of roof slab / chajja slab and parapet / vertical walls shall be provided with cast - in - situ cement concrete 1 : 2 : 4 nominal mix, followed by 12 mm thick cement sand plaster (1 : 4).</p> <p>(h.) Suitable provision shall be made for fixing of ceiling fans in office areas of different structures, buildings and facilities.</p>		
31.00.00	CORROSION PROTECTION		
31.01.00	GENERAL <p>(a) All Steel structures shall be provided with painting as given in the specification. Further, painting system shall also meet the requirements of Corrosivity category C3 (durability High) as per ISO 12944.</p> <p>Painting system for steel surfaces embedded in Concrete is given separately.</p> <p>(b) All Painting shall be done as per technical specification. Painting scheme shall be submitted by the bidder for approval of employer.</p> <p>(c) All steel structures shall be designed by following basic design criteria in ISO 12944 Part 3. However, where it is not feasible to follow the design criteria given in ISO 12944 Part 3 where the steel surface are inaccessible for application of protective coating, corrosion allowance of 1.5 mm shall be kept in thickness(over the design thickness) of structural steel members.</p> <p>d) Painting scheme shall be resubmitted by the Bidder for approval of employer.</p>		
31.02.00	PAINTING OF STEEL SURFACES EMBEDDED IN CONCRETE: <p>a) For the portion of Steel surfaces embedded in Concrete, the surface shall be prepared by Manual Cleaning and provided with Primer Coat of Chlorinated Rubber based Zinc Phosphate Primer of Minimum 50 Micron Dry Film Thickness (DFT).</p> <p>b) All threaded and other surfaces of foundation bolts and its materials, insulation pins, Anchor channels, sleeves, etc. shall be coated with temporary rust preventive fluid and during execution of civil works, the dried film of coating shall be removed using organic solvents.</p>		
31.03.00	PAINTING OF STEEL SURFACES (OTHER THAN THOSE EMBEDDED IN CONCRETE) <p>a) All steel surfaces shall be provided with two component moisture curing zinc (ethyl) silicate primer coat (having minimum 80% of metallic Zinc content in dry film, solid by volume minimum 60% ±2%) of minimum 70 micron DFT to be applied over blast cleaned surface conforming to Sa 2 ½ finish of ISO 8501-1 with surface profile 40-60 Micron. The primer coat shall be applied in shop immediately after blast cleaning by airless spray technique. Zinc dust composition and properties shall be Type-II as per ASTM D520-00.</p> <p>b) Primer coat shall be followed with the application of Intermediate coat of two component polyamide cured epoxy with MIO Content (containing lamellar MIO minimum 30% on pigment, solid by volume minimum 80% ±2%) of</p>		
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31.04.00	<p>minimum 100 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.</p> <p>c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied shop after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer.</p> <p>Notes:</p> <ol style="list-style-type: none"> For Primer, high quality surface preparation is necessary and good amount of moisture is required for proper curing. Below 70 % relative humidity, curing time may go up to 7 days or more. In such a case additional water sprinkling may be ensured for completion of curing. Additionally Inorganic zinc silicate cannot be recoated; even with itself. Typically it should be used when coating bare steel surface for first time. The most frequent problem associated when top coating Primer is bubbling/pin holing especially with non-weathered zinc silicate coatings. To a great extent, this bubbling of finish paint can be eliminated by applying a mist coat of intermediate/topcoat as the first pass of the product, allow the bubbles to subside and then apply a full coat, as required. In case top coating of zinc silicate with epoxy/polyurethane coatings, is expected to be delayed, it is advisable to use a suitable tie coat to avoid formation of white rust. However, if white rust forms then clean the surface with high pressure water, dry and apply the subsequent coats as required. Touch up paintings on damaged areas: Surface preparation by manual tools, wire brush/ emery paper etc. Minimum 6 inches peripheral area, adjoining to damaged area to be covered. If metal surface is exposed, it is to be painted with Zinc rich epoxy (70 micron) or suitable primer with existing paint scheme. If primer is intact, intermediate & top coat to be done with specified DFT in scheme. <p>COATING FOR MILD STEEL PARTS IN CONTACT WITH WATER.</p> <p>a) All mild Steel parts coming in contact with water or water vapour shall be hot dip galvanised. The Minimum Coating of Zinc shall be 610 Gms / Sq. M. for galvanised Structures and shall comply with IS: 4759 and other relevant Codes. Galvanising shall be checked and tested in accordance with IS: 2629.</p> <p>b) The galvanising shall be followed by the application of an etching Primer and dipping in black bitumen in accordance with BS: 3416, unless otherwise specified.</p>			
31.05.00	<p>Gratings</p> <p>All gratings shall be blast cleaned to Sa 2 ½ finish or cleaned by acid pickling as per ISO 8501-1 and shall be hot dip galvanized at the rate of 610 Gms / Sq. M.</p>			
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31.06.00	<p>Hand Railings and Ladders</p> <p>All Mild steel handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. as per IS: 4736. However, Stainless steel handrails shall be provided as specified in General Architectural Specification clause 9.0.0.</p>		
31.07.00	<p>Sea Worthiness</p> <p>All Steel Sections and fabricated Structures, which are required to be transported on sea, shall be provided with anti corrosive Paint before shipment to take care of sea worthiness.</p>		
31.08.00	<p>For Reinforced Concrete Work.</p> <p>i) The protection for concrete sub-structure shall be provided based on aggressiveness of the soil, chemical analysis of soil/sub-soil water and presence of harmful chemicals/salts.</p> <p>ii) The protection to super structure shall depend on exposure condition and degree of atmospheric corrosion.</p> <p>This shall require use of dense and durable concrete, control of water cement ratio, increase in clear cover, use of special type of cement and reinforcement, etc., coating of concrete surface, etc.,</p> <p>Bidder shall furnish the details of corrosion protection measures.</p>		
32.00.00	<p>Miscellaneous</p>		
32.01.00	<p>Ordinary form work shall be used in roofs and floor slabs in transfer houses, footings, pedestals, cable trenches, pits etc., Plywood form work shall be used for all over ground exposed work like columns, beams, floors and ceilings in control room and M. C. C. buildings.</p>		
32.02.00	<p>Monorail girders and fixtures shall be provided for monorails at the locations as required and as described elsewhere in these specifications or drawings. Monorail openings in the walls shall be provided with steel frame doors preferably sliding type or otherwise open able inside, access platforms and ladders.</p>		
32.03.00	<p>Steel frame around openings in roof and on external walls for mounting of exhaust fans shall be provided.</p>		
32.04.00	<p>Ready mix non - shrink cementitious grout of reputed manufacturer as approved by the Employer shall be used for grouting of block outs and foundation bolts, underpinning of base plates and machine bases. Crushing strength of grout shall be one grade higher than the foundation concrete. Minimum crushing strength shall be 30 N / mm² unless higher strength requirement is specified by the equipment supplier or the grout manufacturers.</p>		
32.05.00	<p>The bottom of steel in case of cable / pipe galleries and trestles shall be generally 3m above the ground except for rail / road crossing where it shall be 8m above the rail top / road crest/ground. Further in bunker areas it shall be 8 m above the ground.</p>		
32.06.00	<p>Polysulphide Sealing Compound shall be two-part polysulphide sealant and shall be from approved manufacturer, conforming to IS : 12118. Materials shall consist of polysulphide polymer and a curing agent. Gun grade material shall be used unless</p>		
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	<p>otherwise specified. The application of the sealant shall be strictly followed as per manufacturer's guidelines.</p> <p>33.00.00 SHOTCRETING</p> <p>33.01.00 General Requirements</p> <p>33.01.01 Generally, shotcreting shall be done in accordance with IS : 9012.</p> <p>33.01.02 Reinforcement for shotcreting shall be as detailed below, unless specified otherwise.</p> <p>Reinforcement in one direction consisting of 6 mm M. S. bars at 750 mm c / c shall be connected to the lugs for fastening of the wire fabric. This shall be used in case of 50 mm or above thick shotcreting.</p> <p>33.01.03 Wire fabric conforming to IS : 1566 shall be used as reinforcement and shall consist of wire, 3 mm diameter, spaced 50 mm both ways and shall be electrically cross welded. Wire fabric shall be securely tied to 6 mm bars for 50 mm thickness. Adjacent sheet of wire fabric shall be lapped at least 100 mm and tied.</p> <p>33.01.04 Clear cover to reinforcement mesh shall not be less than 15 mm.</p> <p>33.01.05 Minimum thickness of shotcreting shall be 50 mm. for abrasion resistant work and 25 mm for ordinary surface protection work.</p> <p>33.02.00 Material</p> <p>Generally, the materials shall be in accordance with aggregates specification given hereunder.</p> <p>33.02.01 Fine aggregate shall consist of natural sand or crushed stone from a known source and shall be strong, hard, coarse, sharp, chemically inert, clean and free from any coating. It shall be free from clay, coal or coal residue, organic or any other impurities that may impair the strength or durability of the concrete and shall conform to IS : 383.</p> <p>33.02.02 Fine aggregate (Sand) shall be well graded and particles shall range in size within the following limits. The Engineer, may approved the use of any other grading as per requirement or as per IS : 9012.</p> <p>33.02.03 The fineness modulus shall be preferably between 2.5 and 3.3. Any other value can be used, with prior approval of the Engineer.</p> <p>33.03.00 Application</p> <p>33.03.01 After the placement of reinforcement and / or welded mesh and not more than six hours prior to the application of shotcrete, the surface shall be thoroughly cleaned of all loose materials and dirt. The Contractor shall properly prepare the surfaces, reinforcement and / or welded mesh to receive the shotcrete. Cleaned surfaces shall be wetted not more than hour prior to shotcreting.</p>		
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33.03.02	<p>The mix as placed on surface shall be one part cement to three parts approved sand by mass. Cement and sand shall be dry mixed; not water shall be added after mixing and before using in the gun. The quantity of water when added shall be only that which is sufficient to hydrate the cement. For average atmospheric conditions, the water cement ratio for shotcrete in place shall be between 0.35 and 0.5 by mass. Suitable admixture shall be used wherever required.</p>		
33.03.03	<p>A uniform pressure of not less than 3 Kg/cm² at the nozzle shall be maintained. Necessary adjustments shall be made to ensure this pressure, taking into account the length of hose and height of the place to be shotcreted, above location of the machine.</p>		
33.03.04	<p>The application shall proceed in an upward direction. Beams, stiffeners and intermediate walls, if any, shall be wrapped with wire fabric and completely covered with shotcreting. All rebound shall be removed from the area of application as the work progresses and such rebound material shall not be reused.</p>		
33.03.05	<p>As soon as the freshly shotcreted surface shows the first dry patches, a fine spray of water shall be applied to keep too moist. After the surface has hardened, it shall be kept continuously moist for minimum seven days. If there is extreme heat, especially when accompanied by hot winds, the shotcreted surface, immediately upon completion, shall be covered with burlap or similar covering, which must be kept continuously moist for 14 days after shotcreting. The temperature of the lining shall not be permitted to exceed 38°C during placing of concrete.</p>		
34.00.00	<p>VIBRATION ISOLATION SYSTEM</p> <p>These specifications are meant for the design, supply and erection of vibration isolation system for supporting crushers.</p>		
34.01.00	<p>Supporting Arrangement</p>		
34.01.01	<p>For Crushers:</p> <p>The crushers shall be supported on vibration isolation system consisting of steel helical springs and viscous dampers. The supporting arrangement for each crusher shall consist of an R. C. C. deck supported on steel helical spring units and viscous damper units which in turn shall be supported on girders. The girders shall be an integral part of the crusher house building.</p> <p>The part of the structure consisting of the R. C. C. deck, springs and viscous dampers shall hitherto be referred to as “spring supported foundation”. The part of the structure, which is below the spring shall hitherto be called “supporting structure”.</p>		
34.01.02	<p>The Contractor should do the Engineering / design, supply and erection of vibration isolation system consisting of steel helical spring units and viscous dampers supporting the top deck which in turn would support the crushers. The vibrations isolation system supplied shall be of a proven make. The Contractor or his sub - contractor who designs and supplies the system should have designed, supplied and installed such systems for not less than five machines of speeds and unbalance</p>		
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<p>34.02.00</p> <p>34.02.01</p>	<p>forces comparable to the machine proposed by the vendor. The vibration isolation systems installed by the contractor or his sub - contractor in such machines should have been working satisfactorily for at least five years.</p> <p>Scope of Work</p> <p>Scope of work shall include the following :</p> <p>(a.) Engineering</p> <p>(1.) Design of the vibration isolation system using steel helical springs and viscous dampers to support an R. C. C. top deck supporting the equipment. This includes the static and dynamic analysis of the vibration isolation system with the R. C. C. top deck and the equipment.</p> <p>(2.) Structural design of the R. C. C. top deck including preparation of General Arrangement drawings, detailed reinforcement drawings, bar - bending schedules etc.</p> <p>(3.) Calculation of loads on the structure supporting the springs and viscous dampers, their points of application and the stiffness requirements of the supporting structure.</p> <p>(4.) Drawings showing embedments and their locations and details on the R. C. C. top deck.</p> <p>(5.) Drawings showing blockouts, recesses etc. on the top deck.</p> <p>(6.) Design of the supporting structure, including preparation of detailed drawings and bill of materials.</p> <p>(b.) Supply including packing and transportation to site</p> <p>(1.) Steel helical spring units and viscous dampers, including associated auxiliaries for installation of the spring units and dampers like steel shims, adhesive pads etc.</p> <p>(2.) Frame (s) for pre-stressing of spring elements.</p> <p>(3.) Suitable hydraulic jacks system including electric pumps, high pressure tubes etc. required for the installation, alignment etc. of the spring units, two extra hydraulic jacks, one hand operated pump and spares for the hydraulic jack system as required.</p> <p>(c.) Erection and Commissioning</p> <p>(1.) Complete erection and commissioning of the vibration isolation system including :</p>		
<p>NCTPP DADRI ST—II(2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6130/0330-109-9</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 57 OF 67</p>


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	<p>(2.) Pre-stressing of spring elements, placing of spring elements in position, checking clearances on the shuttering of the R. C. C. top deck, construction of the supporting structure and the R. C. C. top deck, releasing to pre-stress in spring elements and making final adjustments and alignments after machine installation etc.</p> <p>(3.) The scope of work shall be deemed to include all activities which may not have been explicitly mentioned but are reasonably implied for the successful completion of the work for which these specifications are intended.</p> <p>(4.) This part of the specifications is for vibration isolation system. For the construction of the supporting structure for the crusher and the top deck, the relevant parts of the specification should be referred to.</p> <p>(d.) Documentation</p> <p>(1.) Submission of detailed design calculation, analysis (static and dynamic) and drawings for Employer's acceptance and approval.</p> <p>(2.) Furnishing methodology of providing shuttering and its removal as well as concreting of deck slab, installation of springs and dampers and the sequence of operation.</p> <p>(3.) Furnishing installation and maintenance manual indicating equipment, procedure etc., necessary for installation, maintenance of vibration isolation system.</p> <p>(4.) Furnishing a check list for confirming the readiness of the civil fronts for the installation of vibration isolation system and equipment required at each stage installation.</p> <p>(5.) Bill of materials of various elements such as springs, visco-dampers, with their rating, stiffness etc., included in supply.</p> <p>(6.) Detailed specifications of the vibration isolation system and various items included in the supply and the standard (local or international) to which they conform.</p> <p>(7.) Proposed erection strategy of the entire system.</p> <p>34.03.00 Design Requirements for Crusher Foundation</p> <p>34.03.01 Dynamic Analysis</p> <p>Detailed dynamic analysis shall be done for the top deck together with springs and dampers and the natural frequencies and amplitudes of vibration shall be determined. A mathematical model of the top deck shall be formulated with three - dimensional beam / plate finite elements for the purpose of analysis with the spring idealised with vertical and horizontal stiffnesses. The mass of the machine together with that of the top deck shall be considered for the analysis.</p>		
<p>NCTPP DADRI ST-II(2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6130/0330-109-9</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 58 OF 67</p>


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	<p>Natural frequencies upto at least 10 % above the operating speed shall be determined and these frequencies shall be checked against the design criteria.</p> <p>Forced response dynamic analysis shall be carried out for the operating condition unbalance forces using a sinusoidal forcing function. Unbalance forces as given by this specifications shall be used for his purpose. The amplitudes shall be checked against the design criteria. The dynamic forces from this analysis shall be used for structural design with a suitable fatigue factor.</p> <p>34.03.02 Isolation Efficiency</p> <p>The vibration isolation system shall be designed for about 90 % isolation efficiency.</p> <p>34.03.03 De-coupling</p> <p>A ratio of the least 10 (ten) shall be ensured between the stiffness of the supporting structure and the stiffness of the spring system in the vertical direction to achieve de-coupling between the two (the stiffness of the spring system being lower). This ensures that dynamic analysis of the supporting structure need not be carried out.</p> <p>34.03.04 Frequency Criteria</p> <p>The frequency criterion has already been laid down implicitly by the isolation efficiency criteria and de-coupling required.</p> <p>The first bending mode frequency of the top deck shall be at least 20 % above the operating speed.</p> <p>34.03.05 Unbalance Forces for Crushers</p> <p>Unbalance forces arising out of all the following cases shall be considered for checking the design and amplitudes.</p> <p>(a.) Balance quality grade Q 40 as per VDI 2060 - 1966.</p> <p>(b.) One hammer broken condition. The missing hammer shall be assumed to be closest to the crusher non - drive end of the crusher.</p> <p>(c.) Three hammers broken condition. All the three hammers broken shall be assumed to be from the same suspension bar and located at the non - drive end of the crusher.</p> <p>34.03.06 Amplitude Criteria for Crushers</p> <p>The calculated amplitudes (mean to peak values) shall not exceed following limits under the specified conditions.</p> <p>1) Operating speed of 750 RPM</p>		
<p>NCTPP DADRI ST-II(2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6130/0330-109-9</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 59 OF 67</p>


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	<p>(a.) 150 microns for an unbalance force arising out of balance quality grade Q 40 as per VDI 2060 - 1966.</p> <p>(b.) 300 microns in case of a one hammer broken condition.</p> <p>(c.) Amplitudes need not be checked for a three hammer broken condition.</p> <p>2) Operating speed of 450 RPM</p> <p>(a.) 200 microns for an imbalance force arising out of balance quality grade Q-40 as per VDI -2060-1966.</p> <p>(b.) 400 microns in case of a one hammers broken condition.</p> <p>(c.) Amplitude need not be checked for a three hammer broken condition.</p> <p>For intermediate operating speed between 450 to 750 RPM the amplitude limits can be linearly interpolated.</p> <p>The amplitude limits mentioned above are in both vertical and horizontal directions. The amplitudes shall be calculated at critical points on the top surface of the R. C. C. deck. The amplitudes shall be checked for the most unfavorable superposition of modes in any direction. However, phase difference between the maximum amplitude occurring in different directions due to the rotating vector may be considered while superimposing the modes.</p> <p>34.03.07 Unbalance force and Amplitude Criteria</p> <p>The unbalance forces and amplitude criteria shall be as per the equipment manufacturer's recommendations or as per VDI 2060/ VDI 2056, whichever is more stringent.</p> <p>34.03.08 Transient Resonance</p> <p>Transient resonance, which may occur during the start - up or coasting down condition of the crusher, shall be checked, and the amplitudes in such a condition should not exceed one - and - half times those at operating speed for each design condition.</p> <p>34.04.00 Strength Criteria</p> <p>The following criteria shall apply for the design of top deck :</p> <p>(a.) Dead loads, live loads, Seismic loads and dynamic loads shall be considered for the design. The most unfavorable combination shall considered for design.</p>		
<p>NCTPP DADRI ST-II(2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6130/0330-109-9</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 60 OF 67</p>


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	<p>(b.) Seismic loads shall be assumed to act together with dynamic loads for a one millimeter eccentricity in the rotor. However, seismic loads and dynamic loads arising out of hammer breakage need not be considered together</p> <p>(c.) Fatigue shall be considered while designing for dynamic forces. A fatigue factor of 2.0 shall be used on all dynamic forces to arrive at the equivalent static force for the purpose of design.</p> <p>(d.) Working stress method shall be used for the design of R. C. C. deck. In survival condition, 10 % overstressing may be permitted.</p> <p>(e.) The R. C. C. top deck shall be at least of M35 grade of concrete as per IS : 456.</p> <p>(f.) Fatigue need not be considered for the three hammer broken condition.</p> <p>(g.) For calculating unbalance forces, the heaviest hammer (plain or toothed) shall be considered.</p> <p>34.05.00 Approval of Designs and Drawings</p> <p>All design calculation, drawings and documents shall be in English. All design calculations and drawings shall be submitted to Employer for approval. However, approval of such designs and drawings shall not relieve the contractor of his responsibility regarding the adequacy of the foundation to carry the design forces.</p> <p>34.06.00 Standards</p> <p>Latest revisions of the following Codes shall be used for the design of the crusher foundations.</p> <p>(a.) IS : 456 Code of Practice for Plain and Reinforced concrete.</p> <p>(b.) IS : 2974 (Part IV) Code of Practice for Design and Construction of Machine Foundations (Part IV) for rotary type machine of low frequency.</p> <p>(c.) IS : 1893 (Criteria for Earthquake Resistant Design of Structures).</p> <p>(d.) DIN 4024 Machine Foundations : Flexible supporting structures for machines with rotating masses.</p> <p>(e.) DIN 2089 Helical Compression Springs out of round wire and rod; calculation and Design.</p>		
<p>NCTPP DADRI ST—II(2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6130/0330-109-9</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 61 OF 67</p>


CLAUSE NO.	TECHNICAL REQUIREMENTS			
<p>35.00.00</p> <p>36.00.00</p> <p>37.00.00</p> <p>38.00.00</p> <p>39.00.00</p> <p>39.01.00</p>	<p>(f.) DIN 2096</p> <p>Helical Compression Springs out of round wire and rod; quality requirements for hot formed compression springs.</p>	<p>(g.) VDI 2056 - Criteria for assessing mechanical vibrations of machines.</p>	<p>(h.) VDI 2060 - Criteria for assessing the state of balance of rotating rigid bodies not be permitted to exceed 38°C during placing and curing</p>	
	<p>Packaging and Transportation.</p>			
	<p>All the equipment shall be suitably protected coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials the limitations from the point of view of availability of railway wagon sizes in India should be taken into account. The contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing.</p>			
	<p>Plant Life</p>			
	<p>The plant shall be designed for a minimum operating life of 30 years under the conditions of operation. Assurance shall be given that plant components are adequate for this lifetime. If there are any exceptional items of the plant on which an assurance of meeting this clause cannot be given, life of such components and the difficulties associated with them shall be stated.</p>			
	<p>PTFE (Poly Tetra Fluoroethylene) Bearing</p>			
<p>The bearing shall be of reputed make and manufacturer as approved by the Engineer, for required vertical load and end displacement/rotation. PTFE bearing shall be sliding against highly polished stainless steel and the coefficient of friction between them shall be less than 0.06 at 55 kg/sq.cm. In order to prevent cold flow in PTFE surface it shall be rigidly bonded by a special high temperature resistance adhesive to the stainless steel substrata. The stainless steel surface that slides against the PTFE is mirror polished. The stainless steel shall be bonded to the top plate by special high strength adhesive. The thickness of stainless steel plate shall be between 1.0 mm to 1.5 mm.</p>				
<p>TESTS FOR MATERIAL / WORKMANSHIP</p>				
<p>All tests required for all materials, quality of workmanship or any other tests as desired by the Engineer shall be at contractor's cost.</p>				
<p>MATERIALS</p>				
<p>For Civil, Structural and Architectural works</p>				
<p>Employer will not supply any material. All materials including cement, reinforcement steel and structural steel, whatsoever required for execution and completion of the entire scope of work covered under this specification shall be arranged by the</p>				
<p>NCTPP DADRI ST-II(2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6130/0330-109-9</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 62 OF 67</p>	

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	<p>contractor at his own cost. All materials procured by the contractor shall meet the quality requirements specified in this specification.</p> <p>The contractor shall keep sufficient stock of cement and steel at site at any point of time when the work is in progress excluding what has been already incorporated in the works, so that any disruption / delay in availability of these materials during procurement will not affect the progress of work at site. The minimum quantity of such materials in stock at site shall not be less than the Requirement of one (1) month in case of Cement and Requirement of two (2) Consecutive months in case of Steel.</p> <p>39.02.00 Structural steel</p> <p>Structural Steel (including embedded Steel) shall be straight, sound, free from twists, cracks, flaw, laminations and all other defects. Structural steel shall comprise of mild steel, medium strength steel and high tensile steel as specified below.</p> <p>39.02.01 Mild Steel</p> <p>a) Rolled sections shall be of grade designation E250, Quality A/BR, Semi-killed/ killed conforming to IS 2062. All steel plates shall be of Grade designation E250, Quality BR (fully killed), conforming to IS 2062 and shall be tested for impact resistance at room temperature. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2.</p> <p>b) Pipes shall conform to IS 1161.</p> <p>c) Hollow (square and rectangular) steel sections shall be hot formed conforming to IS: 4923 and shall be of minimum Grade Yst 240.</p> <p>d) Chequered plate shall conform to IS 3502 and shall be minimum 6 mm thick excluding projection. Steel for chequered plate shall conform to grade E250A semi killed of IS: 2062 or equivalent grade conforming to ASTM & BS standards only.</p> <p>39.02.02 Medium and High Tensile Steel</p> <p>Rolled Sections and plates shall be of grade designation E350 or higher, Quality B0 (Fully killed), conforming to IS 2062. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2.</p> <p>39.03.00 Fly ash based portland pozzolana cement conforming to IS:1489 (Part-1) shall be used for all areas other than for the critical structures identified below. Other properties shall be as per IS code.</p> <p>Ordinary Portland Cement (OPC) shall necessarily be used for the following structures.</p> <p>a) Spring supported decks of limestone crusher</p> <p>b) RCC for Chimney shell.</p> <p>The grade of cement shall be Grade 43 for OPC conforming to IS:8112.</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
<p>39.04.00</p> <p>39.05.00</p>	<p>In place of fly ash based portland pozzolana cement, OPC mixed with Fly Ash can be used. Batching plant shall have facility for mixing fly ash. Fly ash shall conform to IS:3812(Part I & Part II). Percentage of fly ash to be mixed in concrete shall be based on trial mix. Mix design shall be done with varying percentage of fly ash mix with cement.</p> <p>Reinforcement steel shall conform to:</p> <p>a) Mild steel bars of grade I of IS: 432 Part – I or grade A of IS: 2062.</p> <p>b) High yield strength deformed TMT steel bars of grade Fe-500 having minimum elongation of 14.5 % or Fe-500D, and conforming to other requirements of IS 1786.</p> <p>Aggregates</p> <p>a) Coarse Aggregate</p> <p>Coarse aggregate for concrete shall be crushed stones chemically inert, hard, strong, durable against weathering of limited porosity and free from deleterious materials. It shall be properly graded. It shall meet the requirements of IS: 383.</p> <p>b) Fine Aggregate</p> <p>Fine aggregate shall be hard, durable, clean and free from adherent coatings of organic matter and clay balls or pellets. Fine aggregate in concrete shall conform to IS : 383. For plaster, it shall conform to IS : 1542 and for masonry work to IS : 2116.</p> <p>c) Petrographic examination of aggregate shall be carried out by the contractor at National Council for Cement and Building Materials (NCB), Ballabgarh, or any other approved laboratory to ascertain the structure and rock type including presence of strained quartz and other reactive minerals. In case, the coarse aggregate sample is of composite nature, the proportions (by weight) of different rock types in the composite sample and petrographic evaluation of each rock should also be ascertained. While determining the rock type, special emphasis should be given on identification of known reactive rocks like chalcedony, opal etc. The procedure laid down in IS 2430 for sampling of aggregates may be followed.</p> <p>The laboratory shall determine potential reactivity of the aggregate, which may lead to reaction of silica in aggregate with the alkalis of cement and / or potential of some aggregates like limestone to cause residual expansion due to repeated temperature cycle. If the same is established, the contractor shall further carry out alkali aggregates reactivity test as per IS 2386 (Pt.VII) and / or repeated temperature cycle test to establish the suitability of the aggregates for the concrete work. The test results, with the final recommendations of the laboratory, as to a suitability of the aggregate, for use in the concrete work for various structures and suggested measures, in case of results are not satisfactory, shall be submitted to the Engineer for his review, in a report form.</p> <p>In case in the report, it is established, that the aggregates contain reactive silica, which would react with alkalis of the cement, the contractor shall change the source of supply of the aggregate or use low alkali cement as per</p>	<p>NCTPP DADRI ST-II(2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6130/0330-109-9</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 64 OF 67</p>

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40.00.00	<p>recommendation or take measures as recommended in the report as instructed by Engineer.</p> <p>In case aggregates indicate residual expansion, under repeated temperature cycle test (from 10° Celsius to 65° Celsius and for 60 temperature cycles) the material shall not be used for concreting of Lime stone crusher decks, Mills, Fans and other equipment foundations which are likely to be subjected to repeated temperature cycle. The contractor shall use aggregates free from residual expansion under repeated temperatures cycle test.</p> <p>CODES AND STANDARDS</p> <p>All standards, specifications, acts and code of practice referred to herein shall be the latest editions including all applicable official amendments and revisions. Other Indian, foreign Codes and Standards not listed here but referred to elsewhere within this specification shall also be deemed to be part of this list.</p> <p>In case of conflict between this specification and those (IS standards, codes etc.) referred to herein, the former shall prevail.</p> <p>Some of the relevant Indian standards, Acts and Codes applicable to this section of the specification are listed below</p> <table border="0"> <tr> <td>IS : 383</td> <td>Specification for coarse and fine aggregates from natural sources for Concrete.</td> </tr> <tr> <td>IS : 432</td> <td>Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.</td> </tr> <tr> <td>IS : 456</td> <td>Code of practice for plain and reinforced concrete.</td> </tr> <tr> <td>IS : 458</td> <td>Specification for concrete pipes.</td> </tr> <tr> <td>IS : 516</td> <td>Method of test for strength of concrete.</td> </tr> <tr> <td>IS : 800</td> <td>Code of practice for use of structural steel in general building construction.</td> </tr> <tr> <td>IS : 814</td> <td>Specification for covered electrodes for metal arc welding for weld steel.</td> </tr> <tr> <td>IS : 816</td> <td>Code of practice for use of metal arc welding for general construction.</td> </tr> <tr> <td>IS : 817</td> <td>Code of practice for training and testing of metal arc welders.</td> </tr> <tr> <td>IS : 875 (Pt. I to V)</td> <td>Code of practice for design loads other than earthquake) for buildings and structures.</td> </tr> </table>			IS : 383	Specification for coarse and fine aggregates from natural sources for Concrete.	IS : 432	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.	IS : 456	Code of practice for plain and reinforced concrete.	IS : 458	Specification for concrete pipes.	IS : 516	Method of test for strength of concrete.	IS : 800	Code of practice for use of structural steel in general building construction.	IS : 814	Specification for covered electrodes for metal arc welding for weld steel.	IS : 816	Code of practice for use of metal arc welding for general construction.	IS : 817	Code of practice for training and testing of metal arc welders.	IS : 875 (Pt. I to V)	Code of practice for design loads other than earthquake) for buildings and structures.	
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	<p>IS : 1038</p> <p>IS : 1172</p> <p>IS : 1361</p> <p>IS : 1786</p> <p>IS : 1892</p> <p>IS : 1893</p> <p>IS : 1904</p> <p>IS : 1905</p> <p>IS : 1948</p> <p>IS : 2062</p> <p>IS : 2131</p> <p>IS : 2212</p> <p>IS : 2645</p> <p>IS:2720 (Part-II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL)</p> <p>IS : 2911</p> <p>(Part-1/Sec.1)</p> <p>(Part-1/Sec.2)</p> <p>(Part-IV)</p> <p>IS : 2974 (Part - I TO V)</p> <p>IS : 3370 (Part I to IV)</p> <p>IS : 3658</p> <p>IS : 3664</p>	<p>Steel doors, windows and ventilators.</p> <p>Basic requirements for water supply, drainage and sanitation.</p> <p>Steel windows for industrial buildings.</p> <p>Specification for high strength deformed steel bars and wires for concrete reinforcement.</p> <p>Code of practice for subsurface investigation for foundation.</p> <p>Criteria for earthquake resistant design of structures.</p> <p>Code of practice for design and construction of foundations in soils; general requirements.</p> <p>Code of practice for structural safety of buildings - Masonry walls.</p> <p>Specification for aluminium doors, windows and ventilators.</p> <p>Steel for general structural purposes.</p> <p>Method of standard penetration test for soils.</p> <p>Code of practice for brickwork.</p> <p>Specification for Integral cement water proofing compounds.</p> <p>Methods of test for soils - determination for water content etc code of practice for earth work on canals.</p> <p>Code of practice for design and construction of pile foundations.</p> <p>Driven cast in situ concrete piles.</p> <p>Bored cast-in-situ concrete piles.</p> <p>Load test on piles.</p> <p>Code of practice for design and construction of machine foundations.</p> <p>Code of practice for concrete structures for the storage of liquids.</p> <p>Code of practice for liquid penetrant flaw detection.</p> <p>Code of practice for ultra sonic testing by pulse echo</p>	
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	<p>method.</p> <p>IS : 4326 Code of practice for earthquake resistant design and construction of buildings.</p> <p>IS : 4990 Specification for plywood for concrete shuttering work.</p> <p>IS : 5624 Specification for foundation bolts.</p> <p>IS : 7215 Tolerances for fabrication steel structures.</p> <p>IS : 8112 Specification for 43 grade Ordinary Portland Cement.</p> <p>IS : 9103 Specification for admixtures for concrete.</p> <p>IS : 9595 Code of procedure of manual metal arc welding of mild steel.</p> <p>IS : 10262 Recommended guidelines for concrete mix design.</p> <p>IS : 13311 Method of non - destructive testing of concrete.</p> <p>IS : 13755 Dust pressed ceramic tiles with water absorption of 3%, E6% (Group B11a)</p> <p>ASTM 898 -89 Standard guide for use of high solid content, cold liquid-applied elastomeric water proofing membrane for use with separate wearing course.</p> <p>AS/NZS 2728 Pre finished / pre painted sheet metal product for interior / exterior building applications – Performance requirements.</p> <p>AS : 1365 Standards for steel manufacturing.</p> <p>AS : 1397 A steel sheet & strip – hot – dipped-zinc-coated or Aluminium-Zinc coated.</p> <p>AS : 3566 Self drilling screws for building and construction industry.</p> <p>IRC : 37 Guidelines for the design of flexible pavements.</p> <p>- Manual on sewerage and sewage treatment (Published by CPH & EEO) As updated.</p> <p>Indian Explosives Act. 1940 as updated.</p> <p>For “Foundation System and Geotechnical Data” refer “Project Information section” of Technical specification.</p>		
<p>NCTPP DADRI ST—II(2X490MW) & IGSTPP, JHAJJAR (3X500MW) FLUE GAS DESULPHURISATION SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6130/0330-109-9</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 67 OF 67</p>

PART - B (DETAILED TECHNICAL SPECIFICATION)
SUB-SECTION- V-Q (QUALITY ASSURANCE)

(MECHANICAL)

SUB-SECTION-V-QM1

FLUE GAS DESULPHURISATION SYSTEM

1.00.0 FLUE GAS DESULPHURISATION SYSTEM**1.01.0 Mills:**

1.01.01 Raw material for shaft, coupling, gears and pinions, Mill Heads ,top and bottom races and other rotating components shall be subjected to UT & Base frame for MPI. MPI/LPI shall be carried out to check surface soundness.
Rubber wear lining of Mill Shell shall be checked for shore hardness.
For Central driven ball mill shall be run tested (without grinding media) for 30 min at shop to check unusual noise and vibration.

1.01.02 Butt welds in the tube/separator/body casing of the mill shall be tested by RT and MPI. All other welds in main tube/separator shall be tested by MPI/LPI for acceptance. The tube shall be statically balanced.

1.01.03 All gearboxes shall be run tested for adequate duration to check rise in oil temperature, noise level and vibration. Check for leak tightness of gear case also shall be performed.

1.02.0 Feeders:

1.02.01 Any welds in the casing/pulley fabrication shall be checked with MPI.

1.02.02 Routine tests shall be done as per relevant Indian Standards or equivalent International Standards.

1.02.03 All major items like plates for casing, head pulley, tail pulley, pulley shaft and major castings shall be procured with respective material test certificates.

1.02.04 Calibration check shall be carried out on all feeders.

1.03.0 Dampers:

1.03.01 All the dampers shall be subjected to operational test/checks.

1.03.02 Gas tight Dampers shall be subjected to shop leakage test to demonstrate the guaranteed tightness as per NTPC Tech Specification.


1.04.0 PIPING, VALVE AND SPECIALITIES:


1.04.01 All pipes and fittings shall be tested as per applicable code.


1.04.02 All valves shall be hydraulically/Air tested for body, seat and back-seat (if applicable) as per relevant standard.

1.04.03 NDT on valves shall be as per relevant standard.

1.04.04 Valves shall be offered for hydro test in unpainted conditions.

CLAUSE NO.	QUALITY ASSURANCE		
1.04.05	Functional checks of the valves for smooth opening and closing shall also be done.		
1.05.00	TANKS / VESSELS:		
1.05.01	Atmospheric tanks: <ol style="list-style-type: none"> i) All welds joints shall be DP tested and complete tanks shall be water fill tested. ii) All atmospheric storage tanks fabricated and erected at site shall be subjected to tests (water fill test, NDT and Vacuum box test) according to design code as applicable. iii) Rubber lining shall be tested for hardness and spark test, as applicable. 		
1.05.02	Pressure vessels: <ol style="list-style-type: none"> 1) NDT on weld joint shall be as per respective code requirements or the minimum as specified as below: <ol style="list-style-type: none"> i) 100% DPT on root run of butt weld, nozzle welds and finished fillet welds. ii) 10% DPT on all finished butt welds. iii) 10% RT (covering all 'T'/cross joints) of butt welds. 2) Butt welds of dished ends shall be stress relieved and subjected to 100% RT. 3) Each finished vessels shall be hydraulically tested to 150% of the design pressure for a duration of 30 minutes. 		
1.07.0	PUMPS:		
1.07.01	UT on shaft forgings (greater or equal to 40mm) and MPI/DPT shall be done on shafts and impeller to ensure freedom from defects.		
1.07.02	The pump casing shall be hydraulically tested at 200% of pump rated head or at 150% of shut off head, whichever is higher. The test pressure shall be maintained for at least half an hour.		
1.07.03	The pump rotating parts shall be subjected to static and dynamic balancing.		
1.07.04	All pumps shall be tested at shop for capacity, head efficiency and brake horse power at rated speed as per relevant/applicable standard.		
1.07.05	Noise and vibration shall be measured during the performance testing at shop.		
1.08.0	STRUCTURES , DUCTS, HOPPERS:		
1.08.01	All materials shall be tested for chemical and mechanical properties as per relevant standard. All plates above 40mm shall be 100% Ultrasonically tested.		
NCTPP DADRI ST-II (2x490MW) & IGSTPP,JHAJJAR(3x500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-6130/0330-109-9	SUB-SECTION – V-QM1 FGD System	Page 2 of 5

CLAUSE NO.	QUALITY ASSURANCE		
1.08.02	Visual inspection of all welds shall be performed in accordance with AWS D1.1.		
1.08.03	NDT requirements of structural steel welds shall be as under:		
	i)	100% RT/UT on butt-welds of plate thickness ≥ 32 mm.	
	ii)	For plates of $25\text{mm} \leq \text{thickness} < 32\text{mm}$ -10% RT and 100% MPI.	
	iii)	For plates of thickness $< 25\text{mm}$ -10% MPI/LPI.	
1.08.04	Edge for shop and field weld shall be examined by MPI for plate thickness ≥ 32 mm.		
1.09.0 VACUUM BELT FILTER SYSTEM:			
1.09.01	Impeller, casing and shaft of vacuum pumps shall be tested for chemical and mechanical properties as per relevant standard. All plates above 40mm shall be 100% Ultrasonically tested.		
1.09.02	UT on shaft (if greater or equal to 40mm) and impeller shall be carried out.		
1.09.03	All vacuum pumps shall be tested at shop for capacity, power, pressure, efficiency, noise and vibration etc.		
1.09.04	Filter cloths and belts shall be tested for physical properties as per relevant standard		
1.10.0 SPRAY NOZZLES:			
1.10.01	Spray nozzles shall be tested for physical properties		
1.10.02	Spray nozzles also shall be subjected to performance test.		
1.11.0 AGITATORS:			
1.11.01	Rubber lining shall be tested for hardness and spark test		
1.11.02	Impellers shall be tested for dimensional and balancing check		
1.11.03	Gear Boxes shall be tested for run test as per standard practice		
1.12.0 FANS:			
1.12.01	Rotor components shall be subjected to ultrasonic test at mill and magnetic particle inspection / liquid penetrant examination after rough machining.		
NCTPP DADRI ST-II (2x490MW) & IGSTPP, JHAJJAR (3x500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6130/0330-109-9	SUB-SECTION – V-QM1 FGD System	Page 3 of 5

CLAUSE NO.	QUALITY ASSURANCE		
1.12.02	Butt welds in rotor components shall be subjected to 100% RT and all welds shall be magnetic particle/dye penetrant tested after stress relieving.		
1.12.03	All rotating components and assemblies of fan shall be balanced dynamically		
1.12.04	Performance test shall be carried out on fans as per Technical specification/ Relevant standard.		
1.12.05	Test for Natural Frequency and hardness of Fans blades shall be carried out as per Technical specification/ Relevant standard		
1.13.0	Thermal Insulation, Lagging & Cladding: (a) Lightly resin bonded mineral wool: LRB mattresses/sections of Rockwool/ Glasswool shall conform to & tested as per relevant clauses of Indian Standards and shall meet the requirements of NTPC data sheet. Type tests except Thermal Conductivity shall be regularly carried out once in three months, Thermal Conductivity Type Test shall be carried out minimum once in twelve months by the manufacturer. Requirements of various components like Binding wires, Lacing wires, Wire mesh, etc. shall be as per NTPC approved data sheet / as given in respective Sub-Section of Technical Requirements of Steam Generator & Auxiliaries. (b) Lagging & Cladding: All insulation shall be protected by means of an outer covering of Aluminium sheeting conforming to ASTM B-209-1060 temper H14 from reputed manufacturer meeting the requirements of NTPC data sheet.		
1.14.0	Oxidation Blower <ul style="list-style-type: none"> • Physical and chemical property of the shaft, gears, impeller to be checked. • Rotor assembly to be dynamically balanced. • Performance test of the blower to be carried out at shop. • Vibration, noise, bearing temperature check, visual and dimensional check of the blower. 		
1.15.0	Rubber and Flake Lining at Site: <ul style="list-style-type: none"> • The surface shall be properly blast cleaned to the Standard SA 2 ½ or better / Technical specification. • Check DFT or thickness of coating and perform adhesion test. • Perform Spark test shall be carried. • Necessary field checked shall be carried out as per NTPC Tech specification/ relevant procedure. 		
NCTPP DADRI ST-II (2x490MW) & IGSTPP, JHAJJAR (3x500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-6130/0330-109-9	SUB-SECTION – V-QM1 FGD System	Page 4 of 5

1.16.0 ~~Rubber Lining of Pipe :~~

The lining shall be checked for adhesion test , Shore hardness, thickness of coating etc. Spark test. Sample rubber compound shall be tested for Tensile, Elongation, Resistance to Bleeding.

1.17.0 OTHER CRITICAL EQUIPMENTS:

Checks/ NDTs shall be done as per relevant Indian Standards or equivalent International Standards.

1.18.0 TC of Absorber lining material as per Tech Spec to be submitted & 100% DPT of all weld joint to be carried out

SUB-SECTION-V-QM2

LIME & GYPSUM HANDLING

Limestone & Gypsum Handling

1.01.00 Brakes and Clamps :

1.01.01 Final testing of brakes shall include load, HV/IR & heat run tests.

1.02.00 Monorails and Hoists

1.02.01 All electric hoist shall be tested as per IS 3938 and chain pulley block shall be tested as per IS 3832.

1.03.00 Hoppers & Liners

1.03.01 Rack & Pinion Gates/Flap Gates/Rod Gates

- a) MPI/DP test shall be conducted on rack and pinion / rod / weld joint
- b) Functional checks on the gates shall be carried out along with respective actuator, if applicable.

1.04.00 Storage Silo and Bag Filter

1.04.01 All material shall be tested for Chemical & Mechanical properties as per relevant standard. MPI/DP test on welding shall be carried out. Fit up assembly checks shall be carried out at shop for all despatchable segments

1.04.02 Bag Filters: Leakage test shall be carried out for pressure parts. Pulsing and sequential test on bag filter shall be done.

1.05.00 Belt Conveyor System

The details of the checks to be carried out in the various equipments are to be submitted by the Contractor for Owner's approval. However, some indicative checks on different items are given below which should necessarily form a part of the Quality Assurance Plan to be agreed with the Owner.

1.05.01 Idlers

- a) Check for run out and free movement shall be carried out on idlers. Run out shall be restricted as per IS:8598
- b) Test for dust proofness, water proofness and dynamic friction factor of the Idlers shall be conducted at shop. The detailed procedures for the same shall be submitted for review and approval.

1.05.02 Belting

- (a) Rubber cover of finished belt shall be checked for tensile strength and elongation at break before and after ageing. Rubber cover shall also be checked for abrasion, tear strength and hardness.
- (b) For finished belts, checks for elongation at 10% nominal tensile strength, tensile and elongation at break in longitudinal (warp) direction and tensile in transverse (weft) direction shall be carried out.
- (c) Adhesion test between ply to ply and cover to ply shall be carried out.
- (d) Troughability test and Test for fire resistance shall be carried out.
- (e) Test for procedure qualification for belt vulcanizing joint (at site) shall be done. Procedure for belt vulcanizing joint shall be discussed and finalized during FQP finalization.
- (f) There will be a limitation on the no. of repairs allowed on the belts. Following will be the acceptance norm for the cover repairs.
- i) The maximum size of a repair shall be limited to a size equivalent to one fifth the belt width. No single dimension shall exceed one fifth(1/5) of belt width.
 - ii) Small local repair by dough filling of size 25mm x 25mm to a limited extent shall not be counted of repairs. However, in case of cluster of repairs, same shall be counted as a patch repair.
 - iii) The maximum number of patch repair shall not exceed 5 per 100 mts. However, the total number of patch and dough filling repairs shall not exceed 10 per 100 meters.
- (g) In addition to above, Steel Cord belt shall also be tested for following.
- i. Cord dia and breaking strength
 - ii. Finished belt shall be tested for cord pull-out strength before and after ageing, peeling resistance.
 - iii. Dynamic cord pull out test
 - iv. Cord dia, pitch and number of cords
- (h) In no case shall the cover thickness or the width of belt be less than that given in specification.
- (i) For testing purpose, belt sample shall be taken from anywhere of the belt roll length offered

1.05.03 Belt Vulcanizing Machine

- a) Check for tensile strength shall be carried out on a sample vulcanized belt joint for each type of belt in shop. However if such test has been done earlier, the report for same shall be submitted for verification.
- b) Complete assembly shall be tested at shop for temp. and pressure developed

1.05.04 Pulleys

- a) In addition to chemical, mechanical, hardness, microstructure as per applicable material specification, pulleys shaft forgings shall be subjected to ultrasonic testing.
- b) 100% MPI/DPT on all welds shall be conducted and 10% RT/UT on butt welds shall be conducted.
- c) Static balancing of pulleys shall be carried out after rubber lagging.
- d) Checks on rubber lagging to include abrasion loss, shore hardness test, peel-off strength test and physical properties. Peel-off strength shall be 10 Kg/Cm, Abrasion loss shall be less than 250 cubic mm when tested as per DIN 53516.

1.05.05 Pull Chord & Belt Sway Switches

- a. Acceptance tests
 - i) Over all dimension and functional test.
 - ii) HV & IR test
 - iii) Degree of protection test report.

1.05.06 Zero Speed Switch, Under Belt Switch and Chute Blockage Switch

- a Acceptance test
 - i) Burn in test at 50 degree C for 48 hours shall be done for electronic switches.
 - ii) Over all dimension and functional test shall be carried out.
 - iii) HV & IR
 - iv) Degree of protection test

1.06.00 Drive Equipments**1.06.01 Gear Boxes:**

- (a) In addition to checks for physical, chemical, hardness, microstructure as per relevant standard, the shaft and gear/pinion forgings shall be subjected to ultrasonic testing .
- (b) MPI to be carried out on Gears/Pinions after machining. Case depth, hardness and MPI after hardfacing shall be checked to ensure freedom from defects.
- (c) Gear reducer shall be checked for reduction ratio, backlash and contact pattern. No load shop trial run to be conducted on gear boxes to check for oil leakage, temperature rise, noise level and vibration.

1.06.02 Flexible Coupling

- (a) Ultrasonic testing shall be conducted on forgings for gear sleeve and gear hub, if gear coupling is provided.
- (b) MPI shall be carried out after machining to ensure freedom from cracks.


1.06.03 Fluid Coupling

- (a) Dynamic balancing shall be carried out for the rotating parts.
- (b) Check for leak tightness of the coupling shall be carried out.
- (c) Functional test on fusible plug for each type of coupling shall be conducted at shop.
- (d) All couplings to be run tested at shop on no load
- (e) Check for temperature rise, torque-speed, torque-slip characteristics and over speed test shall be included during performance test of one coupling of each type preferably at full load.

1.07.00 Belt Scales

The details of the checks to be carried out in the various equipments are to be submitted by the Contractor for Employer's approval. However, some indicative checks are given below which should necessarily form a part of the quality assurance plan to be agreed with the Employer.

- 1.07.01 Mounting arrangement/Overall dimensional check shall be carried out on the Belt Scales.

CLAUSE NO.	QUALITY ASSURANCE		
1.07.02	Belt scale shall be calibrated with test weight/test chain in static at works and with test weight for dynamic condition at site.		
1.07.03	All electronic modules shall be subjected to burn in test at 50 Degree C for 48 hours.		
1.07.04	General check for load cell shall be carried out.		
1.07.05	Test report for degree of protection on enclosure shall be furnished.		
1.07.06	Accuracy/performance check shall be demonstrated at site.		
1.08.00	<p>Dust Control & Miscellaneous Systems (Dust Suppression & Dry Fog Dust Suppression System)</p> <p>The details of the checks to be carried out on the various equipments are to be submitted by the Contractor for Owners approval. However some indicative checks on different items are given below which should necessarily form a part of the Quality Assurance Plan to be agreed with by the Owner.</p>		
1.08.01	<p>Pumps</p> <p>(a) All materials should be of tested quality and test certificates to be provided.</p> <p>(b) DPT of machined shaft and impeller shall be done.</p> <p>(c) Shaft forgings to be also subjected to ultrasonic testing.</p> <p>(d) Impellers to be dynamically balanced to ISO 1940 Gr.6.3</p> <p>(e) All pressure parts shall be hydraulically tested at 150% of the shut-off head or 200% of rated head, whichever is higher for 30 minutes. No leakage is allowed.</p> <p>(f) All pumps to be performance tested as per Hydraulic Institute Standard/Indian Standard. Performance test to include check for noise, vibration level and temperature rise.</p>		
1.08.02	<p>Valves & Specialities</p> <p>(a) Valves and Specialities shall be tested as per relevant standards / codes.</p> <p>(b) Seat Leakage and hydraulic test to be carried out as per relevant standards / codes.</p>		
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1.08.03 Pipes and Fittings


Pipes and fittings shall be tested as per relevant standards/ codes

1.08.04 Air Compressor

- a) All pressure parts shall be hydraulically tested at not less than 150% of design pressure for a duration of 30 minutes prior to painting.
- b) All other parts including inter-connecting piping shall be hydraulically tested wherever possible, as per relevant codes.
- c) Ultrasonic testing shall be carried out on all forgings and rotor for dia 50mm and above. MPI/DPT shall be done on machined area of the components.
- d) During assembly all clearances and alignments shall also be checked and recorded
- e) Rotor shall be statically and dynamically balanced
- f) Performance Test(Shop Test)
 - i. Performance test on the compressor shall be carried out in accordance with ISO:1217/Eq. The test shall also include demonstration of loading and unloading mechanism(Capacity control) and operation of safety valve
 - ii. Vibration and Noise level measurement shall be done during shop performance test.

1.08.05 Air Receiver

- a) Each finished vessel shall be hydraulically tested at 150% of the design pressure for a duration of 30 minutes
- b) NDT on weld joints shall be as per respective code requirements or the minimum as specified below
 - i. 100% DPT on root run of butt welds
 - ii. 100% DPT on all finished butt welds and fillet welds
 - iii. 10% RT on butt welds which shall include all T-Joints

CLAUSE NO.	QUALITY ASSURANCE		
1.09.00	Dust Extraction and Ventilation System		
1.09.01	<p>Fan</p> <p>(a) All materials should be of tested quality and test certificates should be provided.</p> <p>(b) Dynamic balancing of the fan impellers to be carried out.</p> <p>(c) Shop run test shall be conducted on all centrifugal fans including check for noise and vibration level.</p> <p>(d) Performance test shall be conducted on one fan of each type at shop for capacity, pressure, efficiency and power consumption.</p>		
1.09.02	<p>Valves and Specialties</p> <p>Refer 1.08.02 above</p>		
1.09.03	<p>Pipes and Fittings</p> <p>Refer 1.08.03 above</p>		
1.09.04	<p>Package Air-Conditioner</p> <p>Each Unit shall be subjected to production routine Test excluding performance test carried out as per relevant standard. Performance test of PAC shall be carried out as per relevant standard on one unit of each type and rating at site.</p>		
1.10.00	<p>Crushers</p> <p>The details of the checks to be carried out for various components are to be submitted by the Contractor for Owner's approval. However, some indicative checks on different items are given below which should necessarily form part of the Quality Assurance Plan to be agreed with the Owner.</p> <p>(a) All plates equal to or above 25mm thickness shall be ultrasonically tested.</p> <p>(b) Shaft forgings and suspension bars to be checked for ultrasonic testing in addition to check for chemical, mechanical, hardness, microstructure etc. as per applicable material specification.</p> <p>(c) Following minimum NDT requirements to be ensured for welds:</p> <p>i) Butt welds - 10% UT/RT and 100% MPI/DPT.</p>		
<p>NCTPP DADRI ST-II(2x490MW) & IGSTPP,JHAJJAR(3x500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-6130/0330-109-9</p>	<p>SUB-SECTION – V-QM2 LIME & GYPSUM HANDLING</p>	<p>Page 7 of 11</p>

- ii) Fillet Welds - 10% MPI/DPT.
- (d) Crusher rotor to be dynamically balanced. Procedure to be submitted for approval.
- (e) No-load trial run test to be carried out at shop to check for speed (RPM), temperature rise, noise level and vibration.

1.11.00 Mobile Trippers

- (a) Shaft and wheel forgings – Ultrasonic test in addition to check for chemical, mechanical, hardness, microstructure etc. as per applicable material specification shall be conducted.
- (b) Following minimum NDT requirements to be ensured for welds:
 - i) Butt welds - 10% UT/RT and 100% MPI/DPT.
 - ii) Fillet Welds - 10% MPI/DPT.
- (c) Shop trial run test shall be carried out and shall include check for noise level and vibration.

1.12.00 In-Line Magnetic Separators


- i) Overall Dimensional, Visual check alongwith control panel.
- ii) HV & IR.
- iii) Operation, temperature rise, lifting capacity, force index and gauss strength.


1.13.00 Metal Detectors

- i) Functional test including sensitivity, Burn in test, operation of liquid spray marker, detection of smallest piece of different materials as specified.
- ii) Test report for Degree of protection test to be furnished.

1.14.00 Sampling Units

- (a) Free carriage and cutter movement, speed of cutter and dust door closing and sealing shall be tested for samplers.
- (b) “No load test” shall be carried out for crushers.

CLAUSE NO.	QUALITY ASSURANCE		
1.15.00	Elevators (Passenger cum goods elevator) Refer QA table for passenger/service elevator.		
1.16.00	Steel Structure		
1.16.01	Only material which has been identified against mill sheet or test certificates shall be used for construction. Check testing shall be carried out in the absence of MTC. Correlation shall be maintained by Manufacturer. All plates above 40mm thickness shall be 100% ultrasonically tested.		
1.16.02	Visual inspection of all welds shall be performed in accordance with AWS D.1.1.		
1.16.03	NDT requirements of structural steel welds shall be as under: <ol style="list-style-type: none"> 100% RT/UT on butt-welds of plate thickness ≥ 32 mm. Edge for field weld shall be examined by MPI for plate thickness ≥ 32mm. For Plates of $10 \text{ mm} < \text{thickness} < 32 \text{ mm}$ - 10% RT On butt welds. 10% Ultrasonic testing shall be carried out on full penetration welds (other than butt welds) DP Test on Welds: <ul style="list-style-type: none"> 100% on Root Run & 10% on Final Welds of all butt welds At random 5% on fillet of built-up plate girders. 		
1.16.04	Girders/columns/Beams etc shall be trial assembled and match marked prior to dispatch. Trial assembly procedure at shop shall be submitted for NTPC review and approval.		
1.17.00	Paddle feeder		
1.17.01	Shaft and wheel forgings – Chemical, Mechanical, Hardness and Ultrasonic Test shall be conducted.		
1.17.02	Following minimum NDT on Weld Joint shall be carried out <ol style="list-style-type: none"> Butt Welds - 10% UT/RT & 100% MPI/DPT Fillet Welds - 10% MPI/DPT 		
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CLAUSE NO.	QUALITY ASSURANCE		
1.17.03	Shop trial run shall be conducted to check for movement and RPM of Paddle wheel & Travel wheel, function of P/F in locked rotor condition, noise and vibration etc.		
1.18.00	Vibrating Screen Feeders/Vibrating Feeders <p>(a) Shaft forgings to be checked for ultrasonic testing in addition to check for chemical, mechanical, hardness, microstructure etc. as per applicable material specification</p> <p>(b) Following minimum NDT requirements to be ensured for welds:</p> <p>i) Butt welds - 10% UT/RT and 100% MPI/DPT.</p> <p>ii) Fillet Welds - 10% MPI/DPT.</p> <p>(c) Shop trial run test shall be conducted to checks for speed (RPM), amplitude (stroke), temperature rise and noise level.</p>		
1.19.00	APRON FEEDER		
1.19.01	All plates equal to or above 25 mm thickness shall be ultrasonically tested.		
1.19.02	Castings and forgings, forged/rolled bar/section shall be subjected to ultrasonically test in addition to check for chemical, mechanical, hardness, microstructure etc. as per applicable material specification.		
1.19.03	Machined and hard faced surface of casting/forging and other hardened, stellited parts shall be subjected to DPT/MPI in addition to check for case depth, hardness as applicable for chain/sprocket/gear reducer/rollers/wheel/pan etc.		
1.19.04	Suitable check for life time sealing of rollers for protection from dust and water shall be done		
1.19.05	Following minimum NDT requirements shall be followed for welds: <p>i) Butt Welds in Tension- 100% UT/RT and 100% MPI/DPT.</p> <p>ii) Butt Welds in Compression- 10% UT/RT and 10% MPI/DPT.</p> <p>iii) Fillet Welds - 10% MPI/DPT.</p>		
1.19.06	For other items like drive system, motor, pulley, belt relevant portion of specification shall be applicable		
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1.19.07 No load trial run test shall be carried out at shop on completely assembled apron feeder to check for trouble free operation, temperature rise, Noise & vibration.

SUB-SECTION-V-QM3

EQUIPMENT COOLING WATER SYSTEM



EQUIPMENT COOLING WATER SYSTEM													
TEST / CHECKS		Material Test	WPS/PQR/Welder Qualification	DPT/MPI	Assembly Fit Up	Visual & Dimensional Check	UT	RT	Hydraulic / Water Fill	Balancing	Type Test	Performance Test	Other Test
ITEM / COMPONENTS													
A	PLATE TYPE HEAT EXCHANGER		Y	Y ³	Y	Y			Y				
A.1	Heat Transfer Plates	Y ¹		Y ²		Y							Y ⁷
A.2	Gaskets	Y				Y							
A.3	Cover Plates (Front & Rear)	Y ¹				Y	Y ⁵						
A.4	Tie Rods	Y ¹		Y ⁴			Y ⁶						
B	HORIZONTAL CENTRIFUGAL PUMP				Y	Y						Y ¹⁰	
B.1	Casing	Y ¹		Y ⁴		Y			Y ⁸				
B.2	Impeller	Y ¹		Y ⁴		Y				Y ⁹			
B.3	Shaft	Y ¹		Y		Y	Y ⁶			Y ⁹			

NOTES

- 1 One per heat / HT batch
- 2 DP Test shall be conducted for 10% of the lot of HT plates. However, in case of any defect, entire lot shall be tested and only defect free plates shall be accepted.
- 3 100% DP Test shall be conducted on butt welds and 10% DPT on fillet weld after final run.
- 4 100% DPT shall be carried out on machined surfaces.
- 5 UT shall be done on plates with thickness 25 mm or above.
- 6 UT shall be done on shaft / tie rod with diameter above 40 mm.
- 7 After pressing each HT plate shall be subjected to either of the following tests, as per Manufacturer Practice
 - a) Light Box Test
 - b) Vacuum Test
 - c) Air Chamber Test
- 8 All pressure retaining parts shall be hydrostatically tested at 200% of pump rated head or 150% of shut – off head, whichever is higher, for at least 30 minutes. No leakage is allowed.
- 9 Static and Dynamic Balancing shall be carried out on complete rotor assembly.
- 10 All pumps shall be tested at rated speed, for head, flow capacity, efficiency and power consumption for the entire operating range i.e. from shut off head to maximum flow. A minimum of 7 readings shall be taken to plot the curve, with one reading at design flow. Testing standard shall be HIS (Hydraulic Institute Standard) of USA.
Performance test shall be carried out with contract motor, wherever Liquidated Damages are to be ascertained based on performance test at shop.
- 11 For Pipes, Valves and RE Joints refer LP Piping System requirements.

SUB-SECTION-V-QM4

AIR CONDITIONING & VENTILATION SYSTEM

AIR CONDITIONING AND VENTILATION SYSTEM FOR FGDS

CLAUSE NO	QA MODULE FOR AIR CONDITIONING AND VENTILATION SYSTEM
1.00.00	Air cooled Condensing Unit (Outdoor unit), Evaporating unit (Indoor unit)
1.01.00	Compressor of Condensing Unit shall be tested as per relevant standard
1.01.01	Condenser (Heat Exchanger) , Evaporator coils assembly shall be subjected to Hydraulic/Pneumatic pressure/leakage test as applicable and Electronic refrigerant leakage test along with all relevant test on tube as per applicable code..
1.01.02	Assembled Condensing unit (Outdoor Unit) shall be subjected to Leakage test, Vacuum test, Run test/Functional test as applicable
2.00.00	FANS
2.01.00	20% DPT of welding on fan hub, blades, casing and impeller as applicable shall be carried out.
2.02.00	DPT of fan shafts shall be carried out after machining.
2.03.00	UT of fan shafts (diameter equal to or above 50mm) shall be carried out.
2.04.00	Rotating components of all fans shall be dynamically balanced to ISO-1940 Gr. 6.3
2.05.00	All Fans shall be subjected to run test for 4 hrs. or till temperature stabilization is reached. Vibration, Noise level, Temp. rise and current drawn shall be measured during the run test.
2.06.00	One fan of each type and size will be performance tested as per corresponding BIS /AMCA for Air flow, Static Pressure, Speed, Efficiency, Power Consumption, Noise, Vibration and Temp. Rise.
3.00.00	AIR HANDLING UNIT
3.01.00	For Fans refer tests as mentioned at 2.00.00
3.02.00	One per type of assembled AHU (AHU casing and fan assembly) shall be subjected to free run test. Noise, Vibration and Temp. Rise of bearing shall be measured during run test.
3.03.00	All cooling coil shall be pneumatically tested and no leakage shall be permitted.
4.00.00	CENTRIFUGAL PUMP
4.01.00	UT on pump shaft (dia equal to or above 40 mm) and MPI/DPT on pump shaft and impeller after machining shall be carried out.
4.02.00	All rotating components of the pumps shall be dynamically balanced to ISO-1940 Gr. 6.3
4.03.00	A standard hydrostatic test shall be conducted on the pump casing with water at 1.5 times the shut off pressure on the head characteristics curve or twice the rated pressure whichever is higher, for a minimum duration of 30 minutes.
4.04.00	Standard Running Test

4.05.01	All pumps shall be tested in the manufacturer's works preferably with contract motor for capacity, efficiency, head and brake horse power. Pump shall be given running test over the entire operating range covering from the shut-off head to the maximum flow. The duration of test shall be minimum one (1) hr. A minimum of seven readings approximately equidistant shall be taken for plotting the curves with one point at design flow. Testing of pumps shall be in accordance with stipulations of Hydraulic Institute Standard (HIS) and/or as per applicable Indian Standard or equivalent. Acceptance norms shall be as per approved datasheet & HIS standard only.
4.05.02	Noise and vibration shall be measured at shop for reference purpose only.
4.05.03	Pumps shall be subjected to strip down examination visually to check for mechanical damages after testing at shop in case abnormal noise level and/or excessive vibration are observed during the shop test.
4.05.04	NPSH test shall be conducted with water as the medium, if required as per approved data sheets.
5.00.00	LOW PRESSURE AIR DISTRIBUTION SYSTEM
5.01.00	Prototype tests report of fire damper (duly approved/accepted by ENGG) for each type and size as per UL-555 for fire rating shall be furnished.
5.02.00	Site Test- After completion, all ducting system shall be checked/tested for air leakages/tightness (smoke test) at site.
6.00.00	INSULATION
6.01.00	Insulation material shall be tested for all mandatory tests only as per relevant code/standard.
6.02.00	Thermal conductivity tests (for thermal insulation only) shall be done as per relevant code for the same density and thickness of material and validity of test shall be as per relevant standard.
7.00.00	AIR FILTERS
7.01.00	Pre/Fine filters shall be tested for initial and final pressure drop Vs flow and average synthetic dust weight arrestance as per the requirement of BS 6540/ASHARE-52-76/EN779. HEPA (Absolute) filters shall be tested as per applicable code.
8.00.00	PIPES & FITTINGS
8.01.00	All pipes and fittings shall be tested as per applicable codes / standard.
8.02.00	Site test- Pipes shall be tested at site hydraulically/pneumatically as per application requirement
9.00.00	VALVES & SPECIALTIES
9.01.00	Visual and dimensional check of valves as per relevant codes and approved drawing.
9.02.00	All the water line valves shall be hydraulically tested for body, seat and back seat (wherever provided) as per the relevant standard to which these valves are supplied irrespective of the working pressure for which these valves are selected. Check valves shall also be tested for leak tightness test at 25% of the specified seat test pressure.

9.03.00	Valves shall be offered for hydro test and pneumatic test in unpainted condition.
9.04.00	Functional check of the valves for smooth opening and closing shall be done.
10.00.00	SPLIT/CASSETTE / WINDOW AC/ PAC
10.01.00	Split/Cassette/ Window AC will be accepted on the basis of Manufacturer Standard Guarantee and Warrantee certificate.
10.02.00	PAC Each Unit shall be subjected to production routine Test excluding performance test carried out as per relevant standard.
10.03.00	Performance test of PAC shall be carried out as per relevant standard on one unit of each type and rating at site.
11.00.00	Unitary Air Filter (UAF)
11.01.00	Random 10% DPT on weld joints shall be carried out
11.02.00	Hydraulic test of pressure parts at 1.5 times the design. Pressure and water fill test of tanks shall be carried out
11.03.00	Trial assembly of Air washer/UAF for one of each size shall be done in shop.

SUB-SECTION-V-QM5

LP PIPING



PIPES, FITTINGS, BENDS, VALVES, COATING-WRAPPING, STRAINERS EXPANSION, JOINTS, TANKS, HANGERS & SUPPORTS, FASTENERS, LINING ETC.

Tests/Check	Items / Components	Material Test	DPT/MPI / RT	Ultrasonic Test	WPS/ WQS/PQR	Hydraulic / Water Fill Test	Pneumatic Test	Assembly Fit up	Dimensions	Functional/operational Test	Other Tests	All Tests as per relevant Std	REMARKS
1	Pipes & Fittings and Mitre Bends	Y ^a	Y ^b		Y	Y			Y		Y ¹⁵		
2	Diaphragm Valves	Y ^a				Y ⁵			Y		Y ⁶		
3A	Cast Butterfly Valves (Low Pressure)					Y		Y	Y	Y	Y ⁷		
	Body	Y ^a	Y ^b										
	Disc	Y ^a	Y ^b										
	Shaft	Y ^a	Y	Y ^c									
3B	Fabricated Butterfly Valves	REFER NOTE 14											
4	Gate/ Globe/Swing Check / Ball Valves	Y ^a	Y ^b	Y ^c		Y ⁵	Y	Y	Y	Y	Y ⁸		
5	Dual Plate Check Valves	Y ^a	Y ^b	Y ^c		Y	Y	Y	Y	Y	Y ⁴		
6	Rolled & Welded Pipes	Y ^a	Y ³		Y ³	Y ¹			Y		Y ³		
7	Coating & Wrapping of Pipes	Y ²									Y ²		
8	Tanks & Vessels	Y ^a	Y ^b		Y	Y			Y		Y ¹⁶		
9	Strainers	Y ^a	Y ^b		Y#	Y					Y ¹¹		#For Fabricated Strainer
10	Rubber Expansion Joints	Y ^a				Y ¹²		Y	Y		Y ¹³		
11	Internal Lining of Pipes	Y ^a							Y		Y ⁹		
12	Hangers & Supports	Y ^a							Y				
13	Site Welding		Y ¹⁰		Y	Y							

NOTES (MEANING OF SUPERSCRIPTS)

- a One per heat/heat treatment batch/lot.
- b On machined surfaces only for castings and on butt welds.
- c For shaft/spindles > or = 50 mm
- 1 Weld Joints not subjected to hydraulic test shall be subjected to 100% RT.
- 2 Spark Test, Adhesion Test and Material Test for primer and enameled & Coal Tar Tapes as per AWWA-C-203-91/ IS-10221/IS 15337 as applicable.
- 3 Followings are the testing requirements for fabrication of pipes at site

TESTS

QUANTUM OF CHECKS

WPS, PQR, Welder Qualification Test	100%
DPT on root run	100% for pipes up to 1200 mm diameter
DPT after back gauging	100% for pipes above 1200 mm diameter
RT	5%
DPT on finished butt weld joints	10%
Hydraulic Test	100%, 1.5 times the design pressure or 2 times the working-pressure whichever is higher.

CLAUSE NO.


QUALITY ASSURANCE




4	Dry Cycle Test on Dual Plate Check valve spring for one lakh Cycles shall be carried out as a type test.
5	Seat Leakage Test for Actuator Operated Valves, shall be done with by closing the valves with actuator.
6	Tests on rubber parts per batch of rubber mix such as hardness, adhesion, spark test, bleed test and flex test on diaphragm, type test for diaphragm for 50,000 cycles.
7	Hydraulic Test of Body, Seat and disc-strength shall be carried out in accordance with governing design standard in presence of owner's representatives. Actuator operated valves shall be checked for Seat Leakage by closing the valves with actuator. Seat Leakage Test shall be carried out in both directions. For Proof of Design Test refer respective chapters of engineering portion in the technical specification
8	Blue matching, wear travel for gates, valves, pneumatic seat leakage, and reduced pressure test for check valves shall be done as per relevant standard. Maximum allowable vacuum loss is 0.5 mm of Hg abs. for valves to be tested for vacuum operation for internal pressure 25 mm of Hg abs. for a period of 15 minutes. Fire safe test for ball valve shall be done wherever specified. Valves shall be offered for hydro test in unpainted condition.
9	Tensile, Elongation, Hardness, Specific Gravity, Lining Thickness, Humidity Check, Pipe temperature check, Adhesion Test and Holiday Detection Test etc as per applicable standard shall be done for all lining material and application.
10	10% of welds (Root and finished welds) shall be subjected to DPT.(100% DPT for compressed air line and boiler & deaerator fill line.).
11	Pressure drop across the strainer for each type and size as a special test shall be carried out. In case of already carried out, the test report shall be submitted for review and acceptance by NTPC Engineering.
12	During hydraulic and vacuum tests at 25mm Hg abs in 3 positions, the change in the circumference of arch should not be more than 1.5%. 24 hrs after the test permanent set in dimension should not exceed 0.5%.
13	Tests on rubber for tensile, elongation, hardness, hydraulic stability check as per ASTM D 471, ozone resistance test as per ASTM D 1149 aging test and adhesion strength of rubber to fabric, rubber to metal adhesion shall be carried out.
14	In addition of all tests as indicated for Cast Butter Fly valve being applicable for fabricated butterfly valves, following test shall be done for Fabricated Butter Fly Valve: UT as per ASTM A-435 on plate material for body and disc shall be carried out for plate thickness 20mm and above. 100% RT and DPT as per ASTM, Section-VIII, Division-I, on butt joints of body and disc. 10% DPT on other welds shall be done. Post weld heat treatment as per ASME, Section-VIII, Division-I on butt joints of body and disc. Welders and WPS shall be qualified as per ASME- section IX
15	For stainless segmented flanges and stainless steel fabricated fitting, 100% radiography of all weld seams including mother pipe weld seam shall be employed. Segmental Flanges exceeding 37.5 mm thickness shall be stress relieved after welding. All butt weld joints in segmental flange shall be examined by Radiographic Test. Maximum number of segments shall be 4 only.
16	For pressure vessel welds RT shall be done as per design code requirements.

SUB-SECTION-V-QM6

~~COMPRESSOR AIR SYSTEM~~

CLAUSE NO.	QUALITY ASSURANCE		
<p>1.00.00</p> <p>1.01.00</p> <p>1.01.01</p> <p>1.02.00</p>	<p><u>AIR COMPRESSOR SYSTEM</u></p> <p>AIR COMPRESSORS :</p> <p>a) All pressure parts shall be hydraulically tested at not less than 150% of design pressure prior to painting and lining, if applicable. The test pressure will be maintained for 30 minutes.</p> <p>b) All other parts including inter-connecting piping shall be hydraulically tested wherever possible, as per relevant codes.</p> <p>c) Ultrasonic testing shall be carried out on all forgings and shafts (if dia.> 50mm). MPI/DP test will be done on machined areas of the above components.</p> <p>e. Rotor shall be statically and dynamically balanced.</p> <p>PERFORMANCE TEST (SHOP TEST) :</p> <p>a) Performance test on the compressors shall be carried out in accordance relevant standard. The test shall also include demonstration of loading and unloading mechanism (Capacity control) and operation of safety valves.</p> <p>b) Power consumption at motor input terminal at rated capacity as well as at fully unloaded condition of all the compressor shall be measured.</p> <p>c) Vibration and noise level measurement will be done during shop performance test.</p> <p>d) Test shall be carried out on all compressors with contract drive motor where power consumption for compressors has been indicated as a guaranteed parameter</p> <p>AIR RECEIVER, HEAT EXCHANGERS, MOISTURE SEPERATORS, AIR DRYING PLANT:</p> <p>a) Each finished vessel shall be hydraulically tested to 150% of the design pressure for a duration of 30 minutes.</p> <p>b) NDT on weld joints shall be as per respective code requirements or the minimum as specified below:</p> <p>(i) 100 % DPT on root run of butt welds.</p> <p>(ii) 100% DPT on all finished butt welds and fillet welds</p> <p>(iii) 10% RT on butt welds which shall include all T-joints.</p>		
<p>NCTPP DADRI ST-II (2X490MW) & IGSTPP, JHAJJAR (3X500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-6130/0330-109-9</p>	<p>SUB-SECTION -V- QM6 COMPRESSED AIR SYSTEM</p>	<p>Page 1 of 2</p>

CLAUSE NO.	QUALITY ASSURANCE		
1.04.00	<p>c) Tube to Tube sheet joint of the heat exchangers shall be subject to Mock-up test as per the relevant standards.</p> <p>d) Reactivation blowers shall be tested for FAD, temp. rise noise & vibration. Rotating parts shall be dynamically balanced.</p> <p>e) Completely assembled ADP shall be pneumatically tested at design pressure for a duration of 5 minutes. Functional and sequential operation testing of the completely assembled ADP shall be demonstrated at shop. Other accessories shall be tested as per relevant code and sections. Dew point measurement shall be done.</p> <p>H.O.T. CRANE :</p> <p>a) Chain pulley Blocks shall be tested as per IS: 3832.</p> <p>b) Following NDT requirements shall be met :</p> <p>(i) 100% RT of Butt welds in tension and 10% RT of butt welds in compression.</p> <p>(ii) DP at random on all weldments.</p> <p>Deflection, load, overload & travel check on HOT crane assembly shall be carried out as per IS:3177.</p>		
1.05.00	<p>PIPINGS, VALVES, AND FITTINGS</p> <p>a. All pipes and fittings shall be tested as per applicable code.</p> <p>b. All valves shall be hydraulically tested for body, seat and back-seat (if applicable) as per relevant standard. Check valves shall also be tested for leak tightness test at 25% of the specified seat test pressure.</p> <p>c. Valves shall be offered for hydro test in unpainted condition.</p> <p>d. Functional checks of the valves for smooth opening and closing shall also be done.</p> <p>All forgings, dia \geq 50 mm shall be Ultrasonic Tested irrespective of the type, size & rating of the valve.</p>		
<p>NCTPP DADRI ST-II (2X490MW) & IGSTPP, JHAJJAR (3X500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-6130/0330-109-9</p>	<p>SUB-SECTION -V- QM6 COMPRESSED AIR SYSTEM</p>	<p>Page 2 of 2</p>

~~(ELECTRICAL)~~

SUB-SECTION-V-QE1

~~MOTORS~~



MOTOR

TESTS/CHECKS TEMS/COMPONENTS	Visual	Dimensional	Make/Type/Rating Physical Inspection	General /Mech/Chem. Properties	NDT /DP/MPI/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	Routine & Acceptance tests as per IS-325/IS-4722 /IS- 9283/IS 2148/IEC60034/IEC 60079-1/ IS-12615	Vibration	Over speed	Tan delta, shaft voltage & polarization index test	Paint shade, thickness & adhesion
	Plates for stator frame, end shield, spider etc.	Y	Y	Y	Y	Y				Y									
Shaft	Y	Y	Y	Y	Y	Y			Y										
Magnetic Material	Y	Y	Y	Y			Y			Y		Y							
Rotor Copper/Aluminium	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							
Tubes, for Cooler	Y	Y	Y	Y	Y				Y		Y								
Sleeve Bearing	Y	Y	Y	Y	Y				Y		Y								
Stator/Rotor, Exciter Coils	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	Y										

CLAUSE NO.

QUALITY ASSURANCE



Wound stator	Y	Y					Y	Y											
Wound Exciter	Y	Y					Y	Y											
Rotor complete	Y	Y					Y						Y	Y					
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y												
Accessories, RTD, BTDC, CT, Space heater, antifriction bearing, gaskets etc.	Y	Y	Y																
Complete Motor	Y	Y	Y												Y	Y	Y	Y1	Y

Note: 1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed along with relevant supporting documents during QP finalization. However, No QP for LT motor upto 50KW.
 2. Additional routine tests for Flame proof motors shall be applicable as per relevant standard
 3. Makes of major bought out items for HT motors will be subject to NTPC approval.
 4. Y1 = for HT Motor / Machines only.

SUB-SECTION-V-QE2

~~MEDIUM VOLTAGE BUS DUCTS~~

Medium Voltage BUS DUCT

Attributes / Characteristics	Visual & Dimensional Checks	Electrical / Mechanical / Chemical Properties	WPS & PQR	NDT (RT / DP / MPI / UT)	Painting Quality & Adhesion Test	Galvanising Test as per IS: 2629 / 2633 / 6745	Electrical clearance & Creepage distance	Functional/Operational check	Make / Type Rating / Model / TC / Embossing/Printing of make & batch /General Physical Inspection	Trial Assembly at works.	Routine Test as per relevant standard / NTPC Specification
Enclosure / Cubicle	Y	Y		Y	Y		Y				Y
Bus bar Conductor / Flexible Connector & Disconnector Link	Y	Y		Y							
Galvanised Steel Structure & Plate (Steel as per IS:2062)	Y					Y					
Epoxy / Seal-off Bushing & Epoxy / Porcelain Post / Support Insulator	Y	Y					Y		Y		Y
Welding of enclosure & conductor	Y		Y	Y							
Gasket, Silica gel Breather, Elastomer Spring Head		Y						Y	Y		
Complete Bus Duct & Cubicles IS:8084	Y				Y		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) All major Bought Out Items will be subject to NTPC approval.

SUB-SECTION-V-QE3

~~LT POWER CABLES~~

LT Power Cables

Attributes / Characteristics Item / Components / Sub System Assembly	Make, Type & T.C as per relevant standard	Dimension/surface finish	Mechanical properties	Chemical Composition	Spark Test(as applicable)	Electrical properties	Hot Set Test/ Eccentricity & Ovality	Lay length & Sequence	Armour coverage, cross over, looseness, gap between two	Sequential marking/ Batch marking/ surface finish/ cable length	T.S & elongation before & after ageing on outer sheath & insulation	Thermal stability	Anti termite coating on wooden	Constructional requirements feature as per NTPC specification	Routine & Acceptance Tests as per relevant standard & NTPC specification	FRLS Tests
Aluminum (IS-8130)	Y	Y	Y	Y		Y										
XLPE Compound (IS-7098)	Y		Y			Y	Y				Y					
PVC insulation Compound (IS: 5831)	Y		Y			Y					Y	Y				
FRLS PVC Compound (IS-5831, ASTM-D2843, IS10810(Part 58), IEC-60754 Part-1)	Y		Y								Y	Y				Y
Extrusion & curing /Manufacturing of Core (PVC / XLPE)		Y			Y	Y						Y				
Core Laying								Y								
Armour wire/strip	Y	Y	Y													
Inner sheath	Y	Y														
Armouring		Y							Y							
Outer Sheathing		Y								Y						
Power Cable (Finished) (IS-5831, ASTM-D2843, IS10810(Part 58), IEC-60754 Part-1, IEC 60332 part III cat B)								Y	Y	Y	Y	Y	Y	Y	Y	Y
Wooden drum(IS-10418) /Steel Drum		Y											Y	Y		

Notes:

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. Make of all major Bought out items will be subject to NTPC approval.

ROUTINE TESTS	Following routine tests shall be carried out on each drum of finished cables for all types (PVC / XLPE insulated) & sizes.	
1)	Conductor Resistance test	
2)	High voltage test	
ACCEPTANCE TESTS	Following Acceptance tests shall be carried out on each size of each type (PVC / XLPE insulated) of cables, in the offered lot.	
A) For Conductor (as per sampling plan mentioned in IS: 1554 / 7098)		
1)	Annealing test (Copper)	
2)	Tensile Test (Aluminum)	
3)	Wrapping Test (Aluminum)	
4)	Resistance test	
B) For Armour Wires / Formed Wires (If applicable) (as per sampling plan mentioned in IS: 1554 / 7098)		
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 surface defects	
C) For PVC / XLPE insulation & PVC Sheath (as per sampling plan mentioned in IS: 1554 / 7098)		
1)	Test for thickness	
2)	Tensile strength & Elongation before ageing (for tests after ageing see "D")	
3)	Hot set test (For XLPE insulation)	



D) Ageing test:				
	Criteria	Condition	Test Requirements	Remarks
PVC insulation & outer sheath:	Samples as per relevant IS, from each size of cables in the offered lot, shall be tested for tensile strength & elongation (before ageing). Tensile & elongation testing shall preferably be done with a computerized machine. The values will be compared with corresponding values mentioned in the Type Test report accepted by NTPC. These values of Tensile Strength & Elongation (before ageing) should be within +/- 15% of the corresponding values of Type Test report. (Please note that test values should be more than the minimum values indicated in relevant standard).	All sizes which meet the criteria	The size which has maximum negative deviation from type test report values will be put on accelerated ageing test. The samples shall be aged in air oven at temperature of 130°C +/- 2°C for 5 hours and tested for TS & elongation. Acceptance norms shall be as per IS.	In case the size does not meet the requirement in accelerated ageing test then all sizes (which had met the criteria) will be put on ageing test as per IS.
		Sizes which do not meet the criteria	Every size will be put on ageing test as per IS.	----
XLPE insulation	Samples as per relevant IS, from each size of cables in the offered lot, will be put on ageing test as per IS.			

E) Following tests will be carried out on completed cables as per IS on each size of each type (PVC / XLPE insulated)

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

F) Following tests shall be carried out on only one size of offered lot (comprising of all sizes & types)

	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
	4)	Acid gas generation test on outer sheath
G) Flammability test as per IEC 60332 - Part- 3 (Category- B) on completed cables as per following sampling plan:		
		<p>This test will be carried out using composite sampling i.e. irrespective of size; cables of one particular type (i.e. armoured PVC insulated, unarmoured PVC insulated, armoured XLPE insulated, unarmoured XLPE insulated) will be bunched together, as per calculations in line with the IEC. All sizes of PVC & XLPE insulated, armoured & unarmoured cables shall be covered.</p> <p>For one particular type, cables with OD less than or equal to 30 mm shall be clubbed together in touching formation while cables with OD greater than 30 mm shall be clubbed together leaving a gap equal to OD of cable having least diameter. Cable OD shall be taken as nominal overall diameter as per NTPC approved datasheet.</p>
H) Following tests shall be carried on one length of each size of each type (PVC / XLPE insulated) of offered lot:		
	1)	Constructional / dimensional check, surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Sequential marking, drum / Batch (outer sheath extrusion batch)number marking on sheath
	2)	Measurement of Eccentricity & Ovality

SUB-SECTION-V-QE4

~~CONTROL CABLES~~



Control Cables

Attributes / Characteristics Item / Components / Sub System Assembly	Make / Type & T.C as per relevant standard	Dimension/surface finish	Mechanical properties	Chemical Composition	Spark Test(as applicable)	Electrical properties	Lay length & Sequence	Armour coverage, cross over, looseness, gap between two	Sequential marking/ Batch marking/ surface finish/ cable length	T.S & elongation before & after ageing on outer sheath & insulation	Thermal stability	Anti termite coating on wooden	Constructional requirements feature as per NTPC specification	Routine & Acceptance Tests as per relevant standard & NTPC specification	FRLS Tests
Copper (IS-8130)	Y	Y	Y	Y		Y									
PVC insulation Compound (IS: 5831)	Y		Y			Y				Y	Y				
FRLS PVC Compound (IS-5831, ASTM-D2843, IS10810(Part 58), IEC-60754 Part-1)	Y		Y							Y	Y				Y
Extrusion & curing /Manufacturing of Core		Y			Y						Y				
Core Laying						Y									
Armour wire/strip	Y	Y	Y												
Inner sheath	Y	Y													
Armouring		Y					Y								
Outer Sheathing		Y						Y	Y						
Finished Cable (IS-5831, ASTM-D2843, IS10810(Part 58), IEC-60754 Part-1, IEC 60332 part III cat B)						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Wooden drum(IS-10418) /Steel Drum		Y									Y	Y			

Notes:

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. Make of all major Bought out items will be subject to NTPC approval.



ROUTINE TESTS	Following routine tests shall be carried out on each drum of finished cables for all sizes.	
1)	Conductor Resistance test	
2)	High voltage test	
ACCEPTANCE TESTS	Following Acceptance tests shall be carried out on each size of cables, in the offered lot.	
A) For Conductor (as per sampling plan mentioned in IS: 1554)		
1)	Annealing test (Copper)	
2)	Resistance test	
B) For Armour Wires / Formed Wires (If applicable) (as per sampling plan mentioned in IS: 1554)		
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 surface defects	
C) For PVC insulation & PVC Sheath (as per sampling plan mentioned in IS: 1554)		
1)	Test for thickness	
2)	Tensile strength & Elongation before ageing (for tests after ageing see "D")	



D) Ageing test:

	Criteria	Condition	Test Requirements	Remarks
PVC insulation & outer sheath:	Samples as per relevant IS, from each size of cables in the offered lot, shall be tested for tensile strength & elongation (before ageing). Tensile & elongation testing shall preferably be done with a computerized machine. The values will be compared with corresponding values mentioned in the Type Test report accepted by NTPC. These values of Tensile Strength & Elongation (before ageing) should be within +/- 15% of the corresponding values of Type Test report. (Please note that test values should be more than the minimum values indicated in relevant standard).	All sizes which meet the criteria	The size which has maximum negative deviation from type test report values will be put on accelerated ageing test. The samples shall be aged in air oven at temperature of 130°C +/- 2°C for 5 hours and tested for TS & elongation. Acceptance norms shall be as per IS.	In case the size does not meet the requirement in accelerated ageing test then all sizes (which had met the criteria) will be put on ageing test as per IS.
		Sizes which do not meet the criteria	Every size will be put on ageing test as per IS.	----

E) Following tests will be carried out on completed cables as per IS on each size:

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

F) Following tests shall be carried out on only one size of offered lot (comprising of all sizes):

	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
	4)	Acid gas generation test on outer sheath

G) Flammability test as per IEC 60332 - Part- 3 (Category- B) on completed cable will be carried out as per following sampling plan:

		This test will be carried out using composite sampling i.e. irrespective of size; cables of one particular type (i.e. armoured, unarmoured) will be bunched together, as per calculations in line with the IEC. All sizes of armoured & unarmoured cables shall be covered.
--	--	---

H) Following tests shall be carried on one length of each size (armoured & unarmoured) of offered lot:

	1)	Constructional / dimensional check, surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Sequential marking, drum / outer sheath extrusion's batch number marking
	2)	Measurement of Eccentricity & Ovality

SUB-SECTION-V-QE5

CABLING EARTHING & LIGHTNING PROTECTION

CABLING, EARTHING, LIGHTNING PROTECTION

ATTRIBUTES / CHARACTERISTICS ITEMS/COMPONENTS / SUB SYSTEMS	Dimension	Paint shade, paint thickness, adhesion	Pre-treatment of sheet	IP protection	Proof load*	Surface finish	Deflection test*	HV & IR	Galvanise 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 NTPC Specification
Wall Mounted-Lighting Panel (IS-513, IS:5, IS:2629, 2633, 6745)	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	Y													Y
Lighting wire (IS-694)	Y											Y		
Flexible conduits	Y											Y		Y
Conduits (Galvanise & Epoxy) IS-9537 & IS-2629, 2633, 6745	Y		Y						Y			Y		Y
RCC Hume Pipe (IS-458)												Y		
Cable termination & straight through joint (IS 13573)	Y											Y		Y
Cable Trays, bends, tees, crosses, Flexible supports system & accessories IS-513, 2629,2633,6745	Y		Y		Y	Y	Y		Y			Y	Y	Y
Trefoil clamp	Y													Y
GI flats for earthing & lighting protection (IS 2062, 2629, 6745,2633)	Y		Y						Y			Y		Y
GI wire (IS-280)	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 NTPC technical specification & approved MQP. The above acceptance tests shall be done only on one sample from each size of offered lot. This test is not applicable on bends, tees & crosses.
 3. Make of all items will be subject to NTPC approval.

SUB-SECTION-V-QE6

~~HT CABLES~~



MV (3.3 kV / 6.6. kV / 11 kV / 33 kV) Cables

Attributes / Characteristics Item / Components / Sub System Assembly	Make, Type & T.C as per relevant standard	Dimension/surface finish	Mechanical properties	Chemical Composition	Spark Test(as applicable)	Electrical properties	Hot Set Test/ Eccentricity & Ovality	Lay length & Sequence	Armour coverage, cross over, looseness, gap between two wires	Sequential marking/ Batch marking/ surface finish/ cable length	T.S & elongation before & after ageing on outer sheath & insulation	Thermal stability on outer sheath	Metallic (Cu) Screening (If applicable)	Anti termite coating on wooden drums	Constructional requirements feature as per NTPC specification	Routine & Acceptance Test as per relevant standard & NTPC specification	FRLS Test
Aluminum (IS-8130)	Y	Y	Y	Y		Y											
Semiconducting Compound	Y		Y			Y											
XLPE Compound (IS-7098 Part-II)	Y		Y			Y					Y						
FRLS PVC Compound (IS-5831, ASTM-D2843, IS10810(Part 58) ,IEC-60754 Part-1)	Y		Y								Y	Y					Y
Triple Extrusion & curing /Manufacturing of Core		Y			Y		Y										
Copper Tape	Y	Y	Y			Y											
Polyster tape	Y	Y															
Core Laying								Y									
Armour wire/strip	Y	Y	Y														
Copper tapping	Y	Y											Y				
Inner sheath	Y	Y															
Armouring		Y						Y									
Outer Sheathing		Y								Y							
Power Cable (Finished)								Y	Y	Y	Y	Y		Y	Y	Y	Y
Wooden drum(IS-10418) /Steel Drum		Y											Y	Y			

Notes:

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. Make of all major Bought out items will be subject to NTPC approval.



ROUTINE TESTS	Following routine tests shall be carried out on each drum of finished cables for all types & sizes.	
1)	Conductor Resistance test	
2)	High voltage test	
3)	Partial discharge test (for Screened cables only)	
ACCEPTANCE TESTS	Following Acceptance tests shall be carried out on each size of each type (voltage rating) of cables, in the offered lot.	
A) For Conductor (as per sampling plan mentioned in IS: 7098 Part II)		
	1)	Annealing test (Copper)
	2)	Tensile Test (Aluminum)
	3)	Wrapping Test (Aluminum)
	4)	Resistance test
B) For copper tape / Wires (as per sampling plan mentioned in IS: 7098 Part II)		
	1)	Measurement of Dimensions
	2)	Conductivity check
B) For Armour Wires / Formed Wires (If applicable) (as per sampling plan mentioned in IS: 7098 Part II)		
	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 surface defects



C) For XLPE insulation & PVC Sheath (as per sampling plan mentioned in IS: 7098 Part II)

	1)	Test for thickness
	2)	Tensile strength & Elongation before ageing (for tests after ageing see "D")
	3)	Hot set test (For XLPE insulation)

D) Ageing test:

	Criteria	Condition	Test Requirements	Remarks
PVC outer sheath :	<p>Samples as per relevant IS, from each size of each type (voltage rating) of cables in the offered lot, shall be tested for tensile strength & elongation (before ageing). Tensile & elongation testing shall preferably be done with a computerized machine.</p> <p>The values will be compared with corresponding values mentioned in the Type Test report accepted by NTPC. These values of Tensile Strength & Elongation (before ageing) should be within +/- 15% of the corresponding values of Type Test report. (Please note that test values should be more than the minimum values indicated in relevant standard).</p>	All sizes which meet the criteria	For PVC: The size which has maximum negative deviation from type test report values will be put on accelerated ageing test. The samples shall be aged in air oven at temperature of 130°C +/- 2°C for 5 hours and tested for TS & elongation. Acceptance norms shall be as per IS.	In case the size does not meet the requirement in accelerated ageing test then all sizes (which had met the criteria) will be put on ageing test as per IS.
		Sizes which do not meet the criteria	Every size will be put on ageing test as per IS.	----
XLPE Insulation	Samples as per relevant IS, from each size of each type (voltage rating) of cables in the offered lot, will be put on ageing test as per IS.			

E) Following tests will be carried out on completed cables as per IS on each size of each type

	1)	Insulation resistance test (Volume resistivity method)
	2)	High voltage test
	3)	Partial discharge test (for Screened cables only)

CLAUSE NO.

QUALITY ASSURANCE



F) Following tests shall be carried out on only one size of offered lot (comprising of all sizes & types)

- | | |
|----|---|
| 1) | Thermal stability test on outer sheath |
| 2) | Oxygen index test on outer sheath |
| 3) | Smoke density rating test on outer sheath |
| 4) | Acid gas generation test on outer sheath |
| 5) | Flammability test as per IEC 60332 - Part- 3 (Category- B) on completed cable |

G) Following tests shall be carried on one length of each size of each type of offered lot:

- | | |
|----|---|
| 1) | Constructional / dimensional check, surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Sequential marking, marking of drum no. / Batch number of outer sheath extrusion |
| 2) | Measurement of Eccentricity & Ovality |

SUB-SECTION-V-QE7

~~ELECTRIC ACTUATORS WITH INTEGRAL
STARTERS~~

ELECTRICAL ACTUATOR WITH INTEGRAL STARTER

Test/Attributes Characteristics													
ITEM/ COPONENT/ SUB SYSTEM ASSEMBLY/ TESTING	RPM ®	No Load Current ®	IR & HV Test®	Mounting Dimension®	All routine Test as per Standard & Specification®	Correct Phase Sequence®	Operation & Setting of limit Switch/Torque Switch®	Stall Torque/Current (A)	Hand Wheel operation/ Auto de clutch function (A)	Function of Aux. like Potentiometer, space heater, position indicator	EPT output ®	Grease leakage ®	Local/ Remote (Open-Stop-Close) Operation® Safety check (Single phasing, Phase correction, Tripping etc.) (A)
ELECTRICAL ACTUATOR WITH INTEGRAL STARTER(IS_9334)													
Motor	Y	Y	Y	Y	Y								
Final Testing	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
<p>Note: 1) Detailed procedure of Burn-in and Elevated Temperature test shall be as per Quality Assurance Programme in General Technical Conditions</p> <p>2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the practices and procedure adopted along with relevant supporting documents.</p> <p>® - Routine Test (A) - Acceptance Test Y - Test applicable</p>													

SUB-SECTION-V-QE8

~~HT SWTIGCHGEAR~~

QA TABLE FOR HT SWITCHGEAR

ATTRIBUTES CHARACTERISTICS →	ITEMS, COMPONENTS, SUB-SYSTEM ASSEMBLY ↓	Make, Type, Model, Rating & TC	Electrical Properties	Mechanical properties	Chemical Properties	Dimensions & Finish	Constructional, Functional & Operational Features as per NTPC Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint shade, thickness, adhesion & finish	Functional Checks	HV & IR Test	Degree of Protection Routine test as per NTPC spec.	CB Operation timing check	All Routine Tests as per relevant standard
	CRCA steel sheet/ Aluzinc*/ Zincalum*/ Galvalum*	Y		Y	Y	Y		Y							
	Aluminum Bus bar material (IS : 5082)	Y	Y	Y	Y	Y		Y							
	Copper Bus bar material (IS : 613)	Y	Y	Y	Y	Y		Y							
	Bus bar Support Insulator	Y	Y	Y		Y		Y				Y			
	HT Circuit Breaker (IEC-62271-100)	Y				Y	Y	Y			Y			Y	Y
	HT Contactors (IS : 9046 / IEC 60470)	Y				Y	Y	Y			Y				Y
	Protection & Auxilliary Relays	Y				Y	Y	Y			Y				Y
	HT CT's & PT's (IS : 2705 / 3156)	Y				Y		Y							Y
	HT Fuses (IS : 9385)	Y				Y	Y	Y							
	Surge Arrester (IEC : 99 -4)	Y				Y		Y							Y
	LT Contactors (IS : 13947)	Y				Y	Y	Y			Y				
	Control & Selector Switches (IS : 6875)	Y				Y	Y	Y			Y				
	Indicating Meters (IS : 1248)	Y				Y	Y	Y			Y				Y
	Indicating Lamps (IS : 13947)	Y				Y	Y	Y			Y				
	Push Buttons (IS : 4794)	Y				Y	Y	Y			Y				
	Control Transformer (IS : 12021)	Y				Y	Y	Y			Y				Y
	LT Fuses (IS : 13703)	Y				Y	Y	Y							
	Energy Meters (IS : 722)	Y				Y	Y	Y			Y				Y
	Transducers (IEC : 60688)	Y				Y	Y	Y			Y				Y
	Diodes	Y	Y				Y	Y			Y				
	Terminal Blocks	Y	Y				Y	Y							
	Synthetic Rubber Gasket (IS : 11149 / 3400)	Y	Y			Y		Y							
	Breaker Handling Trolley	Y				Y	Y			Y	Y				
	HT Switchgear Panel IEC-62271-200)	Y				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes:

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. Make of all major Bought Out Items will be subject to NTPC approval.
 3. Temperature rise test reports for diode plates with actual heat sink will be verified.
- * CRCA Galvanized steel with metal coating composed of Al (55%), Zn (43.4%) & Si (1.6%),

SUB-SECTION-V-QE9

~~LT SWTIGCHGEAR~~

LT SWITCHGEAR

(MCC, PCC, ACDB, DCDB, FUSE BOARDS, LOCAL PUSH BUTTON STATION, LOCAL MOTOR STARTERS)

ATTRIBUTES CHARACTERIS-TICS → ↓ ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLY	Make, Model, Type, Rating & TC	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per NTPC Spec.	Item to conform to relevant	Pretreatment as per IS 6005	Paint Shade, Adhesion, Thickness	Functional Checks	Milli-volt drop Test	IR – HV – IR Test	Degree of Protection Routine test as per NTPC spec	All Routine tests as per NTPC
Sheet Steel (IS : 513)	Y	Y		Y	Y		Y							
Aluminum Bus bar Material (IS : 5082)	Y	Y	Y	Y	Y		Y							
Copper Bus bar Material (IS : 613)	Y	Y	Y	Y	Y		Y							
Support Insulator	Y	Y	Y	Y			Y							
Air Circuit Breaker (IS: 13947)	Y	Y				Y	Y		Y	Y				Y
Energy Meters (IS : 13010, 13779)	Y	Y				Y	Y		Y					Y
Power & Aux. Contactors (IS : 13947)	Y	Y				Y	Y		Y					
Protection & Aux. Relays (IS : 3231) (IEC 60255 / IEC 61850)	Y	Y				Y	Y		Y					Y
Control & Selector Switches (IS : 13947)	Y	Y				Y	Y		Y					
CT's & PT's (IS 2705 / 3156)	Y	Y					Y							Y
MCCB (IS : 13947)	Y	Y					Y		Y					
Indicating Meters (IS : 1248)	Y	Y				Y	Y		Y					Y
Indicating Lamps (IS : 13947)	Y	Y				Y	Y		Y					
Air Break Switches (IS : 13947)	Y	Y				Y	Y		Y					
Control Terminal Blocks	Y	Y				Y	Y							

LT SWITCHGEAR

(MCC, PCC, ACDB, DCDB, FUSE BOARDS, LOCAL PUSH BUTTON STATION, LOCAL MOTOR STARTERS)

ATTRIBUTES CHARACTERISTICS /	ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLY												
	Make, Model, Type, Rating & TC	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per NTPC Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint Shade, Adhesion, Thickness & Functional Checks	Milli-volt drop Test	IR – HV – IR Test	Degree of Protection Routine test as per NTPC spec	All Routine tests as per NTPC spec. & IS
Fuse (IS 13703)	Y	Y				Y	Y						
Control Transformer (IS : 12021)	Y	Y				Y	Y		Y				Y
Push Buttons (IS : 4794)	Y	Y				Y	Y		Y				
Transducer (IEC : 60688)	Y	Y				Y	Y		Y				Y
MCB (IS : 8828)	Y	Y				Y	Y		Y				
Breaker Handling Trolley	Y	Y				Y			Y	Y			Y
Synthetic Rubber Gasket (IS : 11149)	Y	Y		Y	Y		Y						
LT SWITCHGEAR (IS : 8623)	Y	Y				Y	Y	Y	Y	Y	Y	Y	Y

Notes:

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. Makes of all major Bought Out Items will be subject to NTPC approval.

LT BUSDUCT

ATTRIBUTES
CHARACTERISTICS

ITEM, COMPONENTS, SUB
SYSTEM ASSEMBLY

	Dimension & Surface Finish	Make, Type, Rating & TC	Electrical Properties	Mechanical Properties	Chemical Properties	Item to conform to relevant IS	WPS Approval, Welder Qualification	Weld Quality Check (DP test & x-ray	Paint Shade, Thickness, Adhesion &	Tightness by Torque measurement	Electrical Clearances	Galvanizing Test as per IS 2629/ 2633/	IR – HV – IR Test	Phase Sequence Check	Degree of Protection routine test as per NTPC spec.
Aluminum Sheets / Plates / Strips / Flexibles / tubes (IS : 5082 / 737)	Y	Y		Y	Y	Y	Y	Y							
CRCA Flats / ISMC (IS 2062)	Y	Y		Y	Y	Y									
Neoprene / Synthetic Rubber Gaskets (IS 11149 / 3400)	Y	Y		Y	Y										
Rubber Bellows (IS : 3400)	Y	Y		Y	Y										
Support Insulator (BS : 2782, IEC : 660, IS : 10912)	Y	Y	Y	Y											
Galvanized Structure & GI Earthing Flat (IS : 2629 / 2633 / 4749)	Y	Y				Y					Y				
Space Heater & Thermostat		Y	Y									Y			
LT Busduct (IS : 8623 PART 2)	Y	Y				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes:

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. Makes of all major Bought Out Items will be subject to NTPC approval.

SUB-SECTION-V-QE10

~~DIESEL GENERATORS~~



DIESEL GENERATOR SET

SQE_18

DIESEL ENGINE

ITEMS/COMPONENTS	Material Test	DP/MPI	UT(On forging and piston Bonding)	Balancing	Hydraulic/water fill test	Assy./fit up	Dimension	Functional/Operation test	Performance test as per BS-5514/or equivalent IS/ISO- Standard including Governing Test for 3 hors at full load and one hr at 10% overload	Fuel consumption, rated power measurement, rated speed	All other tests(if applicable) as per Spec./ relevant standard
Crank shaft	Y	Y	Y	Y							
Cylinder blocks/heads	Y				Y						
Liner/ Radiator	Y				Y						
Rotating/moving parts other than crank shaft	Y	Y									
Piston	Y	Y	Y								
Diesel Engine						Y	Y	Y	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 in line in case required as per agreement with NTPC.
 2. Make of all major BOIs will be subject to NTPC approval.

CLAUSE NO.

QUALITY ASSURANCE



ALTERNATOR

TESTS/CHECKS	Visual	Dimensional	Make/Type/Rating/TC/General Inspection	Mech/Chem. Properties	NDT /DP/MPI/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	All tests as per IS--4722	Vibration	Over speed	Tan delta, shaft voltage & polarisation index test
Plates for stator frame,end shield, spider etc.	Y	Y	Y	Y					Y									
Shaft	Y	Y	Y	Y	Y	Y			Y									
Magnetic Material	Y	Y	Y	Y	Y		Y			Y		Y						
Rotor Copper/Aluminium	Y	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	Y									
Insulating Material	Y		Y	Y			Y					Y						
Tubes for Cooler	Y	Y	Y	Y	Y				Y		Y							
Sleeve Bearing	Y	Y	Y	Y	Y				Y		Y							
Stator/Rotor, Exciter Coils	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									



ALTERNATOR

TESTS/CHECKS ITEMS/COMPONENTS	Visual	Dimensional	Make/Type/Rating/TC/General Physical Inspection	Mech/Chem. Properties	NDT /DP/MPI/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	All Routine tests as per IS-/IS-4722	vibration	Over speed	Tan delta, shaft voltage & polarisation index test
	Wound stator	Y	Y					Y	Y									
Wound Exciter	Y	Y					Y	Y										
Rotor complete	Y	Y					Y						Y	Y				
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y											
Accessories, RTD, BT, CT, AVR, Diodes, Space heater, antifriction bearing, cable glands, lugs, gaskets etc.	Y	Y	Y															
Alternator (IS 4722)	Y	Y	Y												Y	Y	Y	Y1

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 during QP finalisation.
 2. Make of all major BOIs will be subject to NTPC approval.
 Y1= for HT Machines only.



FINAL ASSEMBLY										
TESTS/CHECKS	Material Test	Dimension	WPS/PQR/Welding	NDT/DP/MPI/UT	Check completeness	Hydraulic/Leak/Pressure test	Functional Tests	All routine test as per Spec/ IS	No load test for 5 min & partial load for one hour of the DG set assembly	Clearances & Alignment
ITEMS/COMPONENTS										
Base frame	Y	Y	Y	Y	Y					
Fuel Tank	Y	Y	Y	Y	Y	Y				
Battery								Y		
Battery Charger								Y		
Control Panel								Y		
Assembled DG Set		Y			Y		Y		Y	Y

NOTES:

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 during finalisation of QP.
2. Make of all major Bought Out Items will be subject to NTPC approval.

SUB-SECTION-V-QE11

~~AUXILIARY TRANSFORMERS~~

CLAUSE NO.

QUALITY ASSURANCE



AUXILIARY / LT TRANSFORMER

Attributes / Characteristics Items/Components Sub Systems	Visual & Dimensional Checks	Mechanical properties	Electrical strength	Thermal properties	Chemical Composition	Compatibility with oil	NDT / DPT / MPI / UT	Ageing Test.	Voltage Ratio, Vector Group & Polarity, Magnetic Balance Test	Make / Type / Rating / Model / TC / General Physical Inspection.	Functional check	WPS & PQR	Routine Test as per relevant standard / NTPC Specification
Tank, H.V. & L.V. Cable Box / Flange throat	Y	Y					Y					Y	
Conservator / Radiator / Cooler / Pipes	Y	Y					Y						
Copper Conductor (IS:191)	Y	Y	Y		Y								
Insulating Material	Y	Y	Y	Y	Y	Y							
CRGO Lamination & Built Core	Y	Y	Y		Y	Y				Y			
Bushing / Insulator (IS:2544 / 5621)	Y	Y								Y			Y
Gasket	Y	Y			Y	Y		Y		Y			Y
Transformer Oil (IEC296)			Y										Y
OLTC / Off-Circuit Tap Changer	Y									Y			Y
Core Coil Assembly & Pre-tanking	Y								Y	Y			
Marshalling Box	Y									Y	Y		Y
WTI, OTI, MOG, PRD, Breather, Terminal Connector, Bucholz Relay, Valves	Y									Y	Y		
Welding (ASME Sect-IX)	Y						Y					Y	
Complete Transformer (IS:2026/ IEC-60076)	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) All major Bought Out Items will be subject to NTPC approval.													

SUB-SECTION-V-QE12

~~ELEVATOR~~

Passenger/ Service Elevators

TEST /CHECK ITEM	Material Test	DPI/MPI	Ultrasonic Test	Dimensions/Physical	Functional/ Operational Test/ Run Test	Performance Test	Other Tests	All routine tests as per applicable standard	Plain shade, thickness & adhesion	Assembly/fit up
Shaft/ /Gears/Pinion/Pulley/Sheave	Y	Y	Y	Y						
Spring	Y	Y	Y	Y				Y		
Plates	Y			Y						
Wire rope				Y			Y5			
Safety device								Y		
Geared Machine					Y					
VVVF Drive					Y			Y		
Power, Control & Trailing Cables								Y4		
Control Panel				Y					Y	
ARD System					Y			Y		
Electrical motor								Y		
Controller assembly with VVVF drive					Y		Y3			
Complete Elevator				Y	Y1	Y1	Y2			Y

Y1 –Test to Be Done At Site

Y2 - Load/Overload Test to Be Done At Site as Applicable.

Y3 – Burn in test on electronic card

Y4 – Routine tests including FRLS tests as per Tech. Spec.

Y5- Test report as per relevant std.

NOTE: 1. This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the applicable practices and procedures followed along with relevant supporting documents during QAP finalization.

2. Makes of all bought out items shall be subject to NTPC approval

SUB-SECTION-V-QE13

VFD MODULE

VFD MODULE SQE_28

ATTRIBUTES / CHARACTERISTICS ITEMS/COMPONENTS, SUB SYSTEM ASSEMBLY	Visual & Dimensional checks	Make / Type / Rating etc.	Final Inspection as ISS / IEC	Remarks
HT Breaker (IEC 56)	Y	Y	Y	
DC Reactor	Y	Y		For details refer table for DC Reactor
Transformer	Y	Y		For details refer table for Transformer
Motor	Y	Y		For details refer separate table for Motor
VFD Panel	Y	Y		For details refer table for VFD

Note : 1) This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed alongwith relevant supporting documents during QP finalisation.

2) Make of all major Bought Out Items will be subject to NTPC approval.



DC REACTOR

ATTRIBUTES / CHARACTERISTICS ITEMS/COMPONENTS, SUB SYSTEM ASSEMBLY	Visual	Dimensional	Mech. & Chem. Property	Electrical Characteristics	Pretreatment by Seven Tank	Painting by Stove Enameling	Final Inspection as per IS-2026	Welding/NDT
Winding Material (Aluminium)	Y	Y	Y	Y				
Insulation Material	Y	Y		Y				
Sheet Steel	Y	Y	Y					
Winding	Y	Y		Y				
Fabrication of Enclosures	Y	Y			Y	Y		Y
Assembly	Y	Y						
Routine Tests	Y	Y					Y	

Note : 1) This is an indicative list of tests/checks. The manufacturer to furnish a detailed Quality Plan indicating their practice & procedure along with relevant supporting documents during QP finalisation for all items.

2) All major Bought Out Items will be subject to NTPC approval.



TRANSFORMER (OIL FILLED)

Attributes / Characteristics Items/Components Sub Systems	Visual & Dimensional Checks	Mechanical properties	Electrical strength	Thermal properties	Chemical Composition	Compatibility with oil	NDT / DPT / MPI / UT	Ageing Test.	Voltage Ratio, Vector Group & Polarity, Magnetic Balance Test	Make / Type / Rating / Model / TC / General Physical Inspection.	WPS & PQR	Routine Test as per relevant test	Routine Test
Tank, H.V. & L.V. Cable Box / Flange throat	Y	Y					Y						
Conservator / Radiator / Cooler / Pipes	Y	Y					Y						
Copper Conductor (IS:191)	Y	Y	Y		Y								
Insulating Material	Y	Y	Y	Y	Y	Y							
CRGO Lamination & Built Core	Y	Y	Y		Y	Y							
Bushing / Insulator (IS:2544 / 5621)	Y	Y								Y		Y	
Gasket	Y				Y	Y		Y				Y	
Transformer Oil (IS:335 / IEC296)												Y	
Off-Circuit Tap Changer	Y									Y			
Core Coil Assembly & Pre-tanking	Y								Y				
Marshalling Box	Y	Y					Y					Y	
WTI, OTI, MOG, PRD, Breather, Terminal Connector, Bucholz Relay, Globe & Gate Valve,	Y									Y			
Welding (ASME Sect-IX)	Y										Y		
Complete Transformer (IS:2026/ IEC-60076)	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) All major Bought Out Items will be subject to NTPC approval.



DRY TYPE TRANSFORMER

Attributes / Characteristics	Visual & Dimensional check	Mechanical properties	Electrical strength	Thermal Properties	Chemical Properties	NDT / DP / MPI	Voltage Ratio, Vector Group & Polarity	Make / Type / Rating / Model /TC / General Physical Inspection	WPS & PQR	Routine Test as per relevant standard	Measurement of capacitance & tan delta between winding	Routine Test
Items/Components Sub Systems												
Enclosure door, H.V. & L.V. Cable Box / Flange Throat	Y	Y						Y				
Copper Conductor	Y	Y	Y		Y							
Insulating Material	Y			Y	Y							
CRGO Lamination & Built Core	Y											
Bushing /Insulator (IS:2544 / 5621)	Y							Y		Y		
Gasket	Y							Y		Y		
Off-Circuit Tap Changer	Y							Y				
Core Coil Assembly	Y						Y					
Marshalling Box	Y									Y		
WTI, Thermister, Terminal Connector	Y							Y				
Welding									Y			
Complete Transformer (IS:11171 / IEC 60076)	Y										Y	Y

Notes: 1) This is an indicative List of test/checks. The manufacturer is to furnish a detailed Quality Plan indicating his practice and procedure along with relevant supporting documents during QP finalization for all item.

2. All major Bought out Items will be subject to NTPC approval.



VFD PANEL

Attributes Characteristics	Item Components Sub System Assembly	Electrical Properties	Mechanical Properties	Chemical Properties	Dimensions / Finish	Type/ Rating/Functional check	HV/IR	Routine test as per relevant std.	Constructional Features	IS:6005 ,Seven tank process	Paint finish/ shade/thickness	Mountings / BOM/ Make, Completeness	Interlock Functional & Operation Testing / Simulation check	Degree of Protection Test	Final testing as per Relevant
		Sheet Steel (IS-513)		Y	Y	Y									
Aluminum / Copper Bus-bar (IS-5082/IS-613/IS-1987)		Y	Y	Y	Y										
Support Insulator (BS-2782/IEC-660/IS-10912)		Y	Y	Y	Y										
Control / Selector Switch (IS-6875)						Y	Y	Y							
Contactors/ MCB (IS-13947)						Y	Y	Y							
O/L Protection relays (IS-3231)						Y		Y							
C.T /V.T/ Indicating Meter (IS-2705/3156/1248)						Y	Y	Y							
Fuse/ Fuse carrier (IS-13703)						Y	Y	Y							
Terminals/lugs/pvc wires (IS-13947//IS-694)		Y			Y	Y	Y	Y							
Timers (IS-3231)						Y	Y	Y							
Push Button/ Lamp/ (IS-6875)						Y	Y	Y							
Control Transformer (IS-12021)						Y	Y	Y							
Mimic, Annunciater						Y		Y							
GASKET (IS-11149)			Y	Y	Y	Y		Y							
Fabrication									Y						
Pretreatment & Painting										Y	Y				
VFD panel											Y	Y	Y	Y	Y

NOTE:

1. This is an indicative list of Test/ Checks. The manufacturer to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. All major Bought Out Items will be subject to NTPC approval.

SUB-SECTION-V-QE14

~~STATION LIGHTING~~

STATION LIGHTING

SQE_17

Item Components Sub System Assembly Attributes Characteristics	Make, Type , Rating/ TC	Dimension	Pre-Treatment of sheat	Paint Shade Thickness Adhesion & Finish	Galvanization Tests	IP Test	Bought Out Items/ Bill of Material	HV & IR	Functional Check as per spec.	Constructional Feature as per NTPC spec.	Routine Test as per relevant std and spec	Acceptance Test as per relevant std and spec	Item to conform to relevant standard
Luminaries (IS-10322 Part-5 Sec.1 (non –LED type)	Y					Y		Y			Y	Y	Y
Electronic Ballast	Y										Y	Y	Y
Lighting Wire (IS-694)	Y										Y		
Fans (IS-374)	Y										Y		
Pole (IS-2713)	Y			Y					Y		Y	Y	
Lamps (IS-9800, IS-9974)	Y										Y	Y	
Lighting Mast (with raise & lower lantern type)	Y	Y			Y				Y		Y	Y	
Wall Mounted Lighting Panel (IS-513, IS-5)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Switch Box/ Junction Box/Receptacles/ Local Push Button Station / Lighting Panel (IS-513, 2629, 2633, 4759, 6745)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Cable Gland (BS-6121)	Y	Y									Y		
Cable Lug (IS-8309)	Y	Y									Y		
Flexible Conduit	Y										Y		
Lighting Transformer (IS-11171)	Y								Y	Y			
Epoxy & Galvanised Conduit (IS-9537, 2629, 2633, 4759, 6745)	Y	Y									Y		Y

LED Luminaire quality requirements:

- 1) LED modules to conform to IS: 16103 part 2. Manufacturer to issue a certificate of compliance for the same.
- 2) Control gear to conform to IS 15885 part 2 section 13. Manufacturer to issue a certificate of compliance for the same.
- 3) LED luminaire to conform to IS 16107 part 2 section 1. Manufacturer to issue a certificate of compliance for the same.
- 4) LED luminaire marking to be as per IS 16107 part 2 section 1. Manufacturer to issue a certificate of compliance for the same.
- 5) Acceptance tests as per IS 16107 part 2 section 1 to be carried out on LED luminaire except long duration tests i.e. a) Chromaticity coordinates & correlated color temperature (CCT); b) Color rendering index (CRI). Manufacturer will submit a COC for above tests i.e. CCT & CRI
- 6) LED driver make, model, type & rating may be as per recommendations of LED module manufacturer.

Notes:

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. Make of all major Bought Out Items will be subject to NTPC approval.

~~(CONTROL & INSTRUMENTATION SYSTEM)~~

SUB-SECTION-V-QC1

**MEASURING INSTRUMENTS
(PRIMARY & SECONDARY)**

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY) Page- 1/2

ITEMS	TESTS									
	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Test as per standard(R)	Insulation Resistance (R)	IBR Certification (if applicable)(R)	Hydro Test(R)	Material Test certificate ®	
1. PR Gauge (IS-3624)	Y	Y	Y	Y	Y					
2. Temp. Gauge (BS-5235)	Y	Y	Y	Y	Y					
3. Pr./D.P.Switch(BS-6134)	Y	Y	Y	Y	Y	Y				
4. Electronic Transmitter(IEC-60770)	Y	Y	Y	Y	Y	Y				
5. Temp. Switch	Y	Y	Y	Y	Y	Y				
6. Recorder(IS-9319/ANSI C-39.4)	Y	Y	Y	Y	Y	Y				
7. Vertical indicators	Y	Y	Y	Y		Y				
8. Digital Indicators	Y	Y	Y	Y		Y				
9. Integrators	Y	Y	Y	Y						
10. Electrical Metering Instrument (IS-1248)	Y	Y	Y	Y	Y	Y				
11. Transducer (IEC-688)	Y	Y	Y	Y	Y	Y				
12. Thermocouples (IEC – 754 / ANSI-MC-96.1)	Y	Y	Y	Y	Y	Y				
13. RTD(IEC-751)	Y	Y	Y	Y	Y	Y				
14. Thermowell	Y		Y				Y	Y	Y	

R-Routine Test A- Acceptance Test Y – Test applicable

Note: 1) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY) Page- 2/2

ITEMS	TESTS											
	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Requirement as per standard (R)	WPS approval (A)	Non-destructive testing (R)	Calculation for accuracy (R)	Insulation Resistance (R)	IBR Certification as applicable (R)	Hydro test (R)	Material test certificate (A)
15. Cold junction compensation box	Y	Y	Y	Y				Y				
16. Orifice plate(BS-1042)	Y	Y	Y	Y*	Y	Y**	Y**		Y	Y**	Y	
17. Flow nozzle(BS-1042)	Y	Y	Y	Y*	Y	Y	Y		Y	Y	Y	
18. Impact head type element	Y	Y	Y				Y					Y
19. Level transmitter/float type switch	Y	Y	Y	Y				Y	Y	Y	Y	
20. Analysers	Y	Y	Y	Y								
21. Dust emission monitors	Y	Y	Y	Y								
*Calibration to be carried out on one flow element of each type and size if calibration carried out as type test same shall not be repeated.												
** If applicable												
R-Routine Test A- Acceptance Test Y – Test applicable												
Note: 1) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.												

SUB-SECTION-V-QC2

~~INSTRUMENTATION CABLES~~



INSTRUMENTATION CABLE

ITEMS	TESTS														
	Conductor Resistance ® & (A)	High Voltage ® & (A)	Insulation Resistance ® & (A)	Constructional detail, dimensions (A)	Outer-Sheathe/core marking, end sealing (A)	Thermal Stability (A) +	Visual, Surface finish (A) +	Electrical Parameters ** (A) +	Persulphate Test (A) +	Overall/Coverage/Continuity (A)	Swidesh chimney Test (SS-4241475) (A) ++	FRLS Test * (A) ++	Tensile & Elongation before & after aging (A) ++	Vol. Resistivity. at room & Elevated Temp. (A) ++	Spark test report review ®
1. Instrument cable twisted and shielded															
Conductor(IS-8130)	Y			Y		Y									
Insulation(VDE-207)				Y	Y	Y	Y						Y		Y
Pairing/Twisting				Y	Y		Y								
Shielding				Y			Y			Y					
Drain wire	Y			Y			Y		Y	Y					
Inner Sheath				Y	Y	Y	Y					Y	Y		
Outer Sheath				Y	Y	Y	Y					Y	Y		
Over all cable	Y	Y	Y	Y	Y		Y	Y			Y			Y	
Cable Drums(IS-10418)				Y			Y								

Note : High Temp. cables shall be subjected to tests as per VDE-207(Part-6) Compensating cables shall be checked for Thermal EMF/Endurance test as per IS 8784.

Note : This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating his practice & Procedure along with relevant supporting documents during QP finalization for all items.

Note : ® - Routine Test A - Acceptance Test Y - Test Applicable

Note : Sampling Plan for Acceptance test shall be as per IS 8784 (As applicable)

- * FRLS Tests: Oxygen / Temp Index (ASTM D-2863), Smoke Density Rating (ASTM – D 2843), HCL Emission (IEC-754-1)
- ** Characteristic Impedance, Attenuation, Mutual Capacitance, Cross Talk (As applicable)

+ Sample size will be One No. of each size/type per lot.

++ Sample size will be One No. sample for complete lot offered irrespective of size/type.

SUB-SECTION-V-QC3

POWER SUPPLY SYSTEM



POWER SUPPLY FOR C&I SYSTEMS (UPS/BATTERY/BATTERY CHARGER/ACDB/DCDB)

ITEMS	TESTS																
	Visual/dimension/rating/ Paint Adhesion/ Thickness (R)	General arrangement/BOM/make of components /Mimic.®	Efficiency ,regulation(R)	Input voltage variation (A)	Output voltage and frequency adj.range(A)	Preliminary light load test(R)	Load transfer retransfer test (R) *	AC input failure and return test (R)	Parallel operation and current division(R)	Relative harmonic content(R)	Restart with PRI A.C and battery (separately)(R)	System transfer and retransfer (R)*	Asynchronous transfer(R)	Ripple content(R)	Load limiter operation (R)	IR/HV(R)	Tests as per standard &specification (R)&(A)
UPS/CONVERTER (IEC-146 PT-4)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
VOLTAGE STABILISER	Y	Y	Y	Y	Y				Y		Y				Y		
LEAD ACID BATTERY(TUBLAR)-IS-1651																	Y
LEAD ACID BATTERY (PLANTE)-IS-1652																	Y
NICKEL CADMIUM BATTERY(IS-10918/IEC-623)																	Y
SMF BATTERY																	Y
ACDB/DCDB	Y	Y														Y	Y
BATTERY CHARGER	Y	Y	Y	Y	Y			Y					Y	Y	Y	Y	Y


R-Routine Test A- Acceptance Test Y – Test applicable


* Transfer time and Over shoot /under shoot during load & system transfer shall be recorded .

Note: 1) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.


SUB-SECTION-V-QC4


~~DDCMIS~~


CLAUSE NO.	QUALITY ASSURANCE																		
<p>1.00.00</p> <p>1.01.00</p>	<p>REQUIREMENTS OF AUTHORISATION-TO-SHIP-TEST (ATST) FOR DDCMIS</p> <p>(a) Authorization-to-ship-test (ATST) or Factory Acceptance Test (FAT) (both terms have been used interchangeably) shall include all required tests to fully demonstrate to Employer's satisfaction that each equipment/sub-system/system as well as software modules furnished as per this specification as well as DDCMIS as a whole, fully meets the functional, parametric and other requirements of this specification and Employer's approved drawings/documents under all operating regimes. The procedure defined here is applicable for one DDCMIS system. Number of DDCMIS systems and their sub-systems shall be as defined in Part-A of technical specifications.</p> <p>(b) Contractor to note that ATST / FAT procedure given below in subsequent clauses are only indicative in order to help the Contractor in understanding the requirements and help him in submitting a detailed procedure based on these guidelines meeting all the specification requirements.</p> <p>(c) The results of the following activities shall be made available to the Employer's representative before start of ATST / FAT.</p> <p>(i) Compliance check for Major Design Feature (including Customisation if any), as per Part-C, GTR or agreements regarding this.</p> <p>(ii) Implementation check of various applications including those based on NTPC input, as per Part-C, GTR or agreements regarding this.</p> <p>(d) Generally, the ATST / FAT shall be carried out with the equipment earmarked for the particular project and unit. However, for the following item, the testing can be carried out with similar / equivalent dummy equipment fulfilling the following condition, subject to Employer's approval.</p> <table border="1"> <thead> <tr> <th>SN</th> <th>ITEM</th> <th>CONDITION</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>LVS</td> <td>Testing of LVS functionalities can be done by using monitors connected to the LVS Workstations. Dispatch of LVS can be allowed like a cat-III item, but only after successful testing of functionalities as indicated above.</td> </tr> <tr> <td>2</td> <td>LVS WS / OWS</td> <td>LVS WS / OWS for the first unit to be tested on the target machines. In case the testing carries over to next unit, dummy equipment may be used. Dispatch of LVS WS / OWS of subsequent units can be allowed like a cat-III item, but only after successful testing of first unit as indicated above.</td> </tr> <tr> <td>3</td> <td>MASTER CLOCK</td> <td>Can be directly dispatched if alternate test set-up for time synchronization can be arranged.</td> </tr> <tr> <td>4</td> <td>NETWORK COMPONENT</td> <td>To be done with target machines only for first unit. In case the testing carries over to next unit, dummy equipment may be used. Dispatch of network components of subsequent units / station can be allowed like a cat-III item, but only after successful testing of functionalities as indicated above.</td> </tr> </tbody> </table>				SN	ITEM	CONDITION	1	LVS	Testing of LVS functionalities can be done by using monitors connected to the LVS Workstations. Dispatch of LVS can be allowed like a cat-III item, but only after successful testing of functionalities as indicated above.	2	LVS WS / OWS	LVS WS / OWS for the first unit to be tested on the target machines. In case the testing carries over to next unit, dummy equipment may be used. Dispatch of LVS WS / OWS of subsequent units can be allowed like a cat-III item, but only after successful testing of first unit as indicated above.	3	MASTER CLOCK	Can be directly dispatched if alternate test set-up for time synchronization can be arranged.	4	NETWORK COMPONENT	To be done with target machines only for first unit. In case the testing carries over to next unit, dummy equipment may be used. Dispatch of network components of subsequent units / station can be allowed like a cat-III item, but only after successful testing of functionalities as indicated above.
SN	ITEM	CONDITION																	
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<p>NCTPP DADRI ST-II(2x490MW) & IGSTPP,JHAJJAR(3x500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE)</p>	<p>BID DOC. NO.: CS-6130/0330-109-9</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B</p>	<p>SUB-SECTION – V-QC4 DDCMIS</p>	<p>PAGE 1 OF 7</p>															


CLAUSE NO.	QUALITY ASSURANCE												
<p>1.01.01</p> <p>1.01.02</p>	5	VARIOUS BUS SYSTEM CABLES	For FAT, the target Main system bus shall be used. In case the testing carries over to next unit, dummy equipment may be used.										
	<p>The Authorisation-To-Ship-Test (ATST) shall include all reasonable exercises which the combination of equipment and software can be expected to perform. These tests shall be divided into, as a minimum, but not limited to the following categories:</p> <table border="1"> <tr> <td>(a)</td> <td>Hardware tests</td> <td></td> </tr> <tr> <td>(b)</td> <td>Functional tests</td> <td></td> </tr> <tr> <td>(c)</td> <td>Parametric test</td> <td></td> </tr> </table> <p>All reference documents like all approved drawings / documents, NTPC specifications, DDCMIS system manuals, etc. shall be available at the start of ATST. The Quality Assurance related tests shall be as per approved QP (Quality Plan) for DDCMIS. The ATST tests are briefly described in subsequent clauses.</p> <p>Hardware tests</p> <p>These tests shall include but not be limited to the following tests. These tests will be conducted on full population on sample basis as finalized during ATST procedure finalization and NTPC engineer's decision during ATST.</p> <p>(a.) Verification of healthiness of all types of modules e.g., I/O modules, controller modules, processors, peripherals, etc. on a sample basis.</p> <p>(b.) System configuration:</p> <p>(1.) Verification of system configuration with reference to approved configuration diagrams including verification of controller configuration, group / sub-group segregation, grouping of controllers, I/O redundancy, verification of multiple measurement scheme, HMIPIS configuration, etc.</p> <p>(2.) Verification of major features of complete DDCMIS like on line removal of I/O and controller modules, etc. in line with specification requirements.</p> <p>(3.) Verification of spare capacity for example spare channels, spare wired-in space in cabinets/ cubicles, terminal blocks, peripherals, etc. as per approved documents.</p> <p>(c.) Simulation of inputs / Outputs</p> <p>System shall have feature to simulate/ forcing I/Os on OWS / LVS OWS. Additionally hardware simulation of I/Os shall be available for specific applications like fail safe system.</p> <p>(d.) Accuracy test:</p> <p>System accuracy for each type of analog input shall be demonstrated on sample basis, if this test is not carried out in MDFT.</p> <p>(e.) Demonstration of the manual and auto switchover from master to standby system bus, controllers, I/Os, processors etc.</p> <p>(f.) Loop reaction time shall be demonstrated for loops / logics / functions applicable as per specification and ATST procedure.</p>			(a)	Hardware tests		(b)	Functional tests		(c)	Parametric test		
(a)	Hardware tests												
(b)	Functional tests												
(c)	Parametric test												
NCTPP DADRI ST-II(2x490MW) & IGSTPP,JHAJJAR(3x500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE)	BID DOC. NO.: CS-6130/0330-109-9	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION – V-QC4 DDCMIS	PAGE 2 OF 7									

CLAUSE NO.	QUALITY ASSURANCE			
1.01.03	<div style="text-align: right; border: 1px solid black; padding: 2px; width: fit-content; margin: 0 auto;">एनटीपीसी NTPC</div> <p>(g) SOE function shall be tested as follows, where the same is applicable (refer Part-A of specifications). For SER function, verification of resolution of SOE inputs, time synchronization with master clock, data base modification, SOE report, printout, other features etc. For this purpose a test-simulator to generate sequences of 1 ms resolution for 50 points (or as agreed during finalization of ATST procedure) distributed in different panels shall be made available during testing.</p> <p>(h) Power supply: Testing of power supply system to DDCMIS, tolerance of DDCMIS w.r.t. voltage & frequency limits as specified, performance of DDCMIS with power supply break as specified .(One sample of each type)</p> <p>(i) Diagnostics Tests : On – line diagnostic tests on HMIPIS, individual peripherals, Control System, programmer stations, etc.</p> <p>Functional Tests</p> <p>The following tests shall be carried out on Contractor’s DDCMIS.</p> <p>(a.) Functional tests of CLCS:</p> <ol style="list-style-type: none"> (1.) Verification of proper signal acquisition, conditioning and distribution, 2 transmitters / 3 transmitter selection. (2.) Verification of proper realization of controller functions like bump less transfer from auto to manual and vice versa, functional checking of bias circuit (wherever provided), etc. (3.) Verification of response of control system by simulating changes in the system inputs in line with the approved ATST procedure. (4.) Verification of signal exchange between FGs and from other systems (if applicable) <p>(b.) Functional tests of OLCS:</p> <ol style="list-style-type: none"> (1.) Verification of proper signal acquisition, conditioning and distribution, 1v2, 2v3 implementation. (2.) Verification of proper realization of logic functions, sequence control functions, running of complete start up program sequence in all modes of operation, shut down program, etc. (3.) Verification of logic computation in controller by simulating inputs. (4.) Verification of signal exchange between FGs and from other systems (if applicable) <p>(c.) Functional tests for HMIPIS</p> <ol style="list-style-type: none"> (1.) Verification of all types of displays, logs including their formats, bar graphs, X-Y plots etc. availability of all operator functions. 			
NCTPP DADRI ST-II(2x490MW) & IGSTPP,JHAJJAR(3x500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE)	BID DOC. NO.: CS-6130/0330-109-9	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION – V-QC4 DDCMIS	PAGE 3 OF 7

CLAUSE NO.	QUALITY ASSURANCE			
<p>1.01.04</p>	<div style="text-align: right; font-weight: bold; font-size: small;">  </div> <p>(2.) Verification of event generation and handling capabilities of HMIPIS processors by simulating various types of events/data and observing associated event sequence display and alarms..</p> <p>(3.) Calculations: All calculations shall be tested on sample basis to demonstrate that these are in accordance with the specification and Employer's inputs as applicable. The Contractor shall prepare all tests cases for calculations for proper verification for the features required for each type of computations.</p> <p>(4.) Checking historical storage and retrieval functions including long term storage.</p> <p>(5.) Testing of initialization and loading of configuration data, etc.</p> <p>(6.) Verification of all programmer's stations functions for HMIPIS and Control System, as well as for documentation facility as specified.</p> <p>(7.)</p> <p>(8.) Testing of each peripheral viz., monitors, printers, optical disks, hard disk drive, etc.</p> <p>(9.)</p> <p>(10.) Testing of time synchronisation function of system time of DDCMIS (Control System, HMIPIS & Systems on LAN). In case it is not possible to bring the master clock procured under this package, then signal generator with stable source, capable of generating all required type of synchronizing signal to be arranged by Contractor.</p> <p>(11.) Testing of the Station LAN shall be carried out with unit DDCMIS (with panels), standalone DDCMIS (with panels or software simulation) and at least one (1) other DDCMIS system (with panels or software simulation), as well as two client PC's, one third party PLC and Numerical relay system (if applicable). Bidder shall arrange a PC with OPC server (excluded from his scope of supply) which shall be used by the Bidder to simulate signal exchange between Bidder's Station LAN and third party PLC during the testing of Station LAN, at Bidder's works.</p> <p>(12.) Unified HMIPIS: Testing of Unified HMIPIS functionality as per respective approved documents.</p> <p>(d.) Security Audit (as applicable)</p> <p>(1.) For checking compliance to the security policies & procedures in Station LAN/HMI of all DDCMIS, security audit by a certified auditor (as per CERT-IN panel) is to be arranged by the Contractor during ATST. This shall include vulnerability assessment of the workstations/ servers and penetration testing of the Station LAN through the firewall from a node outside the network. Suitable actions based on the findings of the security audit shall be carried out by the Contractor.</p> <p>Parametric tests</p> <p>Following tests shall be carried out to test Contractor's DDCMIS w.r.t. specification requirements.</p>			
	<p>NCTPP DADRI ST-II(2x490MW) & IGSTPP,JHAJJAR(3x500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE)</p>	<p>BID DOC. NO.: CS-6130/0330-109-9</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B</p>	<p>SUB-SECTION – V-QC4 DDCMIS</p>

CLAUSE NO.	QUALITY ASSURANCE				
	<p>(a.) For control system (CLCS+OLCS):</p> <ol style="list-style-type: none"> (1.) CPU loading (2.) Cycle time/controller reaction time. (3.) Memory spare capacity <p>(b.) For MMIPIS</p> <ol style="list-style-type: none"> (1.) CPU loading (2.) Spare duty cycle (3.) Spare memory capacity <p>(c.) Spare duty cycle for system bus</p> <p>(d.) Various display & command response time</p> <p>(e.) System accuracy (if not carried out in MDFT)</p> <p>(f.) Display update time on OWS LVS</p> <p>Parametric tests of Unified HMIPIS for complete Unit DDCMIS shall also be carried out, if specified in Part-A of specifications.</p>				
1.02.00	<p>Integrated Test Set-Up</p>				
	<p>For integrated testing of the total DDCMIS system, the Contractor shall employ a test set-up, which will be capable of generating I/O signals in a requisite manner. It is preferable to adopt soft signal simulating device to avoid / minimise the cumbersome process of physical connection of I/Os through potentiometers, switches, Lamps / LEDs etc. The exact configuration / set-up shall be as finalized during detailed engineering.</p>				
1.02.01	<p>The Contractor is to submit Authorisation-To-Ship-Test (ATST) procedure and requirements of above and other applicable clauses of this specification. Since, the exact definition & extent / parameters of ATST can be finalized only when the engineering of DDCMIS has been finalized to a great extent, it is required that the detailed draft ATST procedure be submitted by the Contractor at a later date as intimated by the Employer during engineering stage for Employer's comment and finalization. Contractor shall incorporate all modifications, additions/ deletions to the ATST procedure as indicated by the Employer. The ATST shall be conducted as per Employer approved procedure for ATST. The Employer reserves the right to ask the Contractor to conduct any other test not covered in ATST procedure also during the ATST which may be required to fully satisfy the Employer regarding full compliance with specification requirements. Contractor shall conduct all such tests also within the quoted lump sum price for this contract.</p>				
1.02.02	<p>The results of all ATS Tests shall be properly documented by the Contractor and submitted to Employer along with all annexures.</p>				
1.02.03	<p>Following the tests, if in the opinion of the Employer, the system has not been adequately manufactured, programmed, tested or debugged the Contractor shall make good all deficiencies, and re-run the test to fully satisfy the Employer regarding full compliance with specification requirements and requisite quality standards.</p>				
1.02.04	<p>The system shall not be shipped without approval of Employer in writing.</p>				
<p>NCTPP DADRI ST-II(2x490MW) & IGSTPP,JHAJJAR(3x500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE)</p>	<p>BID DOC. NO.: CS-6130/0330-109-9</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B</p>	<p>SUB-SECTION – V-QC4 DDCMIS</p>	<p>PAGE 5 OF 7</p>	

CLAUSE NO.	QUALITY ASSURANCE				
1.02.05	Upon successful completion of Authorisation-To-Ship Test, the Employer will provide the Contractor with a written authorisation for shipment of the system equipment to the project site.				
1.02.06	All final documentation as per requirement of this specification shall be available at the time of Authorisation-To-Ship-Test and this shall be dispatched along with the equipment in required number of copies.				
1.02.07	Contractor shall note that no payments towards dispatch of equipment and subsequent activities shall be due and payable to the Contractor till the Contractor is able to successfully demonstrate to Employer's satisfaction that the DDCMIS and parts thereof fully meet the Authorisation-To-Ship Test requirements.				
1.02.08	The ATST or FAT of DDCMIS shall be conducted at the employer approved works of the DDCMIS supplier or DDCMIS Supplier's Associate. Further DDCMIS shall be supplied from the same works.				
2.00.00	The ATST requirements as indicated above shall form an integral part of QAP (Quality Assurance Plan) of DDCMIS system(s) envisaged for the package/project. Over and above the tests and requirement indicated above, the QP for DDCMIS system shall be submitted to employer for approval. The QAP envisaged for the offered DDCMIS system for employer shall also include testing of following attributes of the offered system by Employer.				
2.01.00	The tests indicated in the following QA tables are indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents, if desired by employer.				
NCTPP DADRI ST-II(2x490MW) & IGSTPP, JHAJJAR(3x500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE)	BID DOC. NO.: CS-6130/0330-109-9	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION – V-QC4 DDCMIS	PAGE 6 OF 7	

CLAUSE NO.	QUALITY ASSURANCE										
DISTRIBUTED DIGITAL CONTROL MONITORING & INFORMATION SYSTEM (DDCMIS)											
TESTS											
ITEMS	Pre Power on Check (#) (R)	Post Power on Check (%) (R)	Internal cabling / Wiring checking(R)	Door Alignment, waviness, and Locking (R)	Louvers, Fans, wire mesh, Lifting arrangement (R)	HV / IR on wired panels (R)	Paint Shade, Thickness and Illumination (R)	Hardware/Make as per BOM (R)	Dimensions, GA, layout (R)	Software Reliability/Quality Certification	
DDCMIS											
DDCMIS CUBICLES	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
OWS and Peripherals								Y		Y	
R-Routine Test	A- Acceptance Test					Y – Test applicable					
<p>Note: 1) Detailed procedure of Environmental Stress Screening test shall be as per Quality Assurance Programme in General Technical Conditions. Requirement of test and procedure finalized during QP finalization.</p> <p>2) These test are minimum requirement and necessary covered in Manufacturing Quality Plan and manufacturer is also need to include their practices and Procedure in MQP along with relevant supporting documents.</p> <p># Pre power on check: - Wire dressing, looseness, Availability of Fuses and MCB, Modules are inserted properly, Earthing connection, Input Voltage checking, Availability of resistance matt near panels, Availability of Electro Static Discharge measure for electronics components.</p> <p>% Post Power On Check: - Current & power consumption of DDCMIS Cabinets, I/O check as per signal flow.</p>											

SUB-SECTION-V-QC5

~~CONTROL VALVE ACTUATORS AND ACCESSORIES~~

SUB-SECTION-V-QC6

ELECTRICAL ACTUATOR WITH INTEGRAL STARTERS



ELECTRICAL ACTUATOR WITH INTEGRAL STARTER

Test/Attributes Characteristics														
ITEM/ COPONENT/ SUB SYSTEM ASSEMBLY/ TESTING	RPM ®	No Load Current ®	IR & HV Test®	Mounting Dimension®	All routine Test as per Standard & Specification®	Correct Phase Sequence®	Operation & Setting of limit Switch/Torque Switch®	Stall Torque/Current (A)	Hand Wheel operation/ Auto de clutch function (A)	Function of Aux. like Potentiometer, space heater, position indicator ®	EPT output ®	Grease leakage ®	Local/ Remote (Open-Stop-Close) Operation®	Safety check (Single phasing, Phase correction, Tripping etc.) (A)
ELECTRICAL ACTUATOR WITH INTEGRAL STARTER(IS_9334)														
Motor	Y	Y	Y	Y	Y									
Final Testing	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
<p>Note: 1) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the practices and procedure adopted along with relevant supporting documents.</p> <p>® - Routine Test (A) - Acceptance Test Y - Test applicable</p>														

(CIVIL WORKS)
SUB-SECTION-V-QD1

Clause No	QUALITY ASSURANCE PROGRAMME
	<p style="text-align: center;">SAMPLING, TESTING AND QUALITY ASSURANCE FOR CIVIL WORKS</p> <p>1.0.0 INTRODUCTION</p> <p>1.1.0 This part of the specification covers the sampling, testing and quality assurance requirement (including construction tolerances and acceptance criteria) for all civil and structural works covered in this specification including excavation and filling, cast in situ concrete and allied works, fabrication and erection of structural steel works, masonry / sheeting and allied works, finishing items etc.</p> <p>1.2.0 This part of the technical specification shall be read in conjunction with other Parts of the technical specifications, general technical requirements & erection conditions of the contract. Wherever IS code or standards have been referred they shall be the latest revisions.</p> <p>1.3.0 All tests required for all materials (bought by Contractor) and workmanship shall be done / got done by the contractor at his own cost. The rate for respective items of work or price shall include the cost for all works, activities, equipment, instrument, personnel, material etc. whatsoever associated to comply with sampling, testing and quality assurance requirement including construction tolerances and acceptance criteria and as specified in subsequent clauses of this part.</p> <p>1.4.0 The Contractor shall provide the facilities whatsoever required and also bear the cost for all sampling, testing and quality assurance in the field and in the laboratory. The Contractor shall carry out all sampling and testing in accordance with the relevant Indian standards and / or international standards and this technical specification. Where no specific testing procedure is mentioned, the tests shall be carried out as per the best prevalent engineering practices and to the directions of the Engineer. All sampling shall be done in the presence of the Engineer or his authorised representative. The Contractor shall establish the QA&QC laboratory at site and all field tests shall be done in the presence of the Engineer and / or his authorised representative. The tests which cannot be carried out in the field laboratory shall be done at a laboratory of repute such as CSMRS, NCBM, IITs, National Test House, Kolkata etc. as agreed by the Engineer. The test samples for such test shall be jointly selected and sealed by the engineer and thereafter these shall be sent to the concerned laboratory through the covering letter signed by FQA representative of the engineer. The cost of transportation and other associative cost including the test charges shall be borne by the contractor. These cost shall deemed to be included in the respective item of work in the contract. If the Engineer desires to witness such tests at laboratory, Contractor shall arrange to conduct the test in his presence.</p> <p>1.5.0 The recommendations and suitability of material for concreting and other building materials like brick, cement, aggregates etc., shall be ascertained by contractor prior to start of work.</p> <p>Preliminary evaluation of aggregate and its evaluation for potential alkali-aggregate reactivity as per following scope of work shall be done:-</p> <p><u>A. Evaluation of Aggregates:</u></p> <p style="padding-left: 40px;">I. To carry out different tests on coarse aggregate sample i.e. specific gravity,</p>
<p>NCTPP DADRI ST-II(2X490MW) & IGSTPP, JHAJJAR(3X500MW) PROJECTS, FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p style="text-align: center;">TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO.:CS-6130/0330-109-9</p> <p style="text-align: right;">SUB-SECTION- V-QD1 QA CIVIL WORKS</p> <p style="text-align: right;">Page 1 of 22</p>

Clause No	QUALITY ASSURANCE PROGRAMME
	<p>water absorption, sieve analysis, deleterious material; soundness, crushing value, impact value, abrasion value, elongation index and flakiness index, as per IS: 2386.</p> <p>II. To carry out different tests on fine aggregate sample i.e. specific gravity, water absorption, sieve analysis soundness, deleterious material, silt content, clay content and organic impurities as per IS: 2386.</p> <p>III. To prepare evaluation report based on test results of I) and ii) above and to advise regarding suitability of fine and coarse aggregates.</p> <p>B. <u>Evaluation of Aggregates for Potential Alkali-Aggregate Reactivity:</u></p> <p>Evaluation for Potential Alkali-Aggregate reactivity as per following scope of work:</p> <p>I. To carry out petrographic analysis and accelerated Mortar bar Test on aggregate samples (1N NaOH at 80 deg. Centigrade for 14 days as per ASTM 1260, or the method established/ developed by CSMRS for 22days test.</p> <p>II. To prepare a report based on test results of I) above and to advise regarding suitability of aggregates and further testing required if any.</p> <p>The contractor shall initiate the action with regard to the above mentioned evaluation of aggregates and other building material, so as to ensure timely completion of these tests thereby not affecting any project work. All records shall be submitted, unless specified otherwise, as per the format developed by the Contractor and approved by the Engineer.</p> <p>1.6.0 The Contractor shall enclose a comprehensive list of bought out items (BOIs) envisaged in the contract for carrying out fabrication/ manufacturing/ erection/ construction/ commissioning activities, procurement of forged, cast, semi-finished and finished components/equipment etc and shall indicate the names of reputed manufacturers for each of them in their bid proposal. The items envisaged by the Contractor to be procured from these manufacturers shall meet the specification requirement. An indicative list of major bought out items (not exhaustive) for civil works is enclosed at Annexure-I, for which the contractor shall submit the requisite details / lists of manufacturer's in their bid proposal.</p> <p>1.7.0 The list of manufacturers / sub-vendors of each of the BOIs identified / indicated by the Contractor shall be discussed / reviewed by the NTPC during post bid discussions and the list of proposed manufacturers / sub-vendors for each of the BOI shall be agreed/ approved. The list of manufacturers for all the BOIs envisaged in contract shall be included in the bid proposal and the same shall be discussed for finalization during the post bid discussions before placement of award. Where the manufacturers are placed in "DR" (Details required) category, the details of the manufacturers / sub-vendors placed in the "DR" category shall be submitted to the NTPC for approval within the period agreed at the time of post bid discussions. The Contractor's proposal shall include vendor's site facilities, expertise, facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-Contractors proposed. The formats for furnishing above details shall be given to the Contractor at post bid discussion stage. Monthly progress reports on sub-Contractor detail submission / approval shall be furnished on format no. QS-01-QAI-P-02/F1. The NTPC shall furnish other relevant formats for information/ clarification for manufacturers / sub-vendors approval to the Contractor</p>
<p>NCTPP DADRI ST-II(2X490MW) & IGSTPP, JHAJJAR(3X500MW) PROJECTS, FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO.:CS-6130/0330-109-9</p> <p>SUB-SECTION- V-QD1 QA CIVIL WORKS</p> <p>Page 2 of 22</p>

Clause No	QUALITY ASSURANCE PROGRAMME		
1.8.0	<p>at the time of post bid discussions (Main supplier's evaluation report Format No: QA-01-QAI-P-04/F1-R0 and Sub supplier questionnaire Format no: QA-01-QAI-P-04/F2-R0). Such manufacturers / sub-vendors approval shall not relieve the Contractor from any obligation, duty or responsibility under the contract.</p> <p>Structural steel and Reinforcement steel supply if in the scope of the contractor shall be procured from Main Steel Producers enlisted by NTPC from time to time. Currently, Main Steel Producers enlisted by NTPC are SAIL, JSW Steel Ltd, Jindal Steel & Power, Tata steel Ltd. (for Reinforcement steel/TMT bars), RINL (for long products/Rolled sections and Reinforcement steel/TMT bars), Essar Steel India Ltd. (for Flat products/ Steel Plates), Electrosteel steel Ltd. (for Reinforcement steel/TMT bars) and Monnet Ispat and Energy Ltd. (for long products/Rolled sections and Reinforcement steel/TMT bars). Subsequently, if any new Main Steel Producer/s are enlisted, they may also be considered for procurement during execution of the contract if proposed by the Contractor.</p>		
1.9.0	<p>The Field Quality Plans shall detail out all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site.</p> <p>The contractor shall furnish complete QA & QC programme (QAP) for the work envisaged which may include the following:-</p> <ul style="list-style-type: none"> • The organisation structure for the management and implementation of the proposed Quality Assurance Programme. • Documentation Control System • The procedure for procurement of materials and source inspection. • System for site controls including process controls. • Control of non-conforming items and systems for corrective action • Inspection and test procedures for site activities • System for indication and appraisal of inspection status • System for maintenance of records • System for handling, storage and delivery. • Quality Plan detailing out quality practices and procedures, relevant standards and acceptance levels for all types of work under the scope of this contract. <p>The Contractor shall appoint a dedicated, experienced and competent quality management representative on site, preferably directly reporting to the Project Manager, supported by experienced personnel, to ensure the effective implementation of the approved quality assurance programme.</p> <p>The onsite quality management representative shall have the organisational freedom and authority to implement the requirements of these quality assurance arrangements, free from commercial and programme restraints.</p> <p>The QA & QC setup of the contractor shall consist of qualified and experienced engineers, with their supporting staff. The QA&QC set up in addition to requisite mechanical & electrical engineers shall consist sufficient graduate civil engineers &</p>		
<p>NCTPP DADRI ST-II(2X490MW) & IGSTPP, JHAJJAR(3X500MW) PROJECTS, FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO.:CS-6130/0330-109-9</p>	<p>SUB-SECTION- V-QD1 QA CIVIL WORKS</p>	<p>Page 3 of 22</p>

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	<p>supervisors to take care of quality assurance activities of both site & laboratory. An indicative QA & QC organization chart is attached at Annexure-III. The deployment of man power for QA & QC set up shall be affected on the basis of agreed manpower deployment schedule, which shall be prepared by the contractor based on the L-2 network and the same shall be submitted to the Engineer-in-charge for acceptance.</p> <p>Based on the schedule of work agreed with the Engineer-in-charge and the approved FQP, the Contractor shall prepare a schedule of tests and submit them to the Engineer-in-charge and organise to carry out the tests as scheduled/ agreed.</p> <p>The QA&QC laboratory shall have all necessary equipment, instruments and shall be managed by a qualified / experienced person. An indicative list of test equipment is attached at Annexure-II. All these testing equipment shall be provided by the contractor at his own cost. The contractor shall maintain the equipment in good working condition along with valid calibration certificates, for the duration of the contract. Any other equipment though required for testing but not listed in the equipment list shall be provided / arranged by the contractor at his own cost.</p> <p>QA&QC laboratory building shall be constructed by the Contractor at their own cost. The laboratory building shall be constructed and installed with the appropriate facilities. Temperature and humidity controls shall be available wherever necessary during testing of samples.</p> <p>1.10.0 The contractor shall prepare and obtain approval of the Owner of the Field Quality Plan (FQP) well before the start of the work. This FQP shall cover for all the items / activities covered in the contract/schedule of items and required for completion of the work.</p> <p>1.11.0 All materials / components and equipment covered under the scope of work which are to be manufactured at shop/ factory of the vendor/subvendor shall be covered under a comprehensive quality assurance programme. The detailed quality plan for manufacturing shall be drawn up by the contractor and will be submitted to the owner for approval in the prescribed format for manufacturing quality plan.</p> <p>Manufacturing Quality Plan (MQP) shall detail out all the components and equipment, various test/inspection, to be carried out as per the requirements of this specification and standards mentioned therein. The quality practices and procedures followed by Bidder's/Sub-Bidder's/ sub-supplier's Quality Control Organization shall include , the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of material procurement, manufacture, assembly and final testing / performance testing . The quality plan shall be submitted in electronic media e.g. CD or E-mail in addition to hard copy, for review and approval. After approval the same shall be finally submitted in compiled form on CD.</p> <p>1.12.0 The contractor shall store and handle the materials as per the requirements of the relevant standards at his own cost.</p> <p>1.13.0 All the equipment shall be duly calibrated by NABL/ NPL accredited laboratories/accreditation agencies.</p> <p>1.14.0 The Contractor shall submit to the NTPC Field Welding Schedule for field welding activities in the format No.: QS-01-CQA-W11/F1, this format shall be furnished to</p>		
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the Contractor at pre-award stage. The field-welding schedule shall be submitted to the NTPC along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site. The Contractor shall submit Welding Procedure Specification (WPS) in the format No: QS-01-QAI-W-06/F1 for NTPC approval/ acceptance, this format shall be furnished to the Contractor during post bid discussion stage.

All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the NTPC.

All welding/brazing procedures shall be submitted to the NTPC or its authorized representative for approval prior to carrying out the welding/brazing.

All brazers, welders and welding operators employed on any part of the contract either in the Contractor's/ sub-Contractor's works or at site or elsewhere shall be qualified as per AWS D1.1/ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the NTPC.

Welding procedure qualification and Welder qualification test results shall be furnished to the NTPC for approval. However, where required by the NTPC, tests shall be conducted in presence of NTPC/authorized representative.

No welding shall be carried out on cast iron components for repair.

All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.

All Non-destructive examination shall be performed in accordance with written procedures as per International Standards and as mentioned elsewhere in the technical specification; The NDT operator shall be qualified as per SNT-TC-1A (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job. The records of RT (Films) and UT (inspection records or printed reports if possible) shall be documented and produced to NTPC.

1.15.0

The Contractor shall associate themselves with the reputed specialized blasting agency such as CMRI, NIRM for trials blasts, design blasts, blasting pattern, monitoring of blast during the blasting operations at site. The blasting operation shall remain in charge of a responsible, competent, authorized and experienced supervisor (Man-In-Charge) and thoroughly acquainted workmen. All blasting work shall be done as per approved blasting scheme/ design/ pattern in line with the technical specification requirements and all statutory laws, rules, regulations, relevant standards pertaining to the acquisition, transport, storage, handling along with use of explosives shall be strictly followed by the Contractor.

The Contractor shall install and operate equipments (such as tri-axial seismograph) for continuous monitoring and control of blast induced vibrations, noise level/ air pressure, dust, silica and noxious gases during all blasting operations in line with

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1.16.0	<p>the Technical Specification requirements in association with the specialized blasting agency.</p> <p>The contractor shall submit the un-priced copy of the award on the specialized blasting agencies to NTPC, highlighting the scope of services/ work awarded to them by contractor. The services of such specialized blasting agency shall be available through out the period in which the blasting work is undertaken at site.</p> <p>ASSOCIATED DOCUMENT FOR QUALITY ASSURANCE PROGRAMME:</p> <ul style="list-style-type: none"> i. Field Quality Plan Format No.: QS-01-QAI-P-09/F2-R1 ii. Indicative list of Field Quality Laboratory and Survey equipment list (Annexure-II) iii. Indicative QA&QC Manpower requirements (Annexure-III) iv. Indicative Field Quality Plan for Civil Works (Annexure-IV) v. Indicative Field Quality Plan for Structural Steel Works (Annexure-V) vi. Manufacturing Quality Plan Format No.: QS-01-QAI-P-09/F1-R1 vii. Status of items requiring Quality Plan and sub supplier approval. Format No.: QS-01-QAI-P-02/F1-R0 viii. List of items requiring quality plan and sub supplier approval. Format No.: QS-01-QAI-P-01/F3-R0 ix. Field Welding Schedule Format No.: QS-01-CQA-W-11/F1-R0 x. Welding Procedure Specification (WPS) Format No.: QS-01-QAI-W-06/F1-R0 xi. Main supplier's evaluation report Format No: QA-01-QAI-P-04/F1-R2 xii. Sub supplier questionnaire Format no: QA-01-QAI-P-04/F2-R1 <p>(Note: The field quality plan attached is indicative and the contractor shall prepare the field Quality plan covering the entire scope of work in the contract and submit the same to corporate QA for acceptance/approval. However any addition or deletion in the scope of work, during detailed engineering shall be accordingly added/ deducted from the Field Quality Plan)</p>		
2.0.0	<p>GENERAL QA REQUIREMENTS</p>		
2.1.0	<p>STORAGE AND HANDLING OF COMMON BUILDING MATERIALS</p> <p>All materials shall be stacked and stored by the Contractor as per IS-4082 and as per the requirements specified in NTPC Technical Specification.</p>		
2.2.0	<p>EXCAVATION AND FILLING WORKS</p> <p>The contractor shall submit a work methodology covering various items of works for all stages of excavation and filling works. This methodology shall broadly include the quantity wise and classification wise identification of source of excavation and filling, suitability tests as per specification requirements, method of stockpiling, transportation, placement, spreading , compaction, equipment, list of protocols, in-situ tests, third party lab test if required, acceptance checks for final clearance.</p> <p>For blasting work at site if required, the contractor shall associate themselves with the reputed specialized blasting agency such as CMRI, NIRM for trials blasts, design blasts, blasting pattern, monitoring of blast during the blasting operations at</p>		
<p>NCTPP DADRI ST-II(2X490MW) & IGSTPP, JHAJJAR(3X500MW) PROJECTS, FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO.:CS-6130/0330-109-9</p>	<p>SUB-SECTION- V-QD1 QA CIVIL WORKS</p>	<p>Page 6 of 22</p>

site. The contractor shall install and operate equipment (such as tri-axial seismograph) for continuous monitoring and control of blast induced vibrations, noise level/ air pressure, dust, silica and noxious gases during all blasting operations in line with the technical specification requirements in association with the specialized blasting agency. The contractor shall submit the un-priced copy of the award on the specialized blasting agencies to NTPC, highlighting the scope of services / work awarded to them by contractor. The services of such specialized blasting agency shall be available through out the period in which the blasting work is undertaken at site. The blasting operation shall remain in charge of a responsible, competent, authorized and experienced supervisor (man-in-charge) and thoroughly acquainted workmen. All blasting work shall be done as per approved blasting scheme/ design/ pattern in line with the technical specification requirements and all statutory laws, rules, regulations, relevant standards pertaining to the acquisition, transport, storage, handling along with use of explosives shall be strictly followed by the contractor.

Tolerance for finished surface level shall be within 20 mm of the level shown in the drawing. For an unimportant area, tolerance up to +75mm shall be acceptable at the discretion of the engineer. However, these tolerances shall be applicable for localized areas only.

Acceptance criteria shall be

- a) When only one set of sample is tested, then all individual samples collected and tested should pass without any deviation
- b) For retest of any sample two additional samples shall be collected and tested, and both should pass without any deviation.
- c) Where a large number of samples are tested for a particular test then 9 samples out of every 10 consecutive samples tested shall meet the specification requirement.

2.3.0 MASONRY AND ALLIED WORKS

The execution, finishing, testing and acceptance of masonry related works shall be as per the provisions of technical specifications / relevant practices IS code. Local depressions on account of faulty workmanship, broken / chipped edges shall not be acceptable.

All masonry shall be built true and plumb within the tolerances prescribed as below. Care shall be taken to keep the perpends properly aligned. Unless specified otherwise the tolerances in construction of masonry works shall be as below:

Sl. No.	Type of Check	Tolerance
	Deviation in verticality in total height of any wall of a building	Shall not exceed $\pm 12.5\text{mm}$ (more than one storey) $\pm 6\text{mm}$ per 3m height (within a storey)
	Deviation from the position shown on the plan of any brickwork	Shall not exceed 12.5mm (more than one storey)

	Relative displacement between load bearing walls in adjacent storeys intended to be in vertical alignment	Shall not exceed 6mm
	Deviation of bed joint from horizontal in any length, and it	Shall not exceed 6mm (upto 12m) Shall not exceed 12.5mm total (in any length over 12m)
	Deviation from the specified thickness of bed-joints, cross-joints or perpend	Shall not exceed ± 3 mm
	Finished plastered surface	Deviation not more than 4 mm when checked with a straight edge of 2 m length placed against the surface
	The average thickness of plaster	Not be less than the specified thickness
	The minimum thickness over any portion of the surface	Not less than the specified thickness by more than 3 mm for plaster thickness above 12mm and 1 mm for ceiling plaster

2.4.0 CONCRETE WORKS

For concreting works provisions of technical specifications and IS: 456 shall apply. A detailed methodology for concrete works shall be submitted by the contractor to NTPC for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.

The methodology for concrete works shall broadly contain the suitability of source of aggregates, cement, admixture, water and reinforcement steel, etc. The available concrete mix design recommended from a specialist institute, results of trial mix carried out at site, method / control of batching, mixing, transportation, layer wise placement, compaction, fixing / removal of form work, staging, fixing of water stops at appropriate locations along with specials, expansion joints, contraction joints and construction joints, cover blocks and method of curing, methodology of repair of newly placed hardened concrete, testing and sampling of concrete during production and placement and acceptance checks for final clearance.

The equipment, deployment of manpower and machinery shall arranged by the contractor to ensure the continuous rate of placement of specified grade of concrete so as to prevent segregation, bleeding, formation of cold joints, temperature control for concreting in extreme weather conditions and for mass concreting works.

Exposed surfaces of concrete shall be kept continuously in a damp or wet condition for at least seven days from the date of placing concrete in case of ordinary Portland cement, not be less than 10 days for concrete exposed to dry and hot weather conditions, at least 10 days or period may be extended to 14 days where mineral admixtures or blended cements are used. Approved curing compounds may be used in lieu of moist curing with the permission of engineer-in-charge.

Clause No	QUALITY ASSURANCE PROGRAMME
	<p>Reinforcement steel shall conform to relevant IS codes. Lapping / spacing of reinforcement shall be so staggered that under no circumstances more than 50% of bars at any cross section shall be lapped. Corrosion resistance Steel shall be used for the foundations wherever specified in the technical specification. Sample test for 3% of the number of mechanical bars grips subject to a minimum of three, shall be carried out up to the yield strength of reinforcement of bars.</p> <p>Test shall be conducted for the water tightness of the liquid retaining structures as per technical specifications, IS 3370 and IS 6494.</p> <p>All the materials, equipments, processes used in pre cast concrete work shall conform to the requirements for the cast-in-situ concrete.</p> <p>If fly ash is used in concrete, source of supply shall be checked for suitability as per IS 3812 (Part-I). Routine tests for retention of particles on 45μ sieve and loss on ignition shall be carried out on each lot of fly ash before its use. The storage of fly ash shall be similar to that of cement. Separate Silo for fly ash shall be provided in the batching plant. Validation of Mix design using fly ash shall be carried out by an approved specialist agency, before start of concrete production.</p> <p>The acceptance criteria of concrete shall be in accordance with clause no.16 of IS 456. However in exceptional circumstances and that too in non-critical areas, the engineer may accept concrete work which is marginally unacceptable as per the criteria laid down in IS 456. For such accepted work, payment shall be made at a reduced rate pro rata to the concrete cube strength obtained, against that stipulated.</p> <p>All records of concreting, reinforcement, testing of materials, as-built dimensions, the details of the rectification, etc, shall be maintained as given below. Four copies of such record in a bound form shall be submitted to owner for their record and future reference.</p> <ol style="list-style-type: none"> i. Testing data / report of aggregates including petrographic examination & potential reactivity of aggregate and repeated temperature cycle tests wherever specified ii. Mix design details and record of trial mixes carried out at site iii. Testing records of admixture as per IS-9103 / ASTM C494 including third party test reports. iv. Approved scheme for concreting v. Hourly records of concreting including pour card vi. Protocol indicating the dimensional tolerance and details of inserts vii. Records giving the details of rectification giving the location of grouting, the quantity of grout used at each location, type of grout used viii. Bar bending schedule ix. Location and details of mechanical anchoring used for reinforcement x. Protocol giving the details of checking of reinforcements before concreting and conformance to the reinforcement details as shown in the construction drawings xi. Photographs showing the areas where rectification works have been carried out. Photographs should be taken before and after rectification xii. Temperature control record of concrete at the time of placement if applicable.
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- xiii. Details of curing, staging and fixing / removal of formwork, checklist for formwork as per Clause 9.9 and Annexure-C of IS 14687 including all machine foundations
- xiv. Batching Plant shall be calibrated regularly at least once in a 3 months. Computerized output shall be taken for each batch of production of concrete. For concreting works of ash pipe pedestals, mixer with weight batcher may be used. Production and supply of concrete from batching plant shall conform to the provisions of IS 4926
- xv. Dimensions (length, cross sectional dimensions, straightness, squareness, and flatness) and tolerances for pre cast members as per NTPC Technical Specification. Load test on Pre cast members (except pre- cast tiles to be laid in the reservoir) shall be carried out @ 1% up to 1000 nos., @0.5% from more than 1000 nos. precast members of one type. The load test shall be carried out as per the provisions of IS-456 and relevant IS code.

TOLERANCES			
Description of Item/ Structural Element		Max (mm)	Min (mm)
Cast In Situ Concrete			
1.	Faces of concrete in foundations and structural members against which back fill is placed	+25	-10
2.	Eccentricity of footing as percentage of footing width in the direction of placement	2% but limited to 50mm	
3.	Top surfaces of slabs and of concrete to receive base plates to be grouted	+5	-5
4.	Alignment of beams, lintels, columns, walls, slabs and similar structural elements	+5	-5
5.	Cross sectional dimensions of walls, slabs and similar structural elements	+5	-5
6.	Deviation from specified dimensions of cross-section of columns and beams	+12	-6
7.	Alignment of holding down bolts without sleeves	+1.5	-1.5
8.	Alignment of holding down bolts with sleeves	+5	-5
9.	Level of holding down bolt assemblies	+10	-10
10.	Embedded Parts (in any direction).	+5	-5
11.	Level of embedment for equipment support	+1.5	0
12.	Level of embedment for other embedded parts	+5	-5
13.	Centers of pockets or holes with greatest lateral dimension not exceeding 150mm	+10	-10
14.	Variation in steps <ul style="list-style-type: none"> • Riser • Tread 	+1.5 +3.0	-1.5 -3.0
Pre- Cast Concrete			
15.	Length:	+/- 0.1 percent	+/- 5 + 10
16.	Straightness or Bow	1/750 of the length	+/- 5 +/- 10
17.	Cross-sectional dimensions	+/- 3 mm or +/- 0.1 percent whichever is greater	
18.	Squareness:	When considering the squareness of the corner the length of the two adjacent sides being checked shall be	

TOLERANCES			
	Description of Item/ Structural Element	Max (mm)	Min (mm)
	taken as the base line. The shorter side shall not vary in length from the perpendicular by more than 5 mm.		
19.	Flatness:	The maximum deviation from a 1.5m straight edge placed in any position on a nominal plant surface shall not exceed 5 mm.	
	Placing of reinforcement and for cover (Cover blocks shall be of same grade of concrete in which these would be embedded)	Clause 12.3.1 and 12.3.2 of IS 456	
	Formwork	Clause 9.6 of IS 14687 and 11.1 of IS 456	
	Batching	Clause 10.2.2 of IS 456	

2.5.0

STRUCTURAL STEEL WORK

For structural steel works provisions of technical specifications and IS: 800 shall apply. A detailed methodology for structural steel works shall be submitted by the contractor to NTPC for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.

The contractor shall submit the welding procedures specification (WPS), heat treatment procedures, NDT procedures etc. at least ninety days before scheduled start of erection work at site. All welding and brazing shall be submitted to the NTPC and carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the NTPC.

All brazers, welders and welding operators employed on any part of the contract either in the contractor's / sub-contractor's works or at site or elsewhere shall be qualified as per AWS D1.1/ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the NTPC.

The records of welding procedure qualification and welder qualification test results shall be furnished to the NTPC for approval. However, where required by the NTPC, the tests shall be conducted in presence of NTPC / authorized representative.

No welding shall be carried out on cast iron components for repair. All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.

All Non-destructive examination shall be performed in accordance with written procedures as per International Standards and as mentioned elsewhere in the technical specification. The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test

report with the job. The records of RT (Films) and UT (inspection records or printed reports if possible) shall be documented and produced to NTPC.

Low hydrogen electrode (AWS E-7018) for welding of High/Medium tensile steel, for M.S (IS 2062 Gr. A/Gr. B, IS 8500) sections thickness above 20mm shall be used. Preheating and Post weld heat treatment requirements shall be complied as specified in the technical specification / approved WPS.

The requirements of pre-heating shall be

Thickness of thickest part at the area of welding / heat affected zone	Welding using other than low hydrogen welding electrodes IS 2062	Welding using low hydrogen welding electrodes or submerged arc welding IS 2062
Upto 20 mm (including)	None	None
Over 20 mm to 40 mm (including)	Not allowed	200 C
Over 40 mm to 63 mm (including)	Not allowed	660 C
Over 63 mm	Not allowed	1100 C

The following tests / checks shall be carried out for structural steel works

SL. NO.	TESTS / CHECKS	QUANTUM / STANDARD
	Physical and chemical properties of material if supply in the scope of contractor	As per relevant codes, review of correlated mill test certificates or check testing in absence of MTC
	Ultrasonic test on plates above 40mm	As per ASTM A435
	Welding procedure & welders qualification test	AWSD1.1/ASME Section-IX or BS-4871 or other equivalent International Standards
Fillet Weld		
	Macro-etch examination on production test coupons for main fillet welds	Minimum one joint per built up beams, columns and crane girder etc.
	Tension member of crane girder	Dye penetration test on 25% weld length
	All other fillet welds	DPT on 5% of weld length with minimum 300mm at each location
Butt Weld		
	DPT	100% after back gouging on all butt welds
	Mechanical testing of production test coupons	Minimum one joint per built up beam, column and crane girder.
	Radiography test on butt welds (In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled at that particular location. Acceptance criteria of NDT on welds shall be as per AWS D1.1. Wherever RT is not feasible UT to be carried out with the approval of the	100% RT on butt welds of tension flange (bottom flange) of crane girders 10% RT weld length of each welder on butt welds,

SL. NO.	TESTS / CHECKS	QUANTUM / STANDARD
	engineer)	
	Ultrasonic testing on full penetration welds (other than butt welds)	100% UT on the web to flange joint of crane girder 10% UT on other full penetration joints
	Control assembly check in shop before erection	1st and further every 10th set of identical structure
	Dimensional tolerances during fabrication and erection	as per IS-7215 and IS-12843
	Surface Preparation and Paint thickness	SA 2 1/2 , By elcometer random after each coat, each member

2.6.0

PAINTING WORKS

Painting works shall be carried out as per the provisions of technical specifications. A detailed methodology for painting works shall be submitted by the contractor to NTPC for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.

The methodology for painting works shall broadly contain the source of approved brand of paints, shot / sand blasting as specified, minimum acceptable size of shot used for blasting, application of primer, intermediate coat and final coat, experience of applicator, etc. testing of painting work and acceptance checks for final clearance.

2.7.0

SHEETING WORKS

All bought out items shall be procured from the manufacturer's approved by engineer and tested as per relevant IS Codes/ Specification. Raw material of colour coated sheets shall meet the chemical & physical properties as per relevant standards / codes referred in the approved data sheet. It shall be tested for colour match, bare metal thickness, weight of Z/AZ coating, thickness of painting system, reverse impact, T-Bend adhesion, scratch resistance, salt spray test for 1000 Hrs and any other test / properties as specified in the technical specifications. Colour coated sheets shall be marked with video jet printing at the interval not more than 2m bearing manufacturer's name, date and time of manufacturing. Fasteners shall also be tested for 1000 hrs salt spray test as per the requirement of technical specifications.

Bonded Mineral Wool Insulation shall meet the requirements of thickness, density, thermal Conductivity, all other tests as per the technical specifications and IS-8183.

For sheet installation no gas cut opening shall be allowed at the site, whenever opening is specified these shall be properly cut in the factory and shall be filled with lipping / flashing for true shape / dimension etc. The sheets/ packets shall be stacked neatly clear off the ground at an angle to the ground, over a base pallet to provide drainage. Water / moisture should not be allowed to stagnate on surface, or in between layers. This can damage the coating, and cause corrosion.

2.8.0

TILE WORKS

Clause No	QUALITY ASSURANCE PROGRAMME
	<p>The contractor shall submit the work methodology which shall include the type, grade and make of materials along with their technical data sheets, details, etc, clearance from E-I-C regarding leak proofness and damp proofness of parent concrete surface, surface preparation, the procedure of application, curing, testing and acceptance.</p> <p>The agencies having adequate experience to execute the acid / alkali resistant lining works shall be engaged for executing the acid / alkali resistant lining works after obtaining the approval from the E-I-C.</p> <p>The execution, finishing, testing and acceptance of tile works shall be as per the provisions of technical specifications. The material for tile works shall be procured from the NTPC approved brand / source. Local depressions on account of faulty workmanship, tiles / natural stones with cracked or broken / chipped edges shall not be acceptable.</p> <p>The tests shall be carried out on acid resistant bricks / tile- water absorption, compressive strength, resistance to acid, flexural strength, dimensions and all other tests as per IS 4860 and IS 4457, bitumastic ready mixed paint as per IS 158, bitumastic as per IS 9510, potassium silicate, resin type and sulphur type mortars as per IS 4832, part I, II and III, surface preparation for painting as per IS 2395, epoxy painting shall be carried for required coating thickness and dry film thickness.</p> <p>2.9.0 FIRE PROOF DOORS</p> <p>Fire Proof doors shall be tested for the requirements mentioned in the Technical Specification. The type test of the doors shall be carried out at CBRI Roorkee for minimum 2 hours fire rating and its Fabrication drawing shall also be approved by CBRI, Roorkee. DFT of paint of Fire Proof Doors and its fittings and fixtures as per BOQ shall be checked. The doors shall be finished with suitable fire retardant painting system</p> <p>2.10.0 WATER PROOFING</p> <p>The execution, finishing, testing and acceptance of water proofing works shall be as per the provisions of technical specifications. The material for the works shall be procured from the NTPC approved brand / source and the works shall be executed by the authorized applicator of the supplier.</p> <p>Water proofing shall be tested for water tightness by creating a pond of water minimum 25 mm height on area of 6 m x 6 m, for the period of 48 hrs on fully dried elastomeric membrane surfaces. Minimum 5% area of the roof shall be subjected to water tightness test. Such test necessarily be conducted on vulnerable areas like drain channel / drain head. No dampness shall be visible on the underneath side of roof (i.e. ceiling), parapet and well junctions etc. which have been subjected for testing. The above testing shall be carried out prior to application of wearing course.</p> <p>2.11.0 PILING WORK (If Applicable)</p> <p>For piling works provisions of technical specifications, approved drawings, BOQs and relevant IS codes / standards shall apply. The piling works shall be executed by the agency meeting the qualifying requirements as specified. A detailed methodology for piling works shall be submitted by the contractor to NTPC for</p>
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Clause No	QUALITY ASSURANCE PROGRAMME
	<p>approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.</p> <p>The methodology for piling works shall broadly contain the method of boring, stability of bore hole, termination criteria, tests / checks for termination level, fabrication of cage, cage lowering, concrete batching / mixing, transportation, placing, recording of the time of construction operations, method of conducting initial and routine load tests, testing and sampling of concrete during production and placement and acceptance checks on piles for final clearance.</p> <p>The equipment, deployment of manpower and machinery shall be arranged by the contractor to prevent the collapse of bore hole and to ensure continuous rate of placement of specified grade of concrete.</p> <p>The piling works shall be executed as per the technical specifications, approved drawings, relevant codes / standards, FQP and BOQ. In addition to the requirements of technical specifications, the following shall also be ensured while execution of piling works:</p> <ol style="list-style-type: none"> a) Time gap between completion of pile boring and start of concreting should be kept to the minimum. However the maximum time gap shall not be more than 6 hours. b) Muck Debris should be removed from the pile bore by air lift technique (by keeping the tremie & air pipe as close as to bottom of pile bore) i.e. after completion of boring, after completion of SPT (wherever applicable), after lowering reinforcement cage, but before start of concreting. c) Density of bentonite slurry shall be checked from the sample taken from the bottom of pile bore (not at 1.0 m above the bottom of the pile bore) d) Minimum two welding sets shall be kept ready to join the two cages of reinforcement by engaging 3 or more welders. This will ensure the lowering of R/F cage in minimum time. e) While lowering the R/F cage into the pile bore, two hooks shall always be used to ensure balanced/symmetrical insertion of cage into the pile bore. f) Concrete cover blocks at the junction of two R/F cage shall be ensured before lowering the second segment. g) Surge concreting of about 1.0 cum shall be ensured at the start of concreting (i.e. in the first pour), by suddenly allowing to fall through the tremie pipe from the funnel. This will help in displacing left out muck/debris in the pile bore (by the impact). h) Continuous feeding of concrete shall be ensured by deploying at least two transit concrete mixers (if required to be deployed) and mixing done through concrete batching plant (if deployed). Cold joints in the pile shall be avoided. i) In a pile group, SPT shall be carried out at termination level in the pile, taken up first. j) Bentonite slurry circulation to be ensured from start of boring to start of concreting. Flushing of bentonite slurry will only ensure maintaining of density of bentonite slurry uniformly and will not allow bentonite jelly to settle at the bottom, whereas air lift technique with bentonite circulation will ensure removal of muck debris from the bottom of pile bore.
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Clause No	QUALITY ASSURANCE PROGRAMME
2.12.0	<p>k) Properties of drilling mud shall be checked prior to commencement of the piling work and thereafter, minimum once per week or as found necessary by the engineer. One sample consisting of 3 specimens shall be tested for the above.</p> <p>l) Low strain pile integrity test on all job piles and test piles shall be conducted as specified in the Technical Specification. This test shall be suitably used to identify the piles for routine tests. High Strain dynamic test shall be done as per the technical specification. The frequency of the test shall be as per the BOQ</p> <p>m) For Working Piles: Minimum one sample consisting of 6 test cubes shall be made for first ten piles. Out of these 3 shall be tested for 7 days cube strength and 3 for 28 days cube strength. Minimum one sample of 6 test cubes for every 25 nos. of piles shall be tested, out of these 3 shall be tested for 7 days cube strength and 3 for 28 days cube strength</p> <p>PILE LOAD TEST</p> <p>Pile load testing shall conform to the requirements of IS-2911 (Part IV) and the technical specification. Initial load tests as specified in the contract documents shall be conducted to assess the safe load carrying capacity of pile before start of work. To verify the load carrying capacity of the working piles, routine load test shall be conducted.</p> <p>Pile load-testing procedure and the test setup / scheme shall be submitted for approval of NTPC. The contractor shall use the test setup having arrangement for anchor piles / rock anchors alone or combination of anchor piles / rock anchors and kentledge for both vertical compression and uplift (tension) Load test (initial) on piles. The cost of reaction system / piles shall deem to be included in the cost of test piles</p> <p>All the gauges and instruments shall be calibrated before the start of the tests on test piles and working piles and the calibration record shall be verified before start of execution of the test.</p> <p>WATER SUPPLY, DRAINAGE & SANITATION</p> <p>Material used for sanitary and plumbing fittings and fixtures shall conform to and be tested as per the requirements of relevant IS Codes specified in NTPC technical specification.</p> <p>The obstructions in sewer lines shall be checked by inserting a smooth ball, of diameter 13 mm less than the pipe bore at the high end of the sewer or drain. If absence of any obstructions, such as yarn or mortar projecting through the joints, ball shall roll down the invert of the pipe and emerge at the lower end. The straightness shall be checked by means of a mirror at one end of the line and lamp at the other. If the pipeline is straight, the full circle of the light may be observed. The mirror will also indicate obstruction in the barrel, if the pipeline is not straight.</p> <p>The service pipes shall be slowly and carefully charged with water, allowing all air to escape avoiding all shock or water hammer. The service pipe shall then be inspected under test / working condition of pressure and flow, when all draw-off taps</p>
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Clause No	QUALITY ASSURANCE PROGRAMME						
<p>2.13.0</p>	<p>are closed. The service pipes shall be checked for satisfactory support and protection from damage, corrosion and frost.</p> <p>ARCHITECTURAL & MISC. WORKS</p> <p>Material used for sanitary and plumbing fittings and fixtures, floor finishes and allied work shall conform and tested as per the requirements of relevant IS Codes specified in NTPC technical specification.</p> <p>Fabricated item like metal doors, windows, ventilators, louvers, rolling shutters and grills etc. shall be checked for correctness of locations and smoothness of operation and fixtures. All controls and locking devices shall give fault free performance. Door and window shutters shall operate without jamming. The clearance at head and jamb for door shutters shall not exceed 1.5 mm. For double leaf doors, the gap at the meeting stiles shall not be more than 2.5 mm.</p> <p>Materials used in glass and glazing shall be procured from source approved by NTPC and shall conform to the requirements of the Technical Specification and IS Codes.</p> <p>False ceiling panels shall be best quality material in thickness and properties called for in the specification / schedule of items. Material Test Certificate to be submitted before bulk supply.</p> <p>All bought items covered in the scope of contract shall be procured from sources approved by NTPC and shall conform to the requirements of the technical specifications and referred standards /codes.</p>						
<p>2.14.0</p>	<p>PRE CAST CONCRETE WORKS</p> <ol style="list-style-type: none"> 1. All the materials used in Pre cast Concrete work shall be tested and conform to the requirements of IS codes and NTPC Tech. Specification. 2. Concrete mix for Pre cast members shall conform to IS-456-2000. 3. All relevant QA requirements pertaining to cast insitu concrete shall be applicable. 4. Pre Cast Concrete member shall be checked for dimensions (length, cross sectional dimensions, straightness, squareness, and flatness) and tolerances shall be as per NTPC Technical Specification. 						
<p>2.15.0</p>	<p>FABRIC EXPANSION COMPENSATOR:</p> <p>Each layer of fabric Compensator shall be checked for thickness, unit weight, tensile strength & elongation, composite layer of the expansion joint shall be tested for temperature withstand ability test.</p> <p>Thermal Insulation shall be checked for thickness, density, thermal conductivity test and all other tests as per IS:8183.</p> <p>Tests and checks on all other items shall be carried out as per relevant codes.</p>						
<p>2.16.0</p>	<p>SLIPFORM SHUTTERING</p>						
<table border="0" style="width: 100%;"> <tr> <td style="width: 33%; vertical-align: top;"> <p>NCTPP DADRI ST-II(2X490MW) & IGSTPP, JHAJJAR(3X500MW) PROJECTS, FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p> </td> <td style="width: 33%; vertical-align: top; text-align: center;"> <p>TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO.:CS-6130/0330-109-9</p> </td> <td style="width: 33%; vertical-align: top; text-align: right;"> <p>SUB-SECTION- V-QD1 QA CIVIL WORKS</p> </td> </tr> <tr> <td colspan="2"></td> <td style="text-align: right; vertical-align: top;"> <p>Page 17 of 22</p> </td> </tr> </table>		<p>NCTPP DADRI ST-II(2X490MW) & IGSTPP, JHAJJAR(3X500MW) PROJECTS, FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO.:CS-6130/0330-109-9</p>	<p>SUB-SECTION- V-QD1 QA CIVIL WORKS</p>			<p>Page 17 of 22</p>
<p>NCTPP DADRI ST-II(2X490MW) & IGSTPP, JHAJJAR(3X500MW) PROJECTS, FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO.:CS-6130/0330-109-9</p>	<p>SUB-SECTION- V-QD1 QA CIVIL WORKS</p>					
		<p>Page 17 of 22</p>					

Clause No	QUALITY ASSURANCE PROGRAMME
	<ol style="list-style-type: none"> 1. The monitoring of the leveling of the yoke and the platform of the slip form shuttering to be done in each shift to avoid tilt during the casting of the chimney shell. 2. Manning of each shift shall be done by at least two experienced operators and a foreman particularly in night shift. 3. Suitable removal/ reduction of overhung / excess yoke beam length shall be affected with the decrease in the diameter of Chimney shell, as per the approved plan. 4. The laser centering method to be deployed for chimney alignment and Monitoring of chimney centre should be done by laser instruments at least two points. Monitoring/Recording of the same shall be done in each shift of 8 hours 5. Shuttering plates to be used for slip form shall be new and the grade of steel shall conform to the specification requirements. 6. The outage of the alignment of chimney centre shall be prevented by creating a counterbalance for alignment purpose to avoid differential loading, arising out of placement of reinforcement bars at one side or unloading of concrete in a hopper at one side of the platform for slip form shuttering.
<p>NCTPP DADRI ST-II(2X490MW) & IGSTPP, JHAJJAR(3X500MW) PROJECTS, FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO.:CS-6130/0330-109-9</p> <p>SUB-SECTION- V-QD1 QA CIVIL WORKS</p> <p>Page 18 of 22</p>

Annexure – II

INDICATIVE FIELD QA&QC LABORATORY SET-UP

S.No	Equipment	Nos.
1	Vicat Apparatus with deskpot	2
2	Le Chatelier flask	2

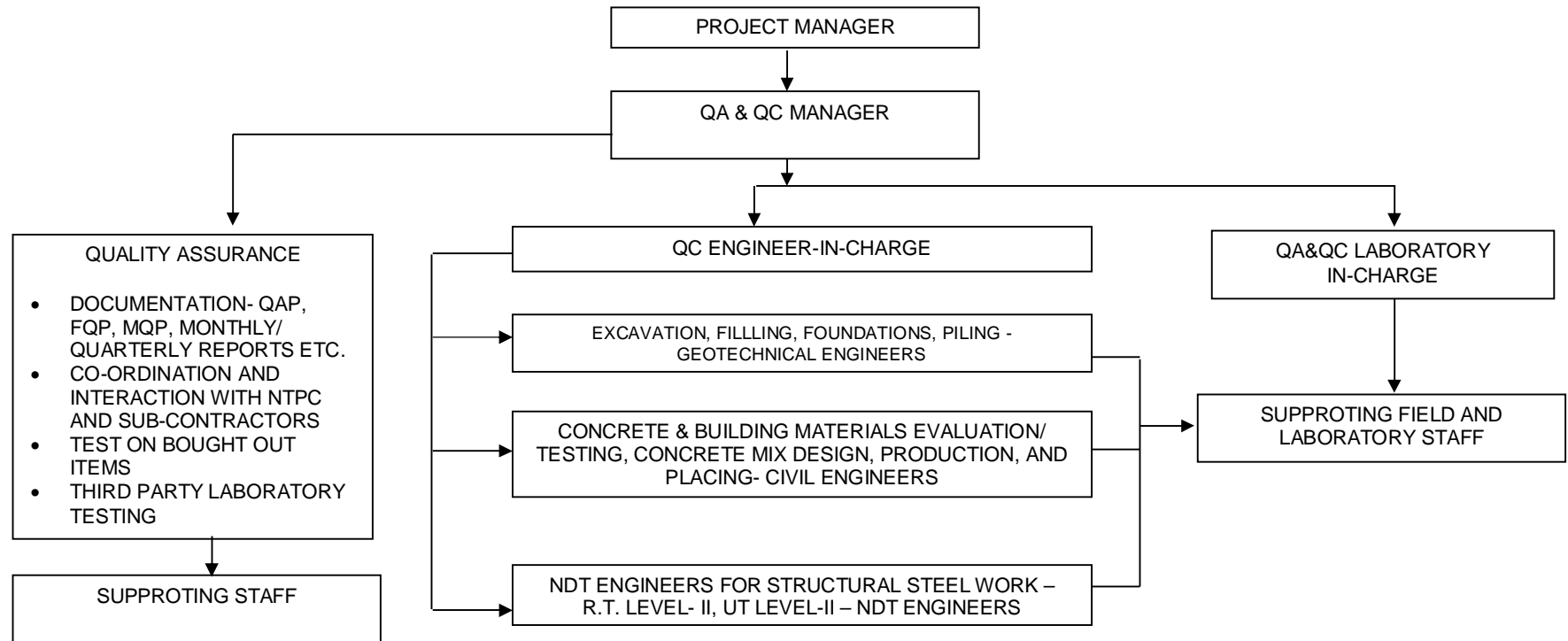
3	Le Chatelier Mould	2
4	Cube Moulds for cement testing	12
5	Vibration Machine	1
6	Length comparator	2
7	Shrinkage Bar mould	2
8	Sieve shaker	1
9	Sieves for sand, coarse & fine aggregate	1 set for each
10	Sieves for coarse aggregate for Road	1 set
11	Proctor testing equipment	2 sets + 18 cores
12	Slump testing equipment	6 sets
13	Oven	2
14	Physical balance	1
15	Rapid moisture meter	2
16	Thermometer	4
17	Burret	2
18	Measuring cylinders	9
19	Measuring flasks	3
20	Compression testing machine	2 sets
21	Cube moulds	30
22	Electronic balance	2 (12 kg capacity), 2 (200 mg capacity)
23	pH balance	As per requirement
24	Radiographic facilities	As per requirement, Party should deploy BARC approved agency for carrying out RT
25	Mechanical weighing machine	1 (100 kg capacity)
26	Ultrasonic testing machine	As per requirement
27	D.P. Test kit	10
28	Vernier 300 mm, 600 mm	2
29	Micrometer (0.25 mm) out side (25.00)	2
30	Radiography film viewer	2
31	Inside Micrometer 25-750 dia	2
32	Digital elcometer for paint thickness	2
33	Baking oven for electrode	3
34	Portable ovens	2
35	Rebar detector to locate the reinforcement before core cutting operation	1
36	Concrete coring machine (55mm, 60mm upto 150 mm dia core bit)	1
37	Rebound hammer	1
38	Ultrasonic pulse velocity tester	May be arranged from specialist laboratory.

Note :

1. The equipments listed above are indicative and required to be mobilised as minimum requirement. additional equipment if any ,required for successful completion of work shall be provided /arranged by the contractor.
2. All test reports/ inspection reports have to be computerized and maintained on LAN with an access to the owner


Clause No	QUALITY ASSURANCE PROGRAMME
	<p>3. Computers - 2 Nos shall be deployed with Windows operating system and connected to the NTPC server</p> <p>4. Based on the schedule (L2/L3 Network), Quality control & Quality Assurance work plan shall be finalized by the contractor and the same shall be submitted to the engineer-in-charge for acceptance/approval. The Finalized work plan shall be maintained on the computer to be accessed by the owner for database and day to day monitoring.</p>
<p>NCTPP DADRI ST-II(2X490MW) & IGSTPP, JHAJJAR(3X500MW) PROJECTS, FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO.:CS-6130/0330-109-9</p> <p>SUB-SECTION- V-QD1 QA CIVIL WORKS</p> <p>Page 21 of 22</p>

INDICATIVE FIELD QA & QC MANPOWER STRUCTURE



NOTE:

1. The above organization setup is minimum, however their deployment shall be as per the agreed deployment schedule. The contractor shall prepare a manpower deployment schedule in line with the finalized work plan and the same shall be submitted to the engineer-in charge for acceptance/ approval.
2. The contractor shall mobilize the QA& QC manpower in line with the finalized manpower deployment schedule and shall ensure their availability well in advance (15 days approx.) of the beginning of the concerned activity/ work.
3. The contractor shall further mobilize required number of skilled & supporting staff and additional resources, if any to meet the work schedule.

	PROJECT: Dadri-II & JHAJJAR	LIST AND STATUS OF ITEM REQUIRING QP AND SUB-SUPPLIER APPROVAL				NTPC DOC NO	
	PACKAGE: FLUE GAS DESULPHURISATION SYSTEM PACKAGE					REV. NO.	0
	MAIN SUPPLIER:					DATE	
	CONTRACT NO.:						
SR. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS	REMARKS
1	CEMENT						
2	CONSTRUCTION CHEMICALS - ADMIXTURES, PLASTISIZERS, RETARDERS, WATER PROOFING COMPOUNDS, GROUTS, RESINS, EPOXY ETC.						
3	COLOUR COATED SHEET(FOR COIL)						
4	PROFILERS FOR DECKING/CLADDING SHEETS						
5	ELECTROFORGED GRATING						
6	PAINT AND PAINTING SYSTEM						
7	GI PIPES						
8	INSULATION WOOL FOR CHIMNEY						
9	NON-METALLIC EXPANSION JOINT						
10	PVC WATER STOP						
11	PLASTIC/ PVC PIPES						
12	FLOOR TILES						
13	FIRE PROOF DOORS						
14	PARTICLE BOARDS, PLYWOOD, MDF						
15	ROOF WATER PROOFING						
16	RCC PIPES						
17	FALSE CEILING - GLASS REINFORCED GYPSUM						
18	BITUMEN ASPHALT						
19	BITUMEN IMPREGNATED FIBER BOARD JOINT						
20	SANITARY ITEMS						
21	CP BRASS TAP AND OTHER SANITARY FITTINGS						
22	POLYTHENE WATER STORAGE TANKS - IS 12701						
23	CHIMNEY ELEVATOR						
24	PTFE BEARING / ELASTOMERIC BEARING						
25	FOUNDATION BOLTS						
<p>LEGENDS:</p> <p>1. SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY NTPC) A – For these items proposed vendor is acceptable to NTPC. To be indicated with letter "A" in the list along with the condition of approval, if any</p> <p>2. QP/INSPN CATEGORY: CAT-I : For these items the Quality Plans are approved by NTPC and the final acceptance will be on physical inspection witness by NTPC. CAT-II : For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis review of documents as per approved CAT-III : For these items Main Supplier approves the Quality Plans. The final acceptance by NTPC shall be on the basis certificate of conformance by the main supplier. UNITS/ WORKS : Place of manufacturing Place of Main Supplier of multi units/works.</p>							
<p>NOTE: For the items placed in CAT-III for Civil Works, the review and final acceptance shall be done by NTPC-EIC/ FQA on the basis of certificate of conformance submitted by the main supplier/ main contractor.</p>							

LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN				ANNEXURE- IV				
		ITEM : CIVIL WORK SUB-SYSTEM : Foundations, Excavation & Fill, Concrete, Building, Masonry Etc.	QP NO. : REV. NO. : DATE : PAGE :	1 0	PROJECT: PACKAGE: CONTRACT NO. MAIN CONTRACTOR	Dadri-II & JHAJJAR FLUE GAS DESULPHURISATION SYSTEM PACKAGE				
Sl. No	Activity and operation	Characteristics / instruments	Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks	
1	2	3	4	5	6	7	8	9	D*	10
1.00 GENERAL REQUIREMENTS										
A	Setting up of Field QA&QC laboratory		As agreed / required	A	Physical	Once prior to start of work	Tech Specs and Const. Drawings	SR	√	Functioning of laboratory equipment in proper working condition to be verified on monthly basis
B	Avialability of requisite laboratory set up and equipment in good working condition well before commencement of concerned activity		As agreed / required	A	Physical	Once prior to start of work and thereof monthly	Tech Specs and Const. Drawings	SR	√	
C	Submission of QA & QC manpower deployment schedule based on agreed L-2 network .		-	A	Physical	Once prior to start of work	Tech Specs and Const. Drawings		√	
D	Availability of QA& QC manpower based on deployment schedule .		-	A	Physical	Once prior to start of work and thereof monthly	Tech Specs and Const. Drawings	SR	√	
E	Sampling for testing of building materials, concrete mix design etc.		As agreed / required	A	Physical	Once per each source prior to start of concern work	Tech Specs and Const. Drawings	SR	√	Test report along with the recommendations from specialist agency to be submitted to NTPC.
F	Submission of schedule of tests to be done monthly / quarterly and maintenace of the same on a computer connected to LAN of NTPC for monitoring		-	A	Physical	Once prior to start of work and thereof monthly	Tech Specs and Const. Drawings	SR	√	
2.00 EXCAVATION AND FILLING IN FOUNDATION WORKS										
Excavations-										
1		Check for the Nature, type of soil/rock before and during excavations	As agreed / required	B	Visual	Random in eah shift	Tech Specs and Const. Drawings	SR		
2		Check for the Initial ground level before start of excavations	As agreed / required	B	Measurement	100%	Tech Specs and Const. Drawings	SR		
3		Check for the final shape and Dimensions of excavations.	As agreed / required	B	Measurement	100%	Tech Specs and Const. Drawings	SR		
4		Check for the Final excavation levels	As agreed / required	B	Measument	100%	Tech Specs and Const. Drawings	SR		
5		Check for the Side slope of final excavation	As agreed / required	B	Measurement	Random in eah shift	Tech Specs and Const. Drawings	SR		
6		Excavation in Hard Rock.								
i		Receipt, Storage, accountability of Explosive	As agreed / required	B	Physical	Random in each week	Indian Explosive Act 1940/all statutory norms, Tech Specs and Const. Drawings	SR	√	NTPC approved specialist blasting agency such as CMRI, NIRM shall be deployed at site for trial blasts, design blasts, blast vibration monitoring etc. Seismographs shall be deployed at site for monitoring of blast operation vibrations.
ii		Execution of Blasting Operation	As agreed / required	B	Physical	Random in eah shift	IS:4081, Tech Specs and Const. Drawings	SR	√	
iii		Submission of Blasting report to EIC	As agreed / required	C	Physical	Each blast	Tech Specs and Const. Drawings		√	
7		Excavation in Hard Rock (Blasting Prohibited)	As agreed / required	B	Physical	100%	As per approved drawing/ scheme, Tech Specs and Const. Drawings	SR	√	
Fill/ Backfill -										
8	Suitability of fill material									
i		Grain size analysis	As required/ agreed	B	Physical	One in every 2000 cum for each type and source of fill materials subject to a min. of 2 samples	IS:2720 (Pt.IV), Tech Specs and Const. Drawings	SR/TR	√	
ii		Liquid & plastic limit	As required/ agreed	B	Physical	One in every 2000 cum for each type and source of fill materials subject to a min. of 2 samples	IS:2720 (Pt.IV) , Tech Specs and Const. Drawings	SR/TR	√	
iii		Shrinkage limit	As required/ agreed	B	Physical	One in every 5000 cum for each type and source of fill materials subject to a min. of 2 samples	IS:2720 (Pt.IV), Tech Specs and Const. Drawings	SR/TR	√	
iv		Free Swell Index	As required/ agreed	B	Physical	One in every 5000 cum for each type and source of fill materials	IS:2720 (Pt.XI), Tech Specs and Const. Drawings	SR/TR	√	
9	Standard proctor Test	Optimum moisture content and max. dry density before fill	As required/ agreed	A	Physical	One in every 2000 cum for each type and source of fill materials	IS 2720 (Pt.VII), Tech Specs and Const. Drawings	SR/TR	√	
10	Moisture content	Moisture content of fill before compaction	As required/ agreed	A	Physical	One in every 2000 cum for each type and source of fill materials	IS 2720 (Pt.II), Tech Specs and Const. Drawings	SR/TR	√	
11	Degree Of Compaction Of Fill / Backfill									
i		Dry density by core cutter method ---- OR---- Dry density in place by sand displacement method	As required/ agreed	A	Physical	i) For foundation fill/ backfill one for every 10 foundations for each compacted layer. ii) For area filling, one every 1000 SQM area for each compacted layer.	IS:2720 (Pt. XXIX), Tech Specs and Const. Drawings IS 2720 (Pt. XXVIII), Tech Specs and Const. Drawings	SR/TR	√	

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		ITEM : CIVIL WORK SUB-SYSTEM : Foundations, Excavation & Fill, Concrete, Building, Masonry Etc.	QP NO. : REV. NO. : DATE : PAGE :	1 0	PROJECT: PACKAGE: CONTRACT NO. MAIN CONTRACTOR	Dadri-II & JHAJJAR FLUE GAS DESULPHURISATION SYSTEM PACKAGE					
Sl. No	Activity and operation	Characteristics / instruments		Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks
1	2	3		4	5	6	7	8	9	D*	10
ii		Relative density (Density Index)	As required/ agreed	A	Physical	----do---- (i) & (ii) above	IS 2720 (Pt. XIV), Tech Specs and Const. Drawings		SR/TR	√	
iii		Dry Density by proctor needle penetration	As required/ agreed	B	Physical	Random checks to be carried out for each compacted layer	Tech Specs and Const. Drawings		SR/TR	√	
3.00	CAST-IN-SITU CONCRETE										
	MATERIALS										
1	Cement										
i		Initial & Final Setting Time	as per IS:4031	A	Physical	Each Lot	IS:4031	As per relevant IS Codes	SR/LB/ Test Report	√	Each consignment of cement shall be duly correlated with manufactureres TC, If cement is stored more than 90 days in godown of contractor same shall be retested for comp. Strength & setting time.
ii		Compressive strength @ 3, 7 & 28 days	as per IS:4031	A	Physical	Each Lot	IS:4031	As per relevant IS Codes	SR/LB/ Test Report	√	
2	Coarse Aggregate										
i		Moisture content		B	Physical	Once for each stack of 100 Cum. or part there of Except during monsoon when this has to be done every day before start of concreting	IS:2386 Part-III, IS : 456, IS : 383/Tech Spec, Tech Specs and Const. Drawings		SR/LB		Accordingly water content of the concrete will be adjusted
ii		Specific gravity, bulk density, voids, water absorption,	As required/ agreed	B	Physical	Once for each source & for every change of source	IS:2386 Part-III, IS : 456, IS : 383/Tech Spec, Tech Specs and Const. Drawings		SR/TR		These tests will be carried out white establishing design mix and the results to be intimated to NTPC.
iii		Particle, size & Shape-(Sieve analysis, determination of material finer than 75 micron, flakiness index, elongation index, angularity number)	As required/ agreed	B	Physical	One per 100 cum., or part thereof/change of source whichever is earlier	IS:2386 Part-I, IS : 456, IS : 383/Tech Spec, Tech Specs and Const. Drawings		SR/LB		-do-
iv		Deleterious materials & organic impurities (determination of clay lumps, fine silt, fine dust , light weight pieces , soft particle & estimation of organic impurities.)	As required/ agreed	B	Physical	Once per source/ on every change of source	IS:2386 Part-II, IS : 456, IS : 383/Tech Spec, Tech Specs and Const. Drawings		SR/TR		Experts opinion regarding suitability of the aggregates shall be obtained from the specialist agency such as NCB BallbhGarh etc. finalised during preaward. Results will be reported nearest to 0.1% of clay lumps.
v		Soundness	As required/ agreed	B	Physical	Once per source/ on every change of source	IS: 2386 Part-V, IS:383 , Tech Specs and Const. Drawings		SR/TR		Experts opinion regarding suitability of the aggregates shall be obtained from the specialist agency such as NCB BallbhGarh etc. finalised during preaward.
vi		Alkali aggregate reactivity	As required/ agreed	A	Physical	Once per source/ on every change of source	ASTM C 1260 , Tech Specs and Const. Drawings		SR/TR	√	the quantity of dissolved silica , and reduction in alkalinity to be reported and hence the aggregate type (deleterious /innocuous)result should be supported by petrographic examination
vii		Petrographic examination	As required/ agreed	A	Physical	Once per source/ on every change of source	IS: 2386 Part-VIII, IS:383 , Tech Specs and Const. Drawings		SR/TR	√	Reporting of petrographic examination shall be done as illustrated in IS 2386 (part-VIII)-1963. petrographic report shall be supported by the analysis and recommendation by a specialist instute.
viii		Crushing value abrasion value and impact value	As required/ agreed	A	Physical	Once per source/ on every change of source	IS:383, IS-2386 Part IV/, Tech Specs and Const. Drawings		SR/TR		-do-
3	Fine Aggregate										
i		Moisture content	As agreed / required	B	Physical	To be done every day before start of work	IS: 2386 Part-III IS:383 , Tech Specs and Const. Drawings		SR/TR		Weight of sand and weight of water shall be adjusted as per moisture content.
ii		Silt, Clay content and organic impurities	As agreed / required	B	Physical	Once per source& for on every change of source	IS: 2386 Part-II, IS:383 , Tech Specs and Const. Drawings		SR/TR		Acceptance limit as per relevant IS code
iii		All other tests similar to coarse aggregates as mentioned above.	As agreed / required	B	As above	Refer S.No. 2.01.02	IS-2386, IS-383, Tech Specs and Const. Drawings		SR/TR		
4	Water										
i		Test for sulphates and chlorides	As required/ agreed	B	Testing	Once per each source thereof yearly.	IS:3025 part 22 and 23 (for test procedure) , IS:456(for acceptance criteria) , Tech Specs		SR/TR		
ii		Tests for ascertaining limit of solids	As required/ agreed	B	Physical	Once per each source thereof yearly.	IS:3025 part 18 (organic),IS:456 , Tech Specs and Const. Drawings		SR/TR		
iii		Tests for pH Value	As required/ agreed	B	Testing	Once per each source thereof yearly.	IS:3025, IS:456, Tech Specs and Const. Drawings		SR/TR		

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Sl. No	Activity and operation	Characteristics / instruments	Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks	
1	2	3	4	5	6	7	8	9	D* 10	
iv	Check for initial set time for used water and distilled water	vicat apparatus	A	Physical	See Remarks	See Remarks, Tech Specs and Const. Drawings	See Remarks	√	Initial set time with used water should not be less than that with distilled water. This check is to be carried out only if the results of the tests mentioned at sl. no. 3.00, .4 i),ii)& iii) mentioned above	
v	Check for Concrete compressive strength with used water and distilled water	standard sand and compression testing machine	As agreed / required	A	Physical	See Remarks	See Remarks, Tech Specs and Const. Drawings	See Remarks	√	This check is to be carried out only if the results of the tests mentioned at sl. no. 3.00, .4 i),ii)& iii) mentioned above
5	CONCRETE PRODUCTION									
i		Check for the proportions of materials for nominal mix concrete as per Table-9 of IS 456	As agreed / required	B	Physical	Random in each shift	IS:456, Tech Specs and Const. Drawings	SR/TR		
ii		Trial mix (Cubes compressive strength) as per Mix Design	As agreed / required	A	Physical	Min. 4 Trial Mixes with admixtures and Without admixtures With fly ash.	IS: 516 & IS:456, IS:10262, Tech Specs and Const. Drawings	SR/TR	√	For trial mix min. of 6 cubes for each mix, 3 specimen shall be tested at 7 days remaining 3 shall be for 28 days comp. Strength. Mix design shall carried out at agency finalised during pre award)
iii		Crushing strength (works Tests cubes)	As agreed / required	A	Physical	One set of 6 cubes per 50 M3 or part thereof for each grade of concrete per shift whichever is earlier.	IS:516, IS:456, Tech Specs and Const. Drawings	SR/TR	√	Min. of 6 cubes for each mix, 3 specimen shall be tested at 7 days remaining 3 shall be for 28 days comp. Strength.
iv		Workability - slump test	As required/ agreed	B	Physical	One sample every 2 hrs. from every mixing plant	IS:456, Tech Specs and Const. Drawings	SR/TR		Slump test for medium and high workability, Compaction factor test for medium and low workability, V.B. test for low to Very low workability
v		Cement content	As agreed / required	B	Physical	At random at the time of batching.	IS:1199 , Tech Specs and Const. Drawings	SR/TR		
vi		Admixtures for Concrete from approved sources	As agreed / required	A	Review of MTC	Random in each shift	IS:456 , Tech Specs and Const. Drawings	SR/TR	√	Admixture of appd. Brand and tested quality shall be used.
vii		Water Tightness Test for Water Retaining Structures	As agreed / required	B	Physical	100%	IS:3370 (Tanks and Revision) , Tech Specs and Const. Drawings	SR	√	
viii		Dimensions and visual examination of finished structure	As agreed / required	B	Physical/ visual	100%	As per Tech. Specification./Appd. Drg./IS-456	SR		
6	CONCRETE CONVEYING, PLACING & COMPACTION									
i	Mixing of concrete	mixing of concrete shall be done in a approved mixer such as to produce a homogenous mix	As required/ agreed			To be calibrated at the time of starting and subsequently once in three months, and shall confirm to IS:4925	Review of calibration chart/ Certificate, IS 457, Tech Specs and Const. Drawings			time of mixing will be as given in IS 457
ii		Calibration of Batching Plant	As required/ agreed	A	Physical	To be calibrated at the time of starting and subsequently once in three months, and shall confirm to IS:4925	Review of calibration chart/ Certificate, Tech Specs and Const. Drawings	SR/TR	√	Cement consumption at batching plant shall also be obtained through comp. Output.Provision of online printer is mandatory
iii		Handling and Transportation of concrete	As required/ agreed	B	Physical	Random in each shift	IS:456, Tech Specs and Const. Drawings	SR		Free fall or drop shall be limited to 150 cm unless permitted concrete should be placed within 30 min of its removal from mixture . Construction methodology to be approved one week prior to start of work.
iv		Placement of concrete	As required/ agreed	B	Physical	Random in each shift	IS:456, Tech Specs and Const. Drawings	SR		No concrete shall be placed until the place of deposit has been thoroughly inspected and approved, the concrete shall be deposited in such a manner to maintain, until completion of unit, a plastic horizontal surface throughout
v		Check for compaction and Curing	As required/ agreed	B	Physical	Random in each shift	Check for period of curing as per IS 456 , Tech Specs and Const. Drawings	SR		Exposed concrete surface shall be protected against heating and drying for atleast 72 hrs after placement, curing compound may be used
vi		Cleanliness, provision of chute and arrangement for transportation & placement of concrete.	As agreed / required	C	Visual	100%	IS:456, Tech Specs and Const. Drawings	SR		
x		check for segregation	As agreed / required	C	Visual	100%	IS:456, Tech Specs and Const. Drawings			
7	TEST/CHECK ON RCC STRUCTURE IN HARDENED CONDITIONS									
i		Core Test	As agreed / required	A	Physical	As required by NTPC Engineer.	As per IS:456, IS 516, Tech Specs and Const. Drawings	SR/LB/ Test Report	√	Acceptable if average equivalent cube strength of the cores is equal to at least 85% of the cube strength of the grade of concrete specified for the corresponding age and no individual conc has result less than 75%
ii		Dimensional check on finished structures & Dimensional tolerances	As agreed / required	B	Measurement	Approved Drawing	As per IS:456, Tech Specs and Const. Drawings	SR/LB		

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Sl. No	Activity and operation	Characteristics / instruments		Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks
1	2	3		4	5	6	7	8	9	D*	10
iii		Rebound Hammer test	As agreed / required	A	physical	As required by the NTPC engineer	Tech Specs and Const. Drawings	SR/LB	√		
8	REINFORCEMENT STEEL										
i		Physical and Chemical Properties for each lot as per relevant IS codes	As required/ agreed	A	Review of MTC	Each batch of delivery	IS : 1786, IS:432, IS:1566, Tech Specs and Const. Drawings	MTC	√		Applicable if steel is procured by Contractor
ii		Cutting tolerance	As agreed / required	B	Measurement	Random in each shift	IS : 1852, IS: 432, IS:1786, Tech Specs and Const. Drawings	SR/LB			Tolerance as per specifications
iii		Freedom from cracks surface flaws, Lamination.	As agreed / required	B	Visual	Random in each shift	IS: 1852, IS:432, IS:1786, Tech Specs and Const. Drawings	SR/LB			To be checked at site. Steel collected from source should be free from excessive rust. To be stored as per Technical Specs.
9	PLACEMENT OF REINFORCEMENT STEEL										
i		Check for bar bending schedule with necessary laps. Spacers & Chairs	As agreed / required	B	Visual & Measurement	Random in each shift	Approved Drawings, Tech Specs and Const. Drawings	SR			
ii		Check for cover, spacing of bars	As agreed / required	B	Visual & Measurement	Random in each shift	Approved Drawings, Tech Specs and Const. Drawings	SR			
iii		Check for bending of bars	As agreed / required	B	Visual & Measurement	Random in each shift	Approved Drawings, Tech Specs and Const. Drawings	SR			
iv		Check for spacers and chairs after the reinforcement cage is put inside the formwork	As agreed / required	B	Visual & Measurement	Random in each shift	Approved Drawings, Tech Specs and Const. Drawings	SR			
v		Acceptance of placement of reinforcement before start of concreting	As agreed / required	B	Visual & Measurement	before start of each concreting	IS : 456/ Drawings & approved bar bending, Tech Specs and Const. Drawings schedule	SR			
10	STAGING AND FORMS										
i		Materials and accessories	As agreed / required	B	Visual	Once before start of work	As per relevant IS, Tech Specs and Const. Drawings	SR			Proper care should be taken in order to combat corrosion. Proper care should be taken while cleaning, moving and stacking the scaffolds
ii		Soundness of staging, shuttering and scaffolding	As agreed / required	B	Visual	Once before start of work	As per manufacturer's spec.and as per 3696,4014, 4990, Tech Specs and Const.	SR			
iii		Acceptance of formwork before start concreting		B	Physical / visual	before start of each concreting	As per provisions and tolerances, Tech Specs	SR			
11	EMBEDDED PART(INCLUDING LAYING OF RAILS & ANCHOR FASTENERS)										
i		Position and levels of embedded parts	As agreed / required	B	Physical/ measurement	100%	As per drawing, Tech Specs and Const. Drawings	SR			Exposed surface of the embedded parts other than holding down bolts are to be painted with primer chlorinated , rubber based zinc phosphate
ii		Position depth and size of bolt hole	As agreed / required	B	Physical/ measurement	Random in each shift	As per drawing, Tech Specs and Const. Drawings	SR			
iii		Location verticality of pipe sleeve/opening of bolt hold	As agreed / required	B	Physical/ measurement	Random in each shift	As per drawing, Tech Specs and Const. Drawings	SR			
iv		Laying of rails under supervision of NTPCs specialised agency.	As agreed / required	B	Physical/ measurement	Random in each shift	As per drawing, Tech Specs and Const. Drawings	SR			
v		Welding / tying of embedment to reinforce-ment	As agreed / required	B	Physical/ measurement	Random in each shift	As per drawing, Tech Specs and Const. Drawings	SR			
12	PRE-CAST CONCRETE										
i		Crushing strength	As required/ agreed	A	Physical	one sample of six cubes per 50 cum or part thereof	IS:516&IS: 456, Tech Specs and Const. Drawings	SR/LB	√		a minimum of three specimen shall be tested for 28 days comp. strength
ii		Workmanship free from visual defects	As required/ agreed	B	Physical	100%	Tech Specs and Const. Drawings	SR			The precast units shall be free from defects like honeycombing, reinforcement exposure and should have good finish. All relevant tests like workability, cube test shall be carried out as per IS 456-2000 Same as applicable to cast in situ concrete.
iii		Dimension of finish structure	As required/ agreed	B	Measurement	100%	As per IS:456, Tech Specs and Const. Drawings	SR			If the material already tested of the cast-in-situ concrete and part of the same is used for precast concrete, further testing is not required, otherwise testing is required for every 50 Cum. Of Concrete.
iv		Workability	slump test apparatus	B	Physical	one sample every two hrs from mixing plant	IS:1199 &IS:456, Tech Specs and Const. Drawings	SR/LB			According to the mix design
v		Water cement ratio	As agreed / required	B	Physical	At random at the time of batching	IS:1199 , Tech Specs and Const. Drawings	SRLB			According to the mix design
vi		Cement content	As agreed / required	B	Physical	At random at the time of batching	IS:1199 /tech spec, Tech Specs and Const. Drawings	SR			According to the mix design
vii		Load Test	As agreed / required	A	Physical	5% or as desired by EIC	IS:456/ As decided by NTPC Site Engr. Incharge., Tech Specs and Const. Drawings	SR	√		These tests shall also be carried out, in case of doubt regarding grade of concrete and poor quality.
13	JOINTS IN CONCRETE										


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i		Check for the joint material - bitumen impregnated fibre board, PVC water stops, Sealing compound, Expanded polystyrene board, Hydrophillic strip, Acrylic polymer etc.	As per manufacturer Standards	A	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings, IS 1838, IS 1834, IS12200	MTC	√	
ii		Acceptance of installation of materials for Joints in concrete	As agreed / required	B	Acceptance	Each installation randomly	As per technical specifications and construction drawings			
14	DAMP PROOF COURSE									
i		Check for the material - Hot bitumen and water proffing materials etc	As agreed / required	A	Review of MTC	Each batch of delivery at site	Tech Specs and Const. Drawings, IS 702	SR	√	
ii		Acceptance of damp proof course	As agreed / required	B	Acceptance	100%	As per technical specifications and construction drawings	SR		
15	GROUTING									
i		Check for the material	As agreed / required	A	Review of MTC	Each batch of delivery	As per technical specifications and construction drawings	SR	√	Check for chemical, epoxy, resin grouts etc
ii		Check for the type of mix - fluid mix, plastic mix, stiff mix etc.	As agreed / required	B	Physical	Prior to start of work	As per technical specifications and construction drawings			
iii		Check for the mixing, placement, application and grout pressure	As agreed / required	B	Physical	Random in each shift	As per technical specifications and construction drawings	SR		
iv		Check for the compressive strength	As agreed / required	A	Physical	Each batch of delivery	As per technical specifications and construction drawings	SR	√	
v		Acceptance of the grouts	As agreed / required	B	Physical	Each grout section	As per technical specifications and construction drawings	SR		
16	SLIPFORM SHUTTERING									
i		Submission of Slipform Work system to be used	-	B	Submission	Before Comencement of work	As per specifications	SR		
ii		Check for the Slipform shutters	As required	B	Physical	Before Comencement of work	As per specifications	SR		Check for water level system, Controls, Walkways etc.
iii		Details Positions and arrangement of Jack rods	-	B	Approval	Before Comencement of work	As per specifications	SR		Submitted to Engineer for approval
iv		Details of Proposed arrangement for continuous readings	-	B	Approval	Before Comencement of work	As per specifications	SR		Submitted to Engineer for approval
v		Check for All type of openings, Chases, Fixing of Blocks and similar built-up features	As required	B	Physical	100% during execution	Construction Drawings and specifications	SR		No any type of openings ,chases , blocks other than shown in the construction drawings or approved by Engineer shall be executed in the concrete.
vi		Details of proposed method for concrete curing and protection	-	B	Approval	Before Comencement of work	Construction Drawings and specifications	SR		Submitted to Engineer for approval
vii		Check of Concrete Curing and Protection	As required	B	Physical	At Random	Construction Drawings and specifications	SR		Concrete shall not remain uncured for period longer than 12 hours
viii		Check for Sliding Operation	As required	B	Physical	Each Sliding	As per specifications	SR		Rate of Sliding, Delays in sliding, Discontinuity or stop strat sliding to be checked
ix		Monitoring of Sliding Portion								
x		Progress Height	As required	B	Physical	Six hourly intervals	As per specifications	SR		To be recorded in tabular form and on graphs immediately after each monitoring
xi		Centre line in relation to the centers at the base	As required	A	Physical	Six hourly intervals	As per specifications	SR	√	To be recorded in tabular form and on graphs immediately after each monitoring
xii		Internal wall faces in relation to the concrete at the base	As required	B	Physical	Six hourly intervals	As per specifications	SR		To be recorded in tabular form and on graphs immediately after each monitoring
xiii		Wall thickness	As required	B	Physical	Six hourly intervals	As per specifications	SR	√	To be recorded in tabular form and on graphs immediately after each monitoring
xiv		Twist	As required	B	Physical	Six hourly intervals	As per specifications	SR	√	To be recorded in tabular form and on graphs immediately after each monitoring
xv		Verticality of the structure	Optical Theodolight	B	Physical	Every day in morning	As per specifications	SR		To be recorded in tabular form and on graphs immediately after each monitoring
xvi		Check for Tolerances for chimney construction	As required	B	Physical	For every day monitoring	As per specifications	SR		
4.00	BRICK MASONARY									
1	Test on Bricks									
i		Check for Dimensions , shape	As required/ agreed	A	Measurement/ Physical Test	As per relevant IS Code/ One Sample for 30,000 Nos. or part thereof	IS: 1077, Tech Specs and Const. Drawings	Inspection Report	√	Efflorescence shall be checked at each source.
ii		compressive strength, water absorption, warpage efflorescence.	As required/ agreed	B	Measurement/ Physical Test	As per relevant IS Code/ One Sample for 30,000 Nos. or part thereof	IS: 1077, IS:3495 part I (Compressive Strength) Part II (Water Absorbtion) Part III(Efflorescence) Part IV (War page), Tech Specs		√	Preconditioning of brick shall be done as per IS. For compersive strength, warpage and water absorption

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2	Test on Mortar	Compressive strength, consistency and water retentivity for each portion of walls, plasters and ceilings.	As required/ agreed	B	Test	At random	IS 2250-1981, Tech Specs and Const. Drawings	LB		Cement used in mortar shall confirm to either IS 269: 1976 or IS 455- 1976 sand shall confirm to IS 2116 -1980
3	Masonry construction	Acceptance of Workmanship, verticality and alignment	As agreed / required	B	Visual/ Physical	100%	IS 2212, IS 1905 , Tech Specs and Const. Drawings	SR/LB		
5.00	FINISHING AND ALLIED WORKS									
1	MATERIALS- FINE SAND, SAND FOR PLASTERING									
i		Deleterious Material	As agreed / required	B	Physical	Once per source	IS : 2386 (Part-I &II) & IS :2116, Tech Specs and Const. Drawings	SR		
ii		Grading	As agreed / required	B	Physical	50 Cum./or part thereof	IS:3150,1542& Apprd. drgs, Tech Specs and Const. Drawings	SR		Table -I of IS:2116
iii		Galvanized hexagonal wire netting for lath plastering	As agreed / required	B	Review of MTC	Each batch of delivery	, Tech Specs and Const. Drawings	SR		
iv		Check for the thickness and finishing of plaster	As agreed / required	B	Visual/ Measurement	Random in each shift	As per IS 1661 , Tech Specs and Const. Drawings	SR/LB		
2	PLASTERING									
i		Check for defects and the remedial measure for bond filler , blistering , cracking and crazing , efflorescence and irregularity of surface texture	As agreed / required	B	Visual/ Physical	Random in each shift	Tech Specs and Const. Drawings, IS: 1661	SR		
ii		Truness of plastering system	As agreed / required	B	Visual/ Physical	Random in each shift	Tech Specs and Const. Drawings	SR		finished plaster surface shall not show any deviation more than 4 mm when checked with straight edge of 2 m length
iii		Acceptance of Grooves and finishing	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings	SR		
3	STONE GRIT PLASTER/ GRANULAR TEXTURED COAT FINISH									
i		Check for Preparation of surface	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings	SR		
ii		Check for material - Size of chips	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings	SR		
iii		Acceptance of Grooves and finishing	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings	SR		
4	WATER PROOFING SYSTEM									
i		Check for the material	As agreed / required	A	Physical and Review of MTC	Each lot of delivery	Tech Specs and Const. Drawings,	SR/ MTC	√	
ii		Acceptance of water proofing system - Application, fixing, laying	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings	SR		Water pounding test shall be done
5	FALSE CEILING									
i)		Check for the Materials - Glass Reinforced Gypsum (GRG), Pre-painted coil coated steel false ceiling system etc.	As agreed / required	A	Physical and MTC Review	Each batch of delivery	As per relevant IS and Tech. Specs / Manufacturer's TC	-do-	√	
ii)		Acceptance of installation	As agreed / required	B	Physical / measurements	Each installation	-do-	-do-		All supports , hangers , accessories shall be as per Tech. Specifications/ approved manufacturer's recommendations
6.00	PAINTING SYSTEM - All surfaces									
1	Check for the Materials and accessories	White wash, Distemper and all types of Primer and Paints - Check for Shade, type from brand and manufacturer as approved by NTPC EIC	As agreed / required	A	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings	SR/MTC	√	Mfr.'s T.C. shall be correlated with the consignment received.
2	Check for Surface prepration		As agreed / required	B	Physical /visual	Random in each shift	Tech Specs and Const. Drawings	SR		
3	Check for DFT of painted surfaces		As agreed / required	B	Physical	Each surface at random	Tech Specs and Const. Drawings	SR		
4	Acceptance of painted surfaces		As agreed / required	B	Physical	Each surface at random	Tech Specs and Const. Drawings	SR		
6.10	CHIMNEY PAINTING									
i		Requirements for Steel Surfaces	As Required	B	Physical	Randomly	Tech Specs and Const. Drawings	SR		No of Coats applied and DFT/WFT to be checked as per specified
ii		Requirements for Cast Iron Surfaces	As Required	B	Physical	Randomly	Tech Specs and Const. Drawings	SR		No of Coats applied and DFT/WFT to be checked as per specified
iii		Requirements for Concrete Surfaces	As Required	B	Physical	Randomly	Tech Specs and Const. Drawings	SR		No of Coats applied and DFT/WFT to be checked as per specified

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iv		Material Requirements	As Required	B	Physical	Randomly	Tech Specs and Const. Drawings		SR		Requirement of DFT to be checked as per Specifications. Procurement to be done from approved/acceptable manufacturer/source
v		Preparation of Surfaces	As Required	B	Physical	Randomly	Tech Specs and Const. Drawings		SR		
vi		Application of Paint	As Required	B	Physical	Randomly	Tech Specs and Const. Drawings		SR		AS per recommendations by Manufacturer along with Relevant IS Codes and Specification requirements
7.00 DOORS, WINDOWS VENTILATORS & GRILL											
1	Check for the material/ items for all type of timber, flush doors, Particle doors, wire guage, Aluminium doors, Fire proof doors, windows fittings, Anodized aluminium works, Mortice locks, Automatic operating system etc received at site	Review of MTC / make or/and Physical checks, tests report (if MTC is not available)	As agreed / required	A	Review of MTC/ Physical	for each batch of delivery	Tech Specs and Const. Drawings		SR	√	
2	Wood work in frames	Wood work in frames - Check for dimensions, surface finish and rebating etc.	As agreed / required	B	Physical	Random for each installation	Tech Specs and Const. Drawings		SR		
3	Wardrobe shutter and show cases										
i		Check for material as per IS 3087 and 3097 - from NTPC approved source	As agreed / required	B	Physical	one sample for each section for each lot of delivery	Tech Specs and Const. Drawings, IS 3087 and 3097		SR		
ii		Acceptance of fixing after completion	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings, IS 3087 and 3098		SR		
4	Pelmets										
i		Check for material as per IS 3087/ 3097 - from NTPC approved source	As agreed / required	B	Physical	one sample for each section for each lot of delivery	Tech Specs and Const. Drawings, IS 3087/ 3097		SR		
ii		Acceptance of fixing after completion	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings, IS 3087/ 3098		SR		
5	MS Grills										
i		Check for the material for section and weight from NTPC approved source	As agreed / required	A	Physical	one sample for each section for each lot of delivery	Tech Specs and Const. Drawings		SR	√	
ii		Check for fabrication done at approved workshop	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings		SR		
		Acceptance of fixing of MS Grills	As agreed / required	B	Acceptance	Random	Tech Specs and Const. Drawings		SR		
6	Fitting and fixtures - MS sliding door bolts, tower bolts, pull bolt lock, MS handles, Safety Chains, brass locks, brass latch, hydraulic floor springs & door closers, etc	Check for fitting items as per relevant IS codes, tech specifications and BOQ- from NTPC approved source	As agreed / required	B	Physical and acceptance	Five samples for each item for each lot of delivery	Tech Specs and Const. Drawings		SR		
7	Fitting and fixtures - Aluminium sliding door bolts, tower bolts, pull bolt locks, handles, door stoppers etc.	Check for fitting items as per relevant IS codes, tech specifications and BOQ- from NTPC approved source	As agreed / required	B	Physical and acceptance	Five samples for each item for each lot of delivery	Tech Specs and Const. Drawings		SR		
8	Fire proof doors										
i		a) Check for the Fire Proof Doors	As required/ agreed	A	Review of MTC	Each lot	As per Technical Specifications and approved drawings, IS 3614 Part (I & II), TAC		MTC	√	
ii		b) Check for DFT and Fire Retardency of Paint	As required/ agreed	B	Physical	Each Door	As per Technical Specifications and approved drawings, IS 3614 Part (I & II)		SR/LB		
9	Acceptance of all type fittings after fixing	Acceptance of fittings after completion	As agreed / required	B	Physical and acceptance	Random for each type of fitting	Tech Specs and Const. Drawings		SR		
8.00 GENERAL STEEL WORK											
1	Check for Material	Review of MTC/ make / Physical checks, tests (if MTC is not available)	As agreed / required	A	Review of MTC for each delivery	For each batch of delivery	Tech Specs and Const. Drawings		SR	√	
2	Rolling shutters										
i		Check for surface finish and thickness of plate of rolling shutters of approved make and DFT	As agreed / required	B	Physical	Random for each batch of delivery	Tech Specs and Const. Drawings		SR		
ii		Acceptance of rolling shutters after fixing	As agreed / required	B	Physical and acceptance	Random	Tech Specs and Const. Drawings		SR		
3	Steel Glazed doors and T-iron frames sections										

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i		Check for shape, tolerances, thickness, welding and finishing of sections (Check MTC wherever applicable)	As agreed / required	A	Review of MTC for each delivery	Random for each delivery	Tech Specs and Const. Drawings	SR	√		
ii		Acceptance of Steel Glazed doors and T-iron frames sections after fixing	As agreed / required	B	Physical and acceptance	Random for each installation	Tech Specs and Const. Drawings	SR			
4	Pressed steel pressed frames/ doors										
i		Check for shape, tolerances, thickness, welding and finishing (Check MTC wherever applicable)	As agreed / required	A	Review of MTC for each delivery	Random for each delivery	Tech Specs and Const. Drawings, IS4351, IS2202	SR	√		
ii		Acceptance of Pressed steel pressed doors after fixing	As agreed / required	B	Physical and acceptance	Random for each installation	Tech Specs and Const. Drawings	SR			
5	Fencing and Gates										
i)	Check for Materials for fencing and gates	PVC coated chain link fencing (IS 2720), Welded wire mesh (IS 1566), Reinforced barbed tape galvanised (IS 2629) etc.	As agreed / required	A	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings	SR/MTC	√	Mfr.'s T.C. shall be correlated with the consignment received.	
ii)	Check for alignments, erection painting, DFT etc.		As agreed / required	B	Physical / measurements	Each installation	Tech Specs and Const. Drawings	SR		Erection shall be as per NTPC Tech. Specs.	
ii)	Acceptance of the installation and working		As agreed / required	B	Physical / measurements	Each installation	Tech Specs and Const. Drawings	SR		Erection shall be as per NTPC Tech. Specs.	
6	Galvanised Chicken Wire Mesh	Check for Guage and Dimensions from NTPC approved Source	As agreed / required	B	Acceptance	Random for each delivery	Tech Specs and Const. Drawings	SR			
9.00	FLOOR FINISHES AND ALIED WORKS										
1	Cement Concrete Flooring										
i		Check for execution of concreting	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings	SR			
ii		Check for providing and fixing glass/ PVC strips in joints	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings	SR			
iii		Check for laying, polishing, curing, finishing for terrazzo, marble chip flooring	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings	SR			
iv		Acceptance of lines, levels and finishing	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings	SR			
10.00	SANITARY INSTALLATIONS										
1		Check for size and surface finish of all sanitary items and fixtures from NTPC approved sources, (Check MTC wherever applicable)	As agreed / required	A	Physical / review of MTC	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings	SR	√	To be procured from NTPC approved source	
2		Acceptance of installations of all sanitary items and fixtures	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings	SR			
3	SCI, CI, S&S Pipes & Fittings etc										
i		Check for Work man ship and finish	As agreed / required	B	Visual	Random	Tech Specs and Const. Drawings	SR			
ii		Check for Unit weight and Dimensions	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings	SR			
iii		Hydrostatic test	As agreed / required	A	Review of MTC for each delivery	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings	SR	√		
11.00	WATER SUPPLY AND ALL TYPES OF FITTINGS										
1		Check for size and surface finish of all water supply, GI/ MS pipes and fittings, Photo Voltaic Control System etc from NTPC approved sources (Check MTC wherever applicable)	As agreed / required	A	Physical / review of MTC	each delivery as per Specifications	Tech Specs and Const. Drawings	SR	√	To be procured from NTPC approved source	
2		Acceptance of installations of all water supply, GI pipes and fittings	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings	SR			
3	CI, S&S Pipes & Fittings										
i		Check for Work man ship and finish	As agreed / required	B	Visual	Random as per Specifications	Tech Specs and Const. Drawings	SR			
ii		Check for Unit weight and Dimensions	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings	SR			
iii		Hydrostatic test	As agreed / required	A	Physical / review of MTC	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings	SR	√		
4	Polyethylene Water Storage Tanks										
i		Check for material of tanks from NTPC approved sources	As agreed / required	A	Physical / review of MTC	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings	SR	√		
ii		Acceptance for instillation and fitting (IS 12701)	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings	SR			

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12.00	DRAINAGE AND SANITATION									
1	Sanitary appliances									
i		Check for Viterous China, Glazed, ceramic sanitary appliances (Water closets, Wash basins, urinals) etc.	As agreed / required	A	Physical / review of MTC	each delivery as per Specifications	Tech Specs and Const. Drawings	SR	√	To be procured from NTPC approved source
ii		Acceptance of installation of Viterous China, Glazed, ceramic sanitary appliances (Water closets, Wash basins, urinals) etc.	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings	SR		
2	SW Pipes and RCC Pipes									
i		Check for size and surface finish of Pipes from NTPC approved sources	As agreed / required	A	Physical	100% after delivery	Tech Specs and Const. Drawings, IS458, IS 1536	SR	√	
ii		Testing of Joints	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings	SR		
i		Acceptance of installations of Pipes	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings	SR		Acceptance tests shall be done as per specifications
3	CI Pipes, Covers and Frames									
i		Check for CI and SFRC covers and frames as per IS 1726 and IS 12592 from NTPC approved sources (Check MTC wherever applicable)	As agreed / required	A	Physical / review of MTC	Each lot of delivery	Tech Specs and Const. Drawings, IS 1536, IS 12592	SR	√	
ii		Acceptance of installations of CI Pipes, Covers and Frames	As agreed / required	B	Acceptance	1	Tech Specs and Const. Drawings	SR		
4	RCC manholes									
		Acceptance of RCC manholes after completion	As agreed / required	B	Acceptance	1	Tech Specs and Const. Drawings , IS 4111	SR		
13.00	FOUNDATION SYSTEM									
1	SHALLOW FOUNDATIONS									
i		Check for the foundation excavation - Location, Layout, size, depth etc	As required / agreed	B	Physical	Each location	As per technical specifications and construction drawings	SR	√	lines and levels to be checked
ii		Check for the foundation casting - Layout, Shape, dimensitions, Reinforcement, concreting, curing etc	As required / agreed	B	Physical	Each foundation	As per technical specifications and construction drawings	SR		lines and levels to be checked. Concrete Grade to be checked as per Mix Design
14.00	SHEETING AND OTHER WORKS									
1		Check for Material like modular areated panel, permanently colour coated sheets , metal decking, pre-engineered buildings, AC sheeting, Fire proof doors and insulations (all tests as per tehcnical Specifications)	As per manufacturer Standards	A	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings	MTC	√	1)FQP for structural steel shall also be applicable.2) For aluminium door/windows, check for anodisation as per Tech. Spec. 3) Fire proof doors shall be procured from TAC Approved parties as per relevant IS/Tech. 4) For aluminium cladding grade of aluminium to be checked.
2		Check for Storage at Site	As agreed / required	B	Visual	Random in each shift	Tech Specs and Const. Drawings	SR		
3		Installation, lap alignment & workmanship.	As agreed / required	B	Visual/ Physical	Random in each shift	Tech Specs and Const. Drawings	SR		No gas cutting of sheets acceptable . Profile sheets will be kept covered in weather proof storage & stored at accurate height to avoid any exposure of actual water. Principle of first in and first out shall be apply for erecting the sheets.
4		Installation of lining & insulation & check thermal insulation for wall cladding , density , thermal conductivityn at 50 deg c and all other tests as per IS:8183	As agreed / required	B	Testing	100%	Tech Specs and Const. Drawings	SR	√	
5		Check for the installation, alignments, finishing etc	As agreed / required	B	Visual/ Physical	Random in each shift	Tech Specs and Const. Drawings	SR/LB		
6		Fasteners for sheeting work	As agreed / required	B	Review of TC including 1000 hrs salt spray test	100%	Tech Specs and Const. Drawings	SR/LB		
7		Acceptance of each type of installation	As agreed / required	B	Visual/ Physical	Each installation	Tech Specs and Const. Drawings	SR/LB		
15.0	PILING WORK (IF APPLICABLE)									
15.1	Execution									
i		100 mm Dia Borehole	As required	A	Physical	100%	NTPC Tech. Specs	SR/LB	√	If carried out by the contractor
ii		Pile layout	Total station	B	Measurement	100%	As per appd. Drawings and technical	SR/LB	√	
iii		Recording ground level	As required	B	Measurement	Random	IS:2911, as per appd. Drawings and technical	SR/LB	√	
iv		Cleaning/Flushing of pile bore	As required	B	Visual	Random	As per appd. Drawings and technical	SR/LB	√	
v		Size of bore and During boring of pile record commencement of SPT/ core recovery to ensure socketing length equivalent in terms of the Diameter of the pile below the socketing horizon.	As required	B	Measurement	100%	As per appd. Drawings and technical specification	SR/LB	√	

LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN					ANNEXURE- IV			
		ITEM : CIVIL WORK SUB-SYSTEM : Foundations, Excavation & Fill, Concrete, Building, Masonry Etc.	QP NO. : REV. NO. : DATE : PAGE :	1 0		PROJECT: PACKAGE: CONTRACT NO. MAIN CONTRACTOR	Dadri-II & JHAJJAR FLUE GAS DESULPHURISATION SYSTEM PACKAGE			
Sl. No	Activity and operation	Characteristics / instruments	Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks
1	2	3	4	5	6	7	8	9	D*	10
vi		Trial mix to ascertain the workability and cube strength	After receiving the recommended mix design from specialist agency,	B	Physical	One for each mix proportion	NTPC tech specification	SR/LB	✓	Necessary correction for moisture content and water absorption according to mix design recommendation may be carried out during the trial mix
vii		Cement content	As required	B	Physical	Once per shift	As per approved design mix.	SR/LB	✓	At batching plant
viii		Pouring of concrete to project above cutoff level.	As required	B	Measurement	100%	As per appd. Drawings and technical specification	SR/LB	✓	
ix		Pile termination level	SPT & core recovery	A	Soil data	As per NTPC specifications	As per appd. Drawings and technical specification	SR	✓	
15.2 Testing										
i		Bentonite	IS:2720	A	Physical / testing	Once per source	As per IS:2720 / tech. Specs.	SR/LB	✓	Review of test report
ii		Density check on sample of mud collected from pile bore bottom	Sample collection	A	Physical	As per Tech. Spec.	As per NTPC Tech Spec.	SR/LB	✓	Tests to be done before placing concrete. Samples to be collected from pile bore bottom.
iii		Slump test of concrete	IS:1199	B	Physical	Every 2 hrs at pouring point of concrete	IS:2911, As per appd. Drawings and technical specification	SR/LB	✓	
iv		Cube sampling for works cube test	IS:456	B	Physical	One set of 6 cubes per 50 CuM or part thereof for each grade of concrete per shift whichever is earlier.	IS:2911, As per appd. Drawings and technical specification	SR/LB	✓	
v		Initial pile load test, Vertical (Compression), Lateral (horizontal) and pullout (tension).	IS:2911 / as required	A	Testing	100% for 3 nos. for each type or as specified in BOQ / Tech. Spec.	IS:2911, As per appd. Drawings and technical specification	SR/LB	✓	In case of compression test method the loading shall be cyclic.
vi		Routine pile tests, compression and horizontal	Calibrated dial gauges etc. as required.	A	Testing	100% for 0.5% of the total number of piles provided for each type of test/Tech. Spec.	IS:2911, As per appd. Drawings and technical specification	SR/LB	✓	Routine Test shall be conducted by direct loading method.
vii		Integrity Tests	PEM	A	Testing	100%	IS:2911, As per appd. Drawings and technical specification and suppliers manual	Test Report	✓	CHP
16.0 SPECIAL ITEMS										
16.1 Earthing Mat (Grounding System)										
i	Material	Earthing mat	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	As per relevant IS and Tech. Specs / Manufacturer's, IS 3043	SR/MTC	✓	
ii		Weld sizes & length	Visual/Tape	B	Visual/ Measurement	1	Tech Specs and Const. Drawings			NTPC approved electrodes shall be used
iii		D P test	DP test Kit	A	Physical	10% at random of the offered lot	Tech Specs and Const. Drawings	TR	✓	
iv		Earth test	Earthing test kit	A	Physical	1	Tech Specs and Const. Drawings.	SR	✓	
16.2 Bitumen layer for tank foundation										
i	Material	Grade of bitumen	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	As per relevant IS and Tech. Specs /MTC	SR/MTC	✓	
ii	Acceptance and workmanship	Application / workmanship	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings	SR		
16.3 Composite Aluminium Panels and structural glazing										
i	Material	Type of aluminium panels / structural glazing / fasteners and fixtures / silicon sealant	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	Technical specifications / drawings	SR/MTC	✓	MTC shall cover all the properties / parameters as per technical specifications
ii	Acceptance and workmanship	Installation / workmanship	As agreed / required	B	Physical	Random	Technical specifications / drawings	SR		
							DOC. NO.:	REV:		
						Legend: D* Records, identified with "Tick" (✓) shall be essentially included by supplier in QA documentation. Legend to be used: Class # : A = Critical, B=Major, C=Minor; SR, TR, MTC, LB				
Manufacturer/ Sub-supplier	Main-supplier	Categorization Witnessing & Accepting (As per NTPC QA&I System) Category 'A' FQA Engineer in association with Executing Engineer, Category 'B' Executing Engineer, Category 'C' Executing Engineer ;SR = Site Register , TR= Test Report, MTC = Manufacturer's Test Certificate				For NTPC USE				
Signature		This document shall be read in conjunction with NTPC Tech. Specifications, BOQ, Drawings				REVIEWED BY		APPROVED BY		APPROVAL SEAL

LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN					ANNEXURE- V			
		ITEM : STRUCTURAL STEEL WORK		QP NO. :	2	PROJECT:	Dadri-II & JHAJJAR			
		SUB-SYSTEM : FABRICATION & ERECTION		REV. NO. :	0	PACKAGE:	FLUE GAS DESULPHURISATION SYSTEM PACKAGE			
				DATE :		CONTRACT NO.				
Sl. No	Activity and operation	Characteristics / instruments	Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks	
1	2	3	4	5	6	7	8	9	D*	10
1.00	MATERIALS									
i		Structural steel procured from NTPC approved sources-Mechanical (YS, UTS, Elg, UT if specified),,and Chemical properties (CE as per IS)	A	Review	For each batch of each section delivered at site	Technical Specification and Construction Drawings, IS 2062	SR	√		Correlated MTC shall be verified. In the event of non submission of MTC , sample shall be selected by FQA for testing
2.00	FIT-UP									
2.01		Marking and Cutting	As agreed / required	B	Visual & Measurement	Each plate/ Section	Tech Specs and Const. Drawings/ Approved cutting plan	SR		
2.02		Match markings for trial assembled components	As agreed / required	B	Physical	Each fit-up	Tech Specs and Const. Drawings	SR		
2.03		Weld Fit Up	As agreed / required	B	Physical	Each fit-up	Tech Specs and Const. Drawings	SR	√	Edge Preparation/ Gap/ Alignment
3.00	PRE HEATING (wherever applicable)									
3.01		Pre-Heating Temperature	As agreed / required	B	Measurement	Each pre-heating	Tech Specs and Const. Drawings, Approved WPS	SR	√	
3.02		Post Weld Heat Treatment (PWHT), if required	As agreed / required	A	Time & Temperature	Each PWHT	Tech Specs and Const. Drawings, Approved WPS	SR	√	
4.00	WELDING REQUIREMENTS									
4.01		PQR and Welder's Qualification	As agreed / required	A	Physical	Each welder	Approved WPS/ PQR, AWS-D1.1/ASME IX, Tech Specs and Const. Drawings	Test Report	√	
4.02		Welding consumables	As agreed / required	B	Physical	Random in each shift	Approved WPS/ Owner Rationalized list of Electrodes.	SR	√	
4.03		Sequence of welding	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings, Agreed scheme	SR		
4.04		Removal/ grinding of temporary attachments	As agreed / required	B	Measurement	All cleats/ attachments	Tech Specs and Const. Drawings, IS-7215/Approved Drg.	SR		
4.05		Completeness after welding-Dimensions/ distortion	As agreed / required	B	Visual	Each structure component	Tech Specs and Const. Drawings	SR		
5.00	NON DESTRUCTIVE AND DESTRUCTIVE TESTING									
5.01	Fillet Welds									
5.01.01		Visual	As required/ agreed	B	Visual/ Measurement	Each welded joint	As per technical specifications and construction drawings	SR		As per requirement of Owner Engineer
5.01.02		Macro-Etch Examination	As required/ agreed	B	Physical	Main fillet weld with min one joint per built up beam, columns and crane girders	As per technical specifications and construction drawings	SR	√	


LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN					ANNEXURE- V				
		ITEM : STRUCTURAL STEEL WORK		QP NO. :	2	PROJECT:	Dadri-II & JHAJJAR				
		SUB-SYSTEM : FABRICATION & ERECTION		REV. NO. :	0	PACKAGE:	FLUE GAS DESULPHURISATION SYSTEM PACKAGE				
				DATE :		CONTRACT NO.					
Sl. No	Activity and operation	Characteristics / instruments		Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks	
1	2	3		4	5	6	7	8	9	D*	10
5.01.03		Dye Penetration Test (DPT)	As required/ agreed	B	Physical	25% weld length of tension member of crane girder- For crane girder 5% of Weld length with min. 300mm at each location - Except Crane Girder, for all other Fillet Welds	As per technical specifications and construction drawings		SR	√	
5.02	Butt Welds										
5.02.01		Visual	As required/ agreed	B	Visual	Random in each shift	As per technical specifications and construction drawings		SR		
5.02.02		Dye Penetration Test	As required/ agreed	B	Physical	100% DPT after back gouging on all butt welds except for coal bunker bins 10% DPT after back gouging-For coal bunker bins	As per technical specifications and construction drawings		SR		All butt welds to be back gouged before DPT
5.02.03		Mechanical testing on production test coupons	As required/ agreed	A	Physical	Min. one joint per built up beams, coloums and crane girder.	As per technical specifications and construction drawings		SR	√	Test on production test coupons
5.02.04		Radiography Test (RT)	As required/ agreed	A	Physical	100% RT on butt welds of tension flange (bottom flange) of crane girders 5% spot RT on butt welds / at inaccessible locations UT on butt welds- For coal bunker bins 10% RT weld length of each welder on butt welds, except for crane girders and coal bunk	As per technical specifications and construction drawings		SR	√	In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled at that particular location. Acceptance criteria of NDT on welds shall be as per AWS D1.1. Wherever RT is not feasible UT to be carried out with the approval of the Engineer
5.03	Full Penetration Welds (Other than butt welds)										


LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN					ANNEXURE- V			
		ITEM : STRUCTURAL STEEL WORK		QP NO. :	2	PROJECT:	Dadri-II & JHAJJAR			
		SUB-SYSTEM : FABRICATION & ERECTION		REV. NO. :	0	PACKAGE:	FLUE GAS DESULPHURISATION SYSTEM PACKAGE			
				DATE :		CONTRACT NO.				
Sl. No	Activity and operation	Characteristics / instruments		Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks
1	2	3		4	5	6	7	8	9	D* 10
5.03.01		Ultrasonic Testing (UT)	As required/ agreed	A	Physical	100% UT on the web to flange joint of crane girder 10% UT on other full penetration joints	As per technical specifications and construction drawings	IR	√	In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled at that particular location. Acceptance criteria of NDT on welds shall be as per AWS D1.1.
5.04	NON DESTRUCTIVE AND DESTRUCTIVE TESTING FOR CHIMNEY STEEL LINER									
i		Visual examination	As required/ agreed	B	Visual	100%	As per technical specifications and construction drawings, IS 822, AWS D 1.1	SR	√	As per requirement of NTPC Engineer
ii		DPT	As required/ agreed	B	Physical	100%	As per technical specifications and construction drawings, IS 822, AWS D 1.1	IR	√	
iii		RT	As required/ agreed	A	Physical	10% FOR SHOP BUTT WELD AND 15% FOR SITE BUTT WELDS	As per technical specifications and construction drawings, IS 822, AWS D 1.1			
6.00	FOUNDATION CHECKS									
6.01		Dimensions and levels	As agreed / required	B	Physical/ Measurement	Each Foundation	Tech Specs and Const. Drawings	SR	√	Shape, lines (including diagonal checks)
6.02		Foundation Bolts (materials)	As agreed / required	A	Physical and MTC Review	Once for each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	√	Foundation bolts shall conform to IS:5624 and property class shall be 4.6 as per IS:1367 (Part-3).
6.02		Foundation Bolts and Embedments	As agreed / required	B	Physical/ Measurement	Each Foundation	Tech Specs and Const. Drawings	SR	√	Measurement of Verticality, Levels, pitch distance
7.00	PRE-ASSEMBLY CHECKS									
7.01		Punch Erection marks and match marks on members	As agreed / required	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings			Markings for - Assembly designation, Part number, Weight, Any other important identifications.
7.02		Pre-assembly as per match mark	As agreed / required	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings			
7.03		Camber, sweep and total length after trial assembly of structure.	As agreed / required	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings	SR	√	
7.04		Control assembly check at shop	As agreed / required	B	Visual/ Physical	Every first and tenth set of identical structure	Tech Specs and Const. Drawings			
8.00	ERECTION CHECKS									
8.01		Alignment, slopes, level, tolerances of erected member	As agreed / required	B	Measurement	Each structural member	Tech Specs and Const. Drawings	SR	√	
8.02		Tightening of bolts including foundation bolts with lock nuts	As agreed / required	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings	SR	√	


LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN					ANNEXURE- V			
		ITEM : STRUCTURAL STEEL WORK		QP NO. :	2	PROJECT:	Dadri-II & JHAJJAR			
		SUB-SYSTEM : FABRICATION & ERECTION		REV. NO. :	0	PACKAGE:	FLUE GAS DESULPHURISATION SYSTEM PACKAGE			
				DATE :		CONTRACT NO.				
Sl. No	Activity and operation	Characteristics / instruments	Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks	
1	2	3	4	5	6	7	8	9	D*	10
8.03		Acceptance of erected structure	As agreed / required	B	Visual/ Physical	Each erected structure	Tech Specs and Const. Drawings, IS 7215 and IS 12843	SR	√	
9.00	INSTALLATION AND ALIGNMENT OF STEEL LINER									
i		Submission of Installation/ Erection Scheme/ methodology for all structures	-	B	Approval	Once prior to erection of each structure	Approved drawings and Technical Specifications	SR	√	
ii		Check for Erection Marks	-	B	Visual	100%	Approved drawings and Technical Specifications	SR		
iii		Check for Installation of Steel Liners	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications	SR		
iv		Check for Site Joints	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications	SR		
v		Check for Installation of Inlet Transition Ducts	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications	SR		
vi		Check for Installation of Insulations and Expansion Compensators	As required	B	Visual, Physical, Acceptance	100%	Approved drawings and Technical Specifications	SR		Each layer of expansion Compensator to be checked at shop for thickness, unit weight, tensile strength & elongation along with temp. withstandability for composite joints
vii		Ensure the Erection of all steel structures along with permissible tolerances and their acceptance	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications	SR		
viii		Check and approval for Dismantling, Modification and Re-erection, if required for any reason.	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications	SR		
10.00	PAINTING SYSTEM									
10.01		Paining Materials and accessories	As agreed / required	A	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings	SR/MTC	√	Mfr.'s T.C. shall be correlated with the consignment received.
10.02		Surface prepration	As agreed / required	B	Physical /visual	Random in each shift	Tech Specs and Const. Drawings, Relevant code/ standards	SR	√	
10.03		DFT of paint - Over steel surface	As agreed / required	B	Physical	Each surface at random	Tech Specs and Const. Drawings	SR	√	
10.04		Acceptance of painted surfaces	As agreed / required	B	Physical	Each surface at random	Tech Specs and Const. Drawings	SR		
11.00	PERMANENT BOLTS AND NUTS AND WASHERS									
11.01		Material	As agreed / required	A	Physical and MTC Review	Once for each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	√	All bolts for connections shall be conforming to IS: 12427 and of property class 5.6 as per IS:1367 (Part 3). Nuts shall conform to IS:1363 (Part 3) of property class 5
11.02		Contact surfaces before bolting	As agreed / required	B	Physical	Random before assembly for bolting	Tech Specs and Const. Drawings, IS 4000	SR		
11.03		Inspection of the assembled bolts	As agreed / required	B	Physical	Randomly in each shift for assembeled bolts	Tech Specs and Const. Drawings, IS 4000	SR		


LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN					ANNEXURE- V					
		ITEM : STRUCTURAL STEEL WORK		QP NO. :	2	PROJECT:	Dadri-II & JHAJJAR					
		SUB-SYSTEM : FABRICATION & ERECTION		REV. NO. :	0	PACKAGE:	FLUE GAS DESULPHURISATION SYSTEM PACKAGE					
Sl. No	Activity and operation	Characteristics / instruments		DATE :	CLASS :	Quantum Of check	CONTRACT NO.	MAIN CONTRACTOR	Reference Document	Acceptance Norms	Format of Record	Remarks
1	2	3		4	5	6	7	8	9	D*	10	
11.04		Tensioning	As agreed / required	B	Physical	Randomly during snug tight test and after full tensinoning	Tech Specs and Const. Drawings, IS 4000		SR	√		
11.05		Acceptance of installed bolts	As agreed / required	B	Physical	Each bolt	Tech Specs and Const. Drawings		SR			
12.00 STAINLESS STEEL HAND RAILS												
12.01		Material	As agreed / required	A	Physical/MTC Review(In case procured by contractor)	Once for each lot of delivery	Tech Specs and Const. Drawings		SR/MTC	√		Also check grade of steel
12.02		DPT for welding	As agreed / required	A	Physical	Random for each fabrication	AWS D1.1 / Tech Specs and Const. Drawings		SR/LB	√		WPS shall be submitted for Owner approval , electrodes used shall be as specified in WPS
12.03		Acceptance of stainless steel hand rails	As agreed / required	B	Physical	Each installation	Tech Specs and Const. Drawings		SR			
13.00 PTFE SLIDING BEARINGS AND ELASTOMERIC BEARINGS												
13.01		Material from approved source	As agreed / required	A	Physical and MTC Review	Once for each lot of delivery	Tech Specs and Const. Drawings		SR/MTC	√		
13.02		Acceptance of installation of bearings	As agreed / required	B	Physical	Each installation	Tech Specs and Const. Drawings		SR			
LEGEND: D * Records, indentified with "Tick" (√) shall be essentially included by supplier in QA												
Legend to be used: Class # : A = Critical, B=Major, C=Minor; SR, TR, MTC, LB												
Manufactur-er/ Sub-supplier	Main-supplier	Categorization Witnessing & Accepting (As per Owner QA&I System) Category 'A' FQA Engineer in association with Executing Engineer, Category 'B' Executing Engineer, Category 'C' Executing Engineer ;SR = Site Register , TR= Test Report,MfrTC = Manufacturer's Test Certificate					For Owner USE			DOC. NO.:	REV: 0	
	Signature	This document shall be read in conjunction with Owner Tech. Specifications, BOQ, Drawings								REVIEWED BY	APPROVED BY	APPROVAL SEAL


SUB-SECTION- VI
(PRE-COMMISSIONING ACTIVITIES, COMMISSIONING
OF FACILITIES AND INITIAL OPERATIONS)


CLAUSE NO.	PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS			
<p>1.00.00</p> <p>GENERAL</p> <p>1.01.00</p> <p>1.02.00</p> <p>1.03.00</p> <p>2.00.00</p>	<p>PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS</p> <p>GENERAL</p> <p>The pre-commissioning and commissioning activities including Guarantee tests, checks and initial operations of the equipment furnished and installed by the Contractor shall be the responsibility of the Contractor as detailed in relevant clauses in Technical Specification. The Contractor shall provide, in addition, test instruments, calibrating devices, etc. and labour required for successful performance of these operations. If it is anticipated that the above test may prolong for a long time, the Contractor's workmen required for the above test shall always be present at Site during such operations.</p> <p>It shall be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and initial operation of the equipment systems which are installed by him. The Contractor shall also be responsible for flushing & initial filling of all oils & lubricants required for the equipment furnished and installed by him so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in these specifications & documents.</p> <p>The Contractor upon completion of installation of equipments and systems, shall conduct pre-commissioning and commissioning activities, to make the facilities ready for sustained safe, reliable and efficient operation. All pre-commissioning/ commissioning activities considered essential for such readiness of the facilities including those mutually agreed and included in the Contractors quality assurance program as well as those indicated in clauses elsewhere in the technical specifications shall be performed by the Contractor.</p> <p>TESTING / COMMISSIONING PROCEDURES</p> <p>The contractor shall submit his testing / commissioning check lists and procedures for various equipments / systems covered under the contract at least 10 months before the actual commissioning of the equipments / systems for review and approval of employer.</p> <p>The testing / commissioning procedures are to be of a standard format in order to maintain consistency of presentation, content and reporting. The list of commissioning check lists and procedures to be submitted and their content details shall be agreed upon during preaward discussions.</p> <p>An indicative list of Testing / Commissioning procedures and Standard Checklists and the details regarding the contents are enclosed as annexure at the end of this</p>			
<p>NCTPP DADRI ST-II (2x490MW) & IGSTPP, JHAJJAR (3x500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-6130/0330-109(-9)</p>	<p>PART-B SUB-SECTION-VI PRE-COMMISSIONING</p>	<p>PAGE 1 OF 5</p>	


CLAUSE NO.	PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS			
	<p>sub-section of section-VI, Part B. The actual list of such equipments / systems shall depend on the equipments / systems being supplied by the contractor.</p> <p>i) Annexure-I : Standard Checklist of items</p> <p>ii) Annexure-II : Testing / Commissioning Procedure</p> <p>iii) Annexure-III : Commissioning procedures requiring approval of Employer.</p> <p>iv) Annexure – IV : Brief write up on Contents of Testing / Commissioning Procedures</p>			
3.00.00	PRECOMMISSIONING & COMMISSIONING ACTIVITIES			
3.01.00	<p>General</p> <p>The pre-commissioning activities including some of the important checks & tests for certain major equipment/ systems (as a minimum) are described below, although it is the Contractor's responsibility to draw up a detailed sequential & systematic list of checks / tests and various activities / procedures connected with pre-commissioning of the complete facilities with all systems, sub-systems and equipment supplied and installed by him and get the same approved by the Employer.</p>			
3.02.00	PRE-COMMISSIONING ACTIVITIES/TESTS:			
3.02.01	<p>Air and Gas Tightness Test</p> <p>After completion of installation of Booster fans, ducts, absorber and before commencement of application of thermal insulation a test shall be performed on the FGD system by the contractor to prove or to establish the tightness of the erected equipments within the Terminal points. The procedure adopted for such tests shall have the prior approval of the Employer. Normally physical leak detection method by pressurizing the section under test by running Temporary blower is adopted. The contractor may adopt any other better method of testing.</p> <p>All equipments including any temporary blanking, if required, for the above test shall be provided by the Contractor.</p> <p>The Contractor's air and gas tightness test procedure shall be such that it shall enable conductance of air/gas tightness test on the ducts in segmented manner (as and when these duct segments are ready), so that these duct segments can be immediately released for application of insulation after their gas tightness tests. Contractor shall made all necessary arrangement for conducting tests in this manner. Any blanking etc. on the duct side required for testing of duct segments</p>			
<p>NCTPP DADRI ST-II (2x490MW) & IGSTPP, JHAJJAR (3x500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-6130/0330-109(-9)</p>	<p>PART-B SUB-SECTION-VI PRE-COMMISSIONING</p>	<p>PAGE 2 OF 5</p>	

CLAUSE NO.	PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS			
3.02.03	<p>shall be provided by Contractor. Contractor shall bring fan / blower (s) of adequate size / capacity and other necessary instruments so that these tests can be conducted. The above equipment shall be brought to site by the Contractor on temporary basis and shall be taken back after successful completion of air / gas tightness test.</p>			
3.02.03	<p>All pre-commissioning tests & activities as indicated in Annexure-I, II & III and elsewhere in the technical specification shall be performed by the Contractor.</p>			
3.03.00	<p>COMMISSIONING OF FACILITIES</p> <p>General</p> <p>Upon completion of pre-commissioning activities/test the Contractor shall initiate commissioning of facilities. During commissioning the Contractor shall carryout system checking and reliability trials on various parts of the facilities.</p> <p>Contractor shall carry out these checks/tests at site to prove to the Employer that each equipment of the supply complies with requirements stipulated and is installed in accordance with requirements specified. Before the plant is put into initial operation the Contractor shall be required to conduct test to demonstrate to the Employer that each item of the plant is capable of correctly performing the functions for which it was specified and its performance, parameters etc. are as per the specified/approved values. These tests may be conducted concurrently with those required under commissioning sequence.</p> <p>The Contractor shall finalize the protocol of check lists, after erection of the system and equipment, as per International Codes/Standard with the Employer.</p> <p>The Contractor shall furnish requisite no. of copies of procedures and list of start up, pre-commissioning, commissioning and initial operation tests for Employer's approval.</p> <p>The Contractor shall also demonstrate the performance of all C&I equipment, the tests on main equipment or prior to that as the case may be.</p> <p>Other tests shall be conducted, if required by the Employer, to establish that the plant equipments are in accordance with requirements of the specifications.</p>			
3.03.01	<p>The Commissioning tests/checks shall specifically include but will not be limited to following:</p> <p>(a) Checks on the operation of all controls of isolating gas and air dampers</p> <p>(b) Checks on operation of fans to ascertain level of noise and vibration</p>			
<p>NCTPP DADRI ST-II (2x490MW) & IGSTPP, JHAJJAR (3x500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-6130/0330-109(-9)</p>	<p>PART-B SUB-SECTION-VI PRE-COMMISSIONING</p>	<p>PAGE 3 OF 5</p>	

CLAUSE NO.	PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS			
3.03.02	<p>(c) Test running of all pumps, blowers & compressors</p> <p>(d) Checks on operation of Fire Fighting System</p> <p>(e) Checks on operation of all ZLD system (wherever provided).</p> <p>(f) Checks on operation of all rotating equipments to ascertain level of noise and vibration</p> <p>(g) Standard commissioning tests and procedures as per Contractor's practice for FGD plant</p> <p>(h) Checks on operation of all individual control loops in the FGD control loops in the FGD control system.</p> <p>(i) Checks on inter-relation between each control loop in the FGD control system.</p> <p>(j) Calibration tests of orifice, flow nozzles, instruments and control equipment to the extent included in these specifications.</p> <p>(k) Checks on operation of all static equipments to ascertain level of noise and vibration</p> <p>(l) Tests on Control & Instrumentation (C&I) Equipments</p> <p>The Contractor shall finalise the protocol of check lists, after erection of the system and equipment, as per International Codes/Standard with the Employer.</p> <p>The Contractor shall furnish requisite no. of copies of procedures and list of start up, precommissioning, commissioning and initial operation tests for Employer's approval.</p> <p>The Contractor shall also demonstrate the performance of all C&I equipment, the tests on main equipment or prior to that as the case may be.</p> <p>Other tests shall be conducted, if required by the Employer, to establish that the plant equipments are in accordance with requirements of the specifications.</p> <p>Balance equipment & systems</p> <p>All pre-commissioning tests & activities as required for successful running of the equipment or as mentioned in the technical specification elsewhere shall be performed by the contractor.</p>			
<p>NCTPP DADRI ST-II (2x490MW) & IGSTPP, JHAJJAR (3x500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-6130/0330-109(-9</p>	<p>PART-B SUB-SECTION-VI PRE-COMMISSIONING</p>	<p>PAGE 4 OF 5</p>	

CLAUSE NO.	PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS			
<p>4.00.00</p> <p>INITIAL OPERATION</p> <p>Upon completion of system checking/tests and as a part of commissioning of facilities, complete FGD plant/facilities shall be put on initial operation for a period of thirty (30) days or 720 hours as stipulated in General Technical Requirements.</p> <p>5.00.00</p> <p>The Contractor shall conduct all the commissioning tests and undertake commissioning activities pertaining to all other auxiliaries and equipments including all Electrical & C&I equipment/systems not specifically brought out above but are within the scope of work and facilities being supplied & installed by the Contractor and follow the guidelines indicated above or elsewhere in these technical specifications (Section-VI).</p> <p>6.00.00</p> <p>The Contractor shall conduct all the commissioning tests and undertake commissioning activities pertaining to all other auxiliaries and equipments including all Electrical & C&I equipment/systems not specifically brought out above but are within the scope of work and facilities being supplied & installed by the Contractor and follow the guidelines indicated above or elsewhere in these technical specifications (Section-VI).</p> <p>7.00.00</p> <p>COMMISSIONING SPARES</p> <p>7.01.00</p> <p>It will be the responsibility of the Contractor to provide all commissioning spares including consumable spares required for initial operation till the Completion of Facilities. The Contractor shall furnish a list of all commissioning spares within 60 days from the date of Notification of Award and such list shall be reviewed by the Employer and mutually agreed to. However, such review and agreement will not absolve the Contractor of his responsibilities to supply all commissioning spares so that initial operation do not suffer for want of commissioning spares. All commissioning spares shall be deemed to be included in the scope of the Contract at no extra cost to the Employer.</p> <p>7.02.00</p> <p>These spare will be received and stored by the Contractor at least 3 months prior to the schedule date of commencement of initial operation of the respective equipment and utilized as and when required. The unutilized spares and replaced parts, if any, at the end of successful completion of guarantee tests shall be the property of the Contractor and he will be allowed to take these parts back at his own cost with the permission of Employer.</p>				
<p>NCTPP DADRI ST-II (2x490MW) & IGSTPP, JHAJJAR (3x500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-6130/0330-109(-9)</p>	<p>PART-B SUB-SECTION-VI PRE-COMMISSIONING</p>	<p>PAGE 5 OF 5</p>	

CLAUSE NO.	PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS			
	<p style="text-align: right;">ANNEXURE-I</p> <p style="text-align: center;"><u>STANDARD CHECKLIST</u></p> <p>This is an indicative list of items. The actual list shall depend on the Equipment / System being supplied by the contractor.</p> <p style="text-align: center;"><u>MECHANICAL</u></p> <p><u>VALVES</u></p> <ol style="list-style-type: none"> 1. Manually Operated Valve 2. Electrically Operated Valve 3. Pneumatically Actuated Valve 4. Hydraulically Actuated Valve 5. Safety Valve 6. Electromatic Relief Valve 7. Steam Trap 8. Non Return Valve (including Hydraulic/ Pneumatic QCNRVS) 9. Control Valve 10. Relief Valve 11. Differential Pressure Regulating Valve 12. Pinch valve <p><u>TANKS & PRESSURE VESSELS</u></p> <ol style="list-style-type: none"> 1. Limestone silos 2. Gypsum storage silos 3. Limestone slurry tanks 4. Filtrate tank 5. Waste water tank 6. Secondary hydrocyclone feed tank 7. Lime dosing tank 8. Process water tank 9. Absorber 10. Auxiliary absorbent tank 11. Mill circuit tank 			
<p>NCTPP DADRI ST-II (2x490MW) & IGSTPP, JHAJJAR (3x500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.: CS-6130/0330-109-9</p>	<p>PART-B ANNEXURE-I SUB-SECTION-VI PRE-COMMISSIONING</p>	<p>PAGE 1 OF 6</p>	

CLAUSE NO.	PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS			
	<p>12. Any other tank not covered above</p> <p>13. Vacuum tanks</p> <p>14. Air Receiver(if any)</p> <p><u>PUMPS</u></p> <ol style="list-style-type: none"> 1. Slurry recirculation pumps 2. Gypsum bleed pumps 3. Limestone slurry pumps 4. Process water pumps 5. All other slurry pumps 6. Vacuum pumps 7. Sump pumps <p><u>PIPE WORK SYSTEM</u></p> <ol style="list-style-type: none"> 1. Steam services 2. Water services 3. Slurry services 4. Air services 5. Constant load support 6. Spring supports 7. Hangers and other Supports <p><u>STRAINER AND FILTER</u></p> <ol style="list-style-type: none"> 1. Strainer / Filter Basket Type 2. Strainer Rotary (Low Pressure) 3. Filter & Strainers Centrifugal Separators 4. Filter & Strainer Y-Type 5. Filter & Strainer (Plate Type) 6. Purifier 7. Filter – Compressed Air Line <p><u>FANS & COMPRESSORS</u></p> <ol style="list-style-type: none"> 1. Booster Fans– Axial Flow pressure Lubricated 			
<p>NCTPP DADRI ST-II (2x490MW) & IGSTPP, JHAJJAR(3x500MW) PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.: CS-6130/0330-109-9</p>	<p>PART-B ANNEXURE-I SUB-SECTION-VI PRE-COMMISSIONING</p>	<p>PAGE 2 OF 6</p>	