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PUBLIC NOTICE

CEA has published 'Guidelines **for Model Quality Assurance Plan (MQAP) for Major Equipment of Power Sector'** in March 2022 covering MQAP for all the segments of power sector i.e. Generation (Thermal, Hydro), Transmission and Distribution.

The draft modification of the above Model Quality Assurance Plan (MQAP) for Major Equipment in Thermal Plant are attached herewith for comments/ suggestions.

All the Stakeholders and members of public may send their comments/ suggestions on aforementioned draft modified MQAP to Chief Engineer (TE&TD), Room No. 903 (9th Floor), Sewa Bhawan (South Wing), R. K. Puram, New Delhi-110 066 by post or through e-mail **(cetetd-cea@gov.in)** latest by 23rd June-2023.

Chief Engineer (TE&TD), CEA
Dt. 08-05-2023

ANNEXURE C

MODEL QUALITY ASSURANCE PLAN (MQAP) FOR MAJOR EQUIPMENT IN THERMAL POWER PLANT

QUALITY ASSURANCE PLAN

1.1 QUALITY ASSURANCE PROGRAMME

All materials, components and equipment covered under the scope of supply shall be procured, manufactured, erected and tested at all stages as per the comprehensive Quality Assurance (QA) programme. The QA document indicating the specific inspection and testing requirements to be followed shall be subject to the approval of the purchaser. The contractor shall submit his quality assurance programme for review by purchaser and shall generally cover the following:

i) Organizational structure for management and implementation of the proposed Quality Assurance programme.

ii) Quality system manual.

iii) Documentation control system.

iv) Qualification and experience data of contractor's key personnel.

v) The procedure for procurement of materials, parts, components and equipment.

vi) Procedure for inspection at source, inspection of incoming raw-materials/ parts/ components & verification of materials purchased.

vii) Procedure for selection of sub-vendors and sub- contractors.

viii) System for shop manufacturing including process controls, fabrication and assembly controls, and procedure for product identification & traceability.

ix) System for inspection and testing during manufacture, processing, fabrication, welding, assembly and other activities.

x) The reference documents, plant standards, acceptance norms, test and inspection procedure etc.

xi) Control of calibration and testing of measuring and testing equipment.

xii) System for quality audits, documentation to indicate conformance or non-conformance of the product to the specification and testing and inspection requirements; review and control of non- conforming items and system for corrective actions.

xiii) System for indication and appraisal of inspection status.

xiv) System for authorizing release of manufactured product to the purchaser.

xv) System for packaging, handling, transportation, storage and delivery.

xvi) System for generation and maintenance of inspection and test records.

xvii) All the accepted non-conformance reports (major/ minor) / deviation including complete technical details/ repair procedure.

xviii) Inspection reports duly signed by the Utilities and contractor for the agreed Customer Hold Points.

xix) Certificate of Conformance (CoC) wherever applicable.

xx) Inspection release note (IRN).

TECHNICAL REQUIREMENTS FOR QUALITY PLAN

1.2 STEAM GENERATOR AND AUXILIARIES

Testing and inspection requirements of major equipment over and above the respective code/standard requirements are given hereunder:

1.2.1 Pressure Parts

Only those materials shall be used in the manufacture of pressure parts which can be identified against mill sheet or manufacturer test certificates. Material shall meet all the mandatory requirements (and supplementary checks, if asked for) of specified specification, Indian Boiler Regulations (IBR), and relevant code/standard. All nondestructive testing as detailed against relevant equipment shall meet the requirement of ASTM section 3 Vol. 3.03 or equivalent BIS standard.

1.2.1.1 Drum

i) Each plate shall be subjected to a 100 % normal and shear ultrasonic at the millto meet the minimum requirements of BS: 5996 grade LC3/ ASTM or equivalent standards. Elevated temperature tensile tests shall also be carried out on plate material for each heat.

ii) After cutting to size and removal of cut outs, the plates shall be subjected to magnetic particle examination (MPE) along the edges of the plate and on areas adjacent to the cutouts.

iii) All forged connections shall be examined by 100% ultrasonic testing (UT) before machining.

iv) Fully machined connecting pieces of internal diameter 100mm and above, except for forgings, shall be subjected to magnetic particle examination / liquid penetrant examination.

v) Mechanical tests shall be carried out on specimens prepared from the production control test plates of the longitudinal welds.

vi) Mechanical tests shall be conducted on the specimens from manhole cutouts of dished ends.

vii) All butt welds shall be subjected to 100% radiographic test (RT) before stress relieving.

viii) On completion of welding, the entire drum shall be subjected to stress relievingin the furnace.

ix) All butt welds shall be subjected to 100% ultrasonic test and magnetic particle examination after stress relieving.

x) All full penetration welds shall be subjected to ultrasonic examination after stress

relief.

xi) After stress relieving, all welds shall be examined by magnetic particle examination (MPE) methods depending on size and accessibility.

xii) Complete drum shall be subjected to hydraulic pressure test and all compensatingpads shall be pneumatically tested. xiii) All connecting tubes & pipes shall be subjected to UT prior to fabrication as per BS 3602 or equivalent with longitudinal calibration notch of depth 5% of wall thickness (0.3 mm min. and 1.5 mm max.)

1.2.1.2 Headers

i) Raw material for headers shall be subjected to UT prior to fabrication. Transverse test on headers (greater than 8") from one end (25% of lot). Flattening test on pipe from one end (25% of lot).

ii) All butt welds shall be subjected to MPE and radiographic examination /PAUT+TOFD before stress relieving.

iii) All full penetration nozzle and attachment welds shall be subjected to UT prior to stress relieving.

iv) All nozzles, branches, stubs and load bearing attachment shall be examined by MPE techniques after the toes of the weld have been ground smooth and stress relieved.

v) Non-load bearing welds shall be examined by MPE techniques after the toes of the welds have been ground smooth and stress relieved.

vi) Completed closed end headers shall be subjected to hydraulic pressure tests and all compensating pads shall be pneumatically tested.

vii) All weld joints in alloy steel headers of P 91, X20 and X22 & other material of P15E group and above shall be checked for Hardness. 3% hardness check shall be carried out on welds of other alloy steel Headers.

viii) Boroscopy examination shall be carried out for those header which will be interconnected with other headers by welding.

1.2.1.3 Tubes and tube elements

i) Raw material for tubes for water wall, superheater, reheater, economiser, riser, supply and connecting tubes including nozzle/stubs, connections for drum, headers, pipe work etc., shall be subjected to 100% UT prior to fabrication as per IBR or ASME E 213 or equivalent with the longitudinal calibration notch of depth 5% of wall thickness (0.3mm minimum and 1.5mm maximum).

ii) All bent tubes, stubs shall be checked for ovality and thinning by ultrasonic method on first off lot and random checks on subsequent pieces. Critical bends, where PWHT is required after bending, shall be subjected to LPI/MPI. For FOT area reduction shall be calculated

iii) All tubes, stubs, panels, coils shall be checked for clearance by steel ball test and for cleanliness by sponge passage.

iv) Finished butt welds shall be subjected to RT or UT. Wherever the code/standard/process specifies random sampling, the same shall be minimum 20%. Finished field butt welds not covered under random sampling for RT/UT, shall be subjected to RT or PAUT.
Minimum 10 % of the fillet welds (including fins if any) shall be subjected to MPE or dye penetration test (DPT).

v) Tubes and fabricated panels, coils shall be subjected to hydraulic pressure test excluding loose tubes but including water wall panel, burner panels, reheaters, superheaters and economizers.

vi) 10% hardness survey on butt welds of P15E material group and above. 10% Hardness checks shall also be carried out on welds of T23 material grade. 3% Hardness checks shall also be carried out on welds of T22 material grade used in water wall panels.

vii) In case of RT of tube welds with DWDI (elliptical view) number of exposure shall be as per relevant code / plant standard and will not be less than two exposures for each weld wherever there is no limitation in carrying out two RT shots

viii) In case of spiral water wall design, trial assembly of complete wall of each side including hopper shall be carried out.

1.2.1.4 Integral piping and valves

i) All raw materials used shall have co-related mill test certificate meeting material specification. All pipe lengths shall be subjected to 100 % ultrasonic examination as per ASMEE213 or equivalent, with longitudinal calibration notch of depth 5% of wall thickness (0.3mm minimum and 1.5mm maximum) or hydraulic tests and UT or RT on longitudinal welds at the tube mill.

ii) All mother pipes shall be subjected to 100% UT prior to fabrication as per ASMEE 213 or equivalent with longitudinal calibration notch of depth 5% of wall thickness (0.3mm minimum and 1.5mm maximum).

iii) All forged fittings shall be checked by UT and formed fittings shall be checkedby MPE.

iv) All pressure parts shall be 100 % UT tested. All welded, cast alloy steel and carbon steel fittings for use above 71 bar design conditions shall be 100 % RT tested. However, wherever the code/standard/process specifies random sampling, the same shall be minimum 20%.

v) All bent pipes shall be checked for ovality and thinning by UT on first off lot andon random samples for subsequent pieces. Outer surface of bends shall be subjected to MPE or DPT.

vi) The edge preparation for shop and site welds in stainless steel and alloy steel shall be subjected to dye penetration check. Non-destructive examination ofwelds shall be carried out after post weld heat treatment, if any.

vii) All butt welds shall be subjected to UT or RT and MPE. For weld on alloy steel piping, UT or RT shall be done after stress relieving. Wherever the code/ standard/ process specifies random sampling, the same shall be minimum 20 %.

viii) All butt welds in alloy steel piping of P91, X20 and X 22 shall be checked for RTor UT and MPE after stress relieving (SR). UT shall be of digital recordable type.

ix) All weld joints in alloy steel piping of P 91, X20 and X22 shall be checked for hardness. For preheating and post weld heat treatment (PWHT) induction heating shall be deployed. However, PWHT can be done in furnace also. 3% hardness check shall be carried out on welds of other alloy steel piping.

x) All load-bearing attachment welds shall be subjected to MPE after stress relieving.

xi) For HP piping, non-destructive examination of welds shall be carried out in accordance with the relevant design/manufacturing codes. However, apart from above, the following requirements shall be met. Further statutory requirement, wherever applicable shall also be complied with the following:

a) Temperature > 400^0C and/ or pressure exceeding 71 bar

- 100% RT or UT on butt welds and full penetration branch welds.
- 100% MPE.

b) Temperature > 175^0C up to 400^0C and/or pressure exceeding 17 bar and up to 71 bar

- 100% RT or UT on butt welds and full penetration branch welds for pipe diameter more than 100NB.
- 10% RT or UT on butt welds and full penetration branch welds for pipe diameter up to 100NB.
- 100% MPE.

c) All other pipes not covered above shall be subjected to 100% MPE or DPT in case of underground pipes and 10% MPE or DPT in case of piping above the ground. Further, 10% of butt welds of underground piping shall be subjected to RT.

Wherever SR/PWHT is envisaged for alloy steel, above NDTs shall be after SR/PWHT.

1.2.1.5 **Fittings***:*

i) Raw material of all forged fitting shall be ultrasonically tested. All mother pipes used for formed fitting shall be ultrasonically tested as per ASME 213 or BS 3602 or equivalent with longitudinal calibration notch of depth 5% of wall thickness (0.3mm min. and 1.5mm max.) shall be adhered to.

ii) Fittings shall be subjected to suitable NDT as per applicable standards. However following minimum NDE requirement shall also be applicable / met.

a) For fittings X20, P-91, P-92 and material group P15E & above
- 100% MPI &
- 10% hardness check &
- For fittings of 200 NB & above 100% UT/RT

b) 100% UT/RT for fittings of 200 NB & above for boiler feed discharge, recirculation and spray piping of boiler feed system.

c) 100% UT/RT for fittings of all other piping of size OD 508mm & above.

1.2.1.6 Valves

i) Pressure retaining parts of valves shall be subjected to NDT as per Table 1.

ii) Hardened and stellitted valve disc and seat shall be subjected to DPT andhardness check.

iii) All forgings rounds above diameter 40 mm shall be ultrasonically tested.

iv) 100% UT of body & bonnet for valves 1500 class or above. 100% MPE for 600 class and above.

v) Color matching of valve disc/plug and seat shall be carried out to ensure minimum 80% contact and no through passage. UT / RT of full penetration welds. & MPE of fillet joints (in case of cast valves).

vi) Hydraulic pressure test and seat leak test shall be carried out as per ANSI 16.34 or IBR.

vii) Air seat leak test shall be carried out as per applicable standards or codes.

viii) Functional tests shall be carried out on each valve to check the following as per the approved valve data sheet

a. Smooth operation.
b. Valve travel, closing and opening time.
c. Current drawn by actuators.

ix) Springs for safety valves shall be tested with suitable NDT and for springstiffness rate.

x) Safety relief valves shall be tested for performance. Lift set pressure, back pressure, reset pressure test in case of safety relief valves.

All critical valve components shall be tested for mechanical and chemical properties.

Table 1: NDT requirements for pressure retaining components of valves

Valve size NB in mm	ANSI Class up to 300	ANSI Class above 300 up to 600	ANSI Class above 600 below 900	ANSI Class 900 and above but below 4500
Less than 50	Visual	Visual	Visual	MPE
50 & above but below 100	Visual	Visual	MPE (for special class valves)	MPE and RT on 100% area
100 & above but less than 300	Visual	MPE	MPE and RT on 10% of valves on change of section and weld ends	MPE and RT on 100% area
300 and above	MPE	MPE	MPE and RT on change of sections and weld ends	MPE and RT on 100% area

Note:

i) For body and bonnet forgings, UT with MPE may be adopted in place of RT.
ii) For austenitic steel, MPE may be replaced by DPT.

1.2.1.7 Non pressure bearing attachments

Load bearing welds shall be subjected to UT and MPE after stress relieving. Non load bearing welds shall be subjected to MPE after stress relief. The toes of the welds adjoining the drum shall be ground smooth prior to stress relieving before carrying out this examination.

1.2.1.8 Hydraulic test

i) The drum and all components which are to be subjected to fluid pressure shall be tested to minimum of 150% of the design pressure. The duration of the pressure tests shall be sufficient, as approved by the purchaser, to show any leakage paths and to permit a thorough examination of the component whilst under pressure.

ii) The temperature of the fluid used for the pressure test shall be such as to avoid any possibility of brittle fracture at a low temperature and the same shall be modified and submitted to the purchaser for approval, before commencing the test.

iii) The fluid used shall be of a sufficient purity and where relevant, suitable inhibits shall be used to avoid excessive corrosion and /or damage to temporary parts either during the test or prior to drying and cleaning.

1.2.1.9 Pneumatic test of compensating pads

All compensating pads shall be provided with two-threaded weep holes to test welds at

0.5 kg/cm^2 (g) with soap solution and no leakage shall be ensured.

1.2.2 Boiler water circulation pumps

i) Raw material for casing, shaft and impeller shall be checked for high temperature physical properties, apart from mandatory and supplementary check of material specification.

ii) All forging and castings shall be subjected to 100% UT or RT and MPE or DPT check.

iii) Static and dynamic balancing of the rotary parts shall be carried out.

iv) Hydraulic pressure test shall be conducted on pump casing at minimum 1.5 times the design pressure.

v) Each pump shall be subjected to performance test at the manufacturer's works under as near actual site conditions as possible.

vi) Following test shall be carried out on assembled units:

A) Type test:

a) NPSH test

b) Temperature rises test.

c) Under voltage test.

d) Quality assurance proof test.

e) Tests to establish unit functioning of pump at operating temperature and pressure.

f) Hot standstill and start up tests.

Note :- Type test if already done on the same model will not be repeated. Documents will be submitted for review and approval of the purchaser.

B) Routine test:

a) Hydrostatic test of complete unit.

b) Over speed test.

c) Tests to determine unit characteristics.

d) Pump performance.

e) Unit run at rated voltage.

f) Starting current at rated voltage.

g) Cold start up test.

h) Endurance test of motor windings, joints and terminal seals

i) Noise level.

j) Inspection of dismantled unit.

k) High voltage test.

vii) For heat exchanger for these pumps, butt welds on pressure parts shall be tested with RT or UT and all other welds shall be tested with MPE or DPT.

viii) Hydraulic test shall be carried out both on tube side as well as shell side at minimum 1.5 times the design pressure.

1.2.3 Air Preheaters, Steam Coil Air Pre-Heater and Fuel Oil Heaters

1.2.3.1 Air Preheaters

i) Forged shafts for air preheater like stub shaft, main rotor forging, housing hub shall be subjected to 100% UT at mill and magnetic particle examination after machining.

ii) For non-modular design, trial assembly shall be carried out at shop prior to dispatch to site.

iii) Critical welds of rotor post shall be subjected to radiographic examination.

iv) Trial run of air preheater rotor drive assembly with gear box, pinion, motor at shop.

1.2.3.2 Steam coil air pre-heater and fuel oil heaters

Hydraulic pressure test shall be carried out on the heating coils. All pipes, valves, steam traps and mountings shall be subjected to hydraulic test as called for under IBR, BS or other approved codes.

1.2.4 Soot Blowers

i) Butt weld between nozzle and lance tube shall be subjected to 20 % radiographytests.

ii) Soot blower shall be subjected to operational checks as below:

a) Smooth operation
b) Long tube travel, closing and opening time.
c) Current drawn.

1.2.5 ID, FD and PA fans

i) Rotor components shall be subjected to ultrasonic test at mill and magneticparticle examination/dye penetration examination after rough machining.

ii) Butt welds in rotor components shall be subjected to 100% UT and all welds shall be subjected to MPE or DPT after stress relieving.

iii) All rotating components of fans shall be dynamically balanced to quality grade 2.5 of ISO 1940.

iv) Test for natural frequency of all fan components, including fan blades shall be carried out for the fans.

v) Full range performance test shall be carried out on one fan of each type and size as per BS 848, Part-1.

vi) Dimensional and profile checking of fan blades

vii) Hydraulic coupling of ID fan shall be checked for string test i.e. operational check of one fan assembly using hydraulic coupling to check temperature rise, smooth operation, vibration and noise level. Dry run test shall preferably be carried out during string test.

1.2.6 Coal Mills, Pulverised Coal Piping and Burners

i) Raw material for shaft, coupling, gears and pinions, top and bottom races and other rotating components shall be subjected to UT. MPE or DPT shall be carried out to check surface soundness.

ii) Wear-resistant parts shall be subjected to UT or RT to check soundness after suitable heat treatment. Check for chemical composition and hardness shall be carried out. For ceramic materials check for various properties including hardness, density, wear rate and composition shall be carried out.

iii) Butt welds in the body casing and separator of the mill shall be tested by RT and MPE. All other welds shall be tested by MPE or DPT for acceptance.

iv) 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.

v) Fabricated pipe welds shall be examined by MPE.

vi) Ceramic/ basalt lined piping and bends etc. shall be checked for proper layout.

vii) Weldments on burner components shall be checked with suitable NDT. The burner assembles shall be tested for operation at shop.

viii) Trial assembly of at least one mill complete with all major components at shop.

ix) All rotating components shall be dynamically balanced.

1.2.7 Coal Feeders

i) All welds in the casing and pulley fabrication shall be checked with MPE.

ii) Type tests including degree of protection and routine tests shall be done as per relevant Indian Standards or equivalent International Standards.

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

iv) Explosion proof test at 50 psi as per NFPA code shall be done as type test. Leak

tightness test shall be done on individual feeder casing. Endurance test for load cell shall be carried out.

v) Test for weighing accuracy, calibration and repeatability shall be carried out at various speeds by coal flow on one feeder.

vi) Calibration check shall be carried out on all feeder cabinet and assemblies prior to dispatch.

1.2.8 Boiler structure, ducts, hoppers, dampers etc.

i) Only those materials which have been identified against mill sheet or test certificates shall be used for construction. Structural steel and built up plate girders for main boiler shall be fully killed fine grained and normalised. All plates of tension and compression flanges and connection material and plates above 40mm thickness shall be 100% ultrasonically tested.

ii) Visual inspection of all welds shall be performed in accordance with AWS D.1.1. Also the butt and fillet welds for built up plate girders shall be inspected 100% by magnetic particle examination.

iii) RT or UT shall be performed on all butt welds of thickness 32mm and above. For thickness below 32mm and up to 25mm, 100% MPE shall be carried out along with 10%RT/UT and for thickness below 25mm 10% MPE or DPT shall be performed. Edge preparations for field welding shall be examined by MPE for plate thickness 32mm and above. Field welds ends in ceiling girder shall be subjected to Ultrasonic examination for 100mm depth from the edges.

iv) Ceiling girders, columns, ducts hoppers and tunnels shall be trial assembled and match marked prior to dispatch/erection. At least two consecutive girders along with cross member shall be assembled at a time.

v) Drum sling rods

a) Sling rods forging shall be subjected to ultrasonic examination.

b) Welds shall be examined by UT and MPE after stress relief.

c) Trial fitment of the rods with the drum shell shall be carried out to ensure proper contact.

d) Screw thread of the rods shall be suitably protected to avoid damage during handling and transport.

ix) Dampers

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

b) Gas tight dampers shall be subjected to shop leakage test to demonstrate

the guaranteed tightness (minimum one damper of each type and sizeoffered). In case such type test is already done, the reports of the same shallbe submitted for review.

c) All dampers shall be checked for sealing dimensions to establish guaranteed tightness.

1.2.9 Electro- Static Precipitators (ESPs)

1.2.9.1 Discharge and collecting electrodes

i) Work tests for discharge electrodes shall include the following (for the wire type electrodes):

a) Chemical and tensile tests.

b) Metallographic examination-longitudinal and transverse (250X)

c) Surface finish and surface purity from chloride ions.

d) Spring back and surface finish after coiling (applicable to helical discharge electrodes

For all other type of electrodes, testing to be carried out as per the applicable standards.

ii) Work tests for collecting electrodes and rigid discharges electrode shall includethe following:

a) Chemical and mechanical properties.

b) Check for profile and straightness.

c) Check for surface finish and dimensional accuracy.

d) Cupping test for deep drawn sheets.

1.2.9.2 ESP structure

i) Visual inspection of all welds shall be performed in accordance with AWS D1.1.

ii) Also the butt and fillet welds for built up plates and columns shall be inspected by 100% MPI.

iii) NDT requirements of structural steel welds shall be as under:-

a) 100% RT/UT on butt-welds of plate thickness $\geq$ 32 mm.

b) For plates of 25mm < thickness < 32mm - 10% RT/UT and 100% MPI.

c) For plates of thickness < 25mm - 10% MPI/LPI.

d) All fillet welds of structural members shall be inspected 100% by MPI.

iv) Edge preparation for field welding shall be examined by MPI for thickness $\geq$ 32mm.

1.3 STEAM TURBINE GENERATOR AND AUXILIARIES

Testing and inspection requirement of major equipment over and above therequirements of respective codes/standards are given hereunder:

1.3.1 Steam Turbine

1.3.1.1 High pressure (HP) and intermediate pressure (IP) enclosures

The following shall be applicable to high pressure cast steel enclosures (for example high pressure and intermediate pressure inner and outer cylinders, steam chests and liners, steam inlet pipes, nozzle boxes):

i) Test pieces fully representative of the material and condition of the casting shall be provided to the purchaser to enable the determination of the properties of material to be used. Casting suppliers should have established practices to ensure requirements of creep and rupture for long exposure of the component/ equipment to high temperatures and pressures. In case of new or non-established vendors, creep data shall be made available by the contractor.

ii) Tests shall be carried out on the casting material to establish its mechanical properties, chemical composition, and microstructure.

iii) Each casting shall be subjected to magnetic particle examination on the entire inner and outer surfaces after heat treatment.

iv) Each casting shall be subjected to visual examination and dimensional check before taking up the machining work on it. Dimensional check shall be carriedout after machining also.

v) Each casting shall be subjected to a 100% examination for internal flaws by UTor RT method after heat treatment and suitable preparation.

vi) Cast enclosure shall be subjected to a hydraulic pressure test based on established practice of manufacturer.

vii) Excavated area of all the defects shall be subjected to MPE to ensure excavation up to sound area. All the areas repaired/ upgraded by welding shall be examined by UT, RT (to confirm findings of UT wherever required) and MPE. Sketches/ reports of location of repair and reports of NDT carried out on repaired areasshall be submitted along with certificates. Hardness survey shall be carried out on the repaired areas.

viii) Where stub pipes and transition pieces are welded to the main body of anenclosure the following shall be carried out:

a) RT and MPE or DPT of weld preparations.

b) MPE of finished welds after stress relieving.

c) RT or UT of finished welds.

d) 100% RT or UT and MPE of site weld preparations on the stub pipes and transition pieces before dispatch to site.

e) Hardness survey on the weld joint, heat affected zone (HAZ) and parent material.

ix) Wall thickness measurement for critical and highly stressed zones of the casting shall be carried out by ultrasonic method.

x) Colour matching of castings by putting two halves together and feeler gauge tightness check from both sides, i.e. inside and outside to ensure required contact area and joint tightness shall be carried out.

xi) Final dimensional check before dispatching should be carried out. Suitable arrangement should be taken care to avoid any distortion during transit/ transportation.

1.3.1.2 Low pressure (LP) enclosure (fabricated)

i) Tests shall be carried out on the plate material to establish its mechanical properties and chemical composition.

ii) Plates used for fabrication shall be subject to 100% UT.

iii) Where welds are made by chipping and grinding back to the first side weld before completing the weld from second side, a magnetic particle or dye penetrant examination of the chipped area shall be carried out.

iv) Fabricated enclosure shall be subjected to stress relieving as per manufacturer's standard practice.

v) Dimensional check shall be carried out on the fabricated enclosure.

vi) The following minimum requirements shall be met for NDT on the welds:

a)	Butt welds & full penetration welds	:	10% RT or UT and 10% MPE or DPT (100%)
b)	Fillet welds	:	10% MPE or DPT (100%)
c)	Nozzle welds	:	10% MPE or DPT (100%)
d)	Lifting lug and other load bearing fillet welds	:	100% MPE or DPT
e)	Site weld edge preparations	:	10% MPE or DPT

vii) Fabricated enclosure shall be subject to hydraulic pressure tests. If it is not the manufacturer's practice, the justification for not carrying out hydraulic test shall be furnished for purchaser's approval.

viii) Feeler gauge tightness check from inside and outside to ensure required joint tightness shall be carried out.

ix) Suitable arrangement should be taken care to avoid any distortion during transit/ transportation.

1.3.1.3 Turbine rotors

1.3.1.3.1 Forgings

Rotor forgings (mono block and/ or discs), impulse wheel and nozzle box and coupling forgings:

i) Fully representative tangential, radial and axial test pieces shall be provided at each end of the body, at each shaft end and from the trepanned core (when a coreis trepanned) to determine mechanical properties including impact, Brinell hardness etc. and tests for notch toughness (both transition temperature and room temperature impact values).

ii) Forging supplier should have established practices to ensure requirements of creep and rupture for long exposure of the component to high temperatures and pressures.

iii) Heat treatment shall be carried out in such a way so as to ensure minimum residual stress in the rotor. Residual stress measurement will be carried out.

iv) Tests shall be carried out on the forging material to establish its mechanical properties, chemical composition and micro structure.

v) Thermal stability tests shall be carried out on HP and IP rotor forgings to ensure the thermal stability of the rotors in service and at over speed.

vi) Each forging shall be subjected to a 100% ultrasonic examination. Normal probes and angular probes with different probe angles shall be used for thorough examination to ensure complete soundness of the forging

vii) Each rotor shall be subjected to a 100% MPE after final machining on journal areas and before gashing on other areas.

viii) When a rotor forging is bored, a visual check and magnetic particle examination of the bore shall be carried out.

ix) Following tests shall be carried out on the rotor welds:

a) Ultrasonic examination with normal and angular probes of the weld to ensure complete coverage and freedom from harmful defects.

b) Run out of rotor before and after welding.

c) MPE on finish welds.

d) Hardness survey on the welds.

e) Stress relieve annealing.

f) Test reports of filler material used.

g) Dimensional record of weld preparation.

x) Dimensional examination of the rotor blade grooves and other important dimensions shall be carried out to ensure the conformance to drawing dimensions and log sheets/records shall be prepared for all important dimensions.

1.3.1.3.2 Complete rotors

i) Axial & radial run-outs and surface finish checks shall be carried out before and after blading and after over speed tests. Run out examination shall be carried out at blade shrouds also.

ii) Check shall be carried out for clearance between rotor groove and blade at the root.

iii) Rotors shall be dynamically balanced at rated speed.

iv) An over speed test shall be carried out during which the rotor shall withstand an over speed of 120% for five continuous minutes or 125% for two continuous minutes. If bidder's practice is different from that stated above, then the same shall be furnished for purchaser's approval. During over speed test, vibration measurement and analysis shall also be carried out.

v) After blading and again after over speed testing, rotor stages with blades over 225 mm of active length are to be subject to standing vibration tests to determine natural frequencies in various vibration modes to ensure that the ranges are outside operating frequencies.

vi) In case impulse stage and or blade discs are fitted on the rotor, fit up between such disc and rotor shall be checked up before and after over speed test.

vii) Lock blade lift after the over speed test shall be checked and record for same shall be maintained.

1.3.1.4 Stator and rotor blades and shroud bands

i) Fully representative test pieces shall be provided to enable mechanical properties of the material to be determined. In case of blades machined from bar stock, mechanical tests shall be carried out on the hardest and softest specimens of each heat treatment batch. Hardness test will be carried out on 100% basis.

ii) Tests shall be carried out on the materials to establish its mechanical properties, chemical composition and micro structure.

iii) Each bar stock for machining blades and forging shall be subjected to 100% ultrasonic examination.

iv) When erosion shielded, the erosion shield and blade joint shall be radiographed.

v) Dye penetrant test shall be made on the erosion shield and blade joint in manufacture prior to fitting to the wheel and after over speed tests.

vi) Magnetic particle examination or dye penetrant test (when MPE is not applicable) shall be carried out on finish machined blade profile, roots and shrouds.

vii) All moving blades of over 225mm active length are to be moment weighed and assembled on shaft in a prescribed sequence to ensure optimum balancing of rotor.

viii) Natural frequencies of the LP turbine blades shall be determined before mounting on rotors to ensure that the same are outside operating frequency range.

ix) Shroud bands after punching and after riveting shall be subjected to 100% DPT to ensure freedom from harmful surface defects.

x) In case of cast blades, following testing shall be done:

a) Chemical analysis and mechanical testing per heat/heat treatment batch.

b) MPE on rough machined and finish machined blade.

c) RT on blades.

d) Before starting mass productions, following technological tests shall be carried out on the first lot of 10 to 15 blades:

- 100% RT and 100% MPE on blades
- 100% hardness testing.
- Mechanical testing and metallurgical testing.
- Weld repair shall not be permitted.

1.3.1.5 Diaphragms

i) Welded and fabricated diaphragms

a) Concentricity checks shall be carried out on final machined diaphragms to ensure that there are no negative overlaps between guide and moving blades.

b) 10% UT and 100% MPE shall be carried out on finished, stress relieved and machined welds. For inaccessible areas, DPT shall be carried out in place of MPE.

ii) Cast, forged and machined diaphragms

a) Tests shall be conducted to determine mechanical properties together with chemical analysis, metallographic/ metallurgical examination, and required heat treatment.
b) Concentricity, flatness, blade drop and area checks shall be carried out on finally machined diaphragms to ensure that there are no negative overlaps between guide and moving blades and port wall.
c) 100% ultrasonic examination shall be carried out on diaphragm materials. Blade junction areas with the side walls shall be checked by MPE or DPT.

iii) Colour matching of all the diaphragms by putting two halves together and feeler gauge tightness check shall be carried out.

1.3.1.6 Exhaust hood

All castings shall be subjected to chemical and mechanical tests as per relevant material standards. In case of fabricated construction of exhaust hood, butt welds shall be subjected to 10% RT and 100% DPT. Exhaust hood shall be pressure tested. No repair of welding shall be carried out on cast iron castings. Blue matching shall be carried out on exhaust hood parting planes.

1.3.1.7 Stop, control and bypass valves, actuators/ servo-motors and steam strainers

i) Test pieces shall be provided to enable the determination of mechanical properties of valve bodies, bonnets, valve disc and seat, and valve spindle. Casting suppliers should have established practices to ensure requirements of creep and rupture for long exposure of the component/ equipment to high temperatures and pressures.

ii) Tests shall be carried out on the materials to establish their mechanical properties, and chemical compositions.

iii) Dye penetrant tests shall be carried out on stellited and nitrided areas of components and on stellite components in the finish ground or honed condition.

iv) Hardness check shall be carried out to ensure required hardness.

v) Valve body and bonnet castings or forgings shall be subjected to 100% RT or 100% UT. Body and bonnet shall also be subjected to 100% MPE on entire surface.

vi) All pressure containing welds in body and bonnet shall be subjected to 100% RT or UT and 100% MPE.

vii) Wall thickness of the body and bonnet after finish machining shall be measured by ultrasonic method and valve seat bore shall be checked for size and concentricity.

viii) Dimensions of valve spindle shall be measured and valve lift shall be checked.

ix) Bar stock of 50 mm and above size for valve stem shall be subjected to UT, and finish machined stem shall be subjected to MPE or DPT.

x) Each valve body and bonnet shall be hydraulically tested at minimum 1.5 times the maximum working pressure after applying temperature corrections for minimum 30 minutes.

xi) All the actuating cylinders and servomotors shall be performance tested.

xii) Performance testing shall be carried out on valve operators and actuators to check functional requirements like trip closing and opening time, valve lift and hysterisis.

xiii) Colour matching of the valve disc and seat to ensure the required contact area is to be carried out.

1.3.1.8 Cast and forged steel components (such as LP casing- in case of cast design, inlet, extraction and exhaust connections, shaft seal covers and rings, governor shaft, breach nut, threaded ring, angle ring, U-ring, servomotor parts such as body, piston, cover, yokes; turning gear casing and other items which are not specifically covered elsewhere)

i) Results of tests conducted to determine mechanical properties, chemical analysis, metallurgical/ metallographic examination, and heat treatment procedures recommended and actually followed shall be recorded on certificates.

ii) Each pressure containing enclosure shall be subjected to a hydraulic pressure test at 1.5 times the design pressure and after applying temperature corrections.

iii) All castings and forgings shall be subject to suitable non-destructive examination by RT or UT and MPE or DPT methods to ensure freedom from harmful defects in line with clause 1.3.1.1.

1.3.1.9 Bolts and nuts for pressure retaining enclosures and rotor couplings

i) Bar stock for bolts shall be subject to 100% UT (having more than 50mm dia.).

ii) Finish machined bolts shall be subject to preferably 100% MPE to detect surface defects. However, DPT can also be done in place of MPE.

iii) Coupling bolts and nuts shall be suitably identified after weight control checks.

1.3.1.10 Governing and protection system equipment (such as electro-hydraulic controller, hydraulic amplifier, hydraulic controller, electro hydraulic convertors, hydraulic convertors, hydraulic speed governor, trip devices etc.)

i) All pressure retaining parts shall be subjected to hydraulic testing.

ii) All the major castings and forgings shall be subjected to suitable NDT methods depending upon their application and criticality to ensure the freedom from harmful defects.

iii) All the main assemblies and sub-assemblies shall be subjected to functional test.

iv) All butt welds shall be subjected to minimum 10% RT or UT and all fillet and corner

welds shall be subjected to MPE or DPT.

v) All control equipment shall be subjected to rig testing, if it is not possible to test it on the steam turbine light run. The purpose of rig testing shall be as far as practical to prove that the functioning of the control equipment is in accordance with the approved design.

vi) Nitrided and stellited components shall be subject to DPT and hardness check.

1.3.1.11 Inspection of completed turbine

i) HP and IP turbines

The steam turbine shall be assembled in the manufacturer's works to such an extent that a thorough inspection can be carried out. The purpose of this inspection shall be to ensure that the fit between mating components is correct and that all clearances are in accordance with the design requirement. The following minimum checks/ measurements shall be carried out on the assembled turbine:

a) Check and measurement of clearance between shaft seal casing and shaft seal ring.

b) Check and measurement of clearance in anti- rotational device in shaft seal casing joint.

c) Check and measurement of axial and radial alignments of inner and outer casings.

d) Check and measurement for radial and axial blade clearances in blading section.

e) Check and measurement for axial and radial clearances in shaft seal.

f) Check and measurement for tightness and elongation of horizontal joint inner casing bolts.

g) Check and measurement of minimum axial clearances and minimum radial clearances in completely assembled steam turbine.

h) Check for alignment of over speed governor.

i) Check for axial distances for shroud bands for casings.

j) No load running test on the steam turbine including functional tests for steam turbine control and emergency control equipment (as per manufacturer's practice).

k) Pre- dispatch inspections including clearance check for transportation device.

ii) LP Turbines

For the LP turbine, the following minimum checks/ measurements shall becarried out on the assembled turbine at the manufacturer's works:

a) Check and measurement of axial and radial alignments of inner and outer casings.

b) Check and measurement for radial and axial blade clearance in blading section.

c) Check and measurement of minimum axial clearances and minimum radial clearances in completely assembled steam turbine.

d) Check and measurement for alignment of stationary blade carriers.

e) No load running test on the steam turbine including functional tests for steam turbine control and emergency control equipment.

f) Pre- dispatch inspections including clearance check for transportationdevice.

iii) No load running tests on complete steam turbine shall be carried out as per manufacturer's standard practice.

1.3.2 Integral Auxiliaries of Steam Turbine

1.3.2.1 Bearing pedestals, housings and bearings

i) Leakage test shall be conducted on pedestals. For fabricated pedestals and housing, 10% weld shall be checked after stress relieving by magnetic particle test and minimum 10% of the butt welds shall be checked by RT or UT.

ii) Bearing shell

a) The shell shall be subjected to suitable nondestructive examination like RT or UT and/or MPE as applicable.

b) Colour matching of the shell by putting two halves together and feeler gauge tightness checks from inside and outside to ensure required contact area and joint tightness shall be carried out.

c) The shell shall be subjected to hydraulic pressure test.

d) Chemical analysis of white metal shall be carried out. The effectiveness of the white metal adhesion shall be checked by UT or other approved method, and the exposed edges of the white metal shall be subject to DPT.

e) Hydraulic test shall be carried out for bearing oil inlet piping and jacking oil piping.

f) Alignment check shall be made for bearing in bearing pedestal.

1.3.2.2 Cross around pipes

i) Weld edge preparation of shop and site welds shall be checked by 100% MPE.

ii) All butt welds shall be subjected to 100% RT.

iii) 100% MPE shall be carried out on all welds.

iv) Check for dimensions and visual inspection shall be carried out on finished pipes.

1.3.2.3 Lubricating oil, jacking oil and control oil systems

i) Pumps

a) Main oil pump shaft shall be subjected to ultrasonic examination. Butt welds shall be subjected to RT or UT.

b) Pump impeller shall be subjected to suitable NDT method like MPE or DPT for surface defect examination. Impeller of main oil pumps shall also be subjected to an over speed test at 120% of rated speed for 5 minutes (as per the guidelines followed for HP Rotor)

c) Pump casing shall be subjected to hydraulic pressure test at 2 times the working pressure or 1.5 times the pump shut off head whichever is higher.

d) Rotor assemblies shall be dynamically balanced.

e) All pumps shall be performance tested at the manufacturer's works. Test shall include check for vibration and noise levels also.

ii) Coolers and lubricating oil tanks

a) All raw materials used shall have co-related mill test certificate meeting mandatory and supplementary checks of material specification.

b) Material for tube plates shall be ultrasonically tested. Drilled tube plates shall be checked for ovality of holes, ligaments, surface finish etc.

c) Dished ends shall be subjected to 100% MPE and RT or UT on welded joints. Knuckle portion shall be checked by MPE for surface defects and thinning shall be checked by UT.

d) Butt welds and full penetration welds shall be checked by suitable RT or UT. Fillet welds shall be checked by MPE or DPT.

e) Tubes shall be tested as per the relevant codes or standards.

f) Before tubes expansion in the tube sheets, the mockup test for expansions shall be carried out, in case not done earlier. Torque setting of expander shall be

based on mock up tests. Joints shall be checked for tube thinning.

g) Completed assemblies shall be pressure tested. The twin oil coolers shall be tested on both tube side and shell side. After hydro test, the coolers shall be suitably dried.

h) Atmospheric tanks shall be tested for leakage by water fill test for at least 12 hrs.

iii) Oil purifiers

a) All pressure parts shall be subjected to hydraulic pressure test.

b) Components/ parts of the equipment shall be subjected to suitable NDT depending upon the criticality of the application to ensure freedom from surface and sub-surface defects.

c) All rotating parts like bowl assembly etc. shall be subjected to static and dynamic balancing test.

d) The complete purifier shall be tested at manufacturer's works for capacity, mechanical running, sequential operation and interlocks, moisture content, vapour tightness, vibration, noise level, quality improvements etc. Sample shall be drawn from inlet and outlet of purifier after works test and shall be tested for moisture content, chemical tests and particle size of impurities. . In case, type test has already been carried out by the contractor for the offered model of the centrifuge, the test shall not be repeated and certificates of test carried out earlier shall be furnished for review of the purchaser.

1.3.3 Steam Condenser

1.3.3.1 Condenser

i) Tests shall be carried out on the materials of plates, tubes and nozzles etc. to establish their mechanical properties, and chemical compositions.

ii) Plates shall be subject to 100% ultrasonic testing.

iii) Tubes shall be subject to dimensional check, 100% eddy current test and 100% hydraulic test. In place of hydraulic test, air under water or Helium leak detection test can also be carried out.

iv) Forgings of the nozzles shall be subject to 100% UT and 100% MPE.

v) All welds shall be visually examined. Radiographic examination of 10% of butt welds (including T-joints) shall be carried out. However, for vacuum containing welds, RT on at least 10% of each butt weld shall be carried out. Surface defect examination by MPE or equivalent test method shall be carried out for minimum 10% weldments. Nozzle welds shall be subject to 100% MPE or DPT. These shall apply to site welds also.

vi) All edge preparations shall be examined for surface defects. Edge preparation for welds to be carried out at site shall be checked by magnetic particle examination method before dispatch.

x) In case of fabricated flanges, welds shall be checked by 100% RT or UT and 100% MPE to ensure freedom from internal and surface defects.

xi) To ensure dimensional control of condenser, parts/ sub-assemblies shall be trial assembled at shop. Trial insertion of a few tubes through main tube plates and support plates shall be carried out to ensure alignment of tube plates and proper fitting and matching of parts and sub-assemblies.

xii) Dimensional check including tube hole diameter, ligament pitch etc. shall be carried out.

xiii) Mock-up test for tube to tube sheet expansion shall be carried out. In case such a test is already conducted for similar tube/ tube sheet thickness and materials, record for the same shall be furnished for purchaser's review and approval.

xiv) Tube to tube sheet weld joints shall be subject to 100% DP test.

xv) Water fill test on shell side of condenser shall be carried out. No leakage shall be permitted.

xvi) Water fill test of standpipe, Flash tank etc. shall be carried out. No leakage shall be permitted.

xvii) Hydraulic test of tube side of condenser shall be carried out. No leakage shall be permitted.

xviii) All compensating pads (RF pads) shall be pneumatically tested.

1.3.3.2 Spring assembly

i) Static load testing of the springs shall be carried out and spring characteristics shall be drawn and verified.

ii) Surface defect test shall be carried out on all the springs after coiling and heat treatment.

1.3.3.3 Condenser air evacuation system

i) Vacuum pumps

a) Tests shall be carried out on the materials of Head, Body, Rotor/Impeller, Shaft and Bearing Housing etc. to establish their mechanical properties, and chemical compositions.

b) Vacuum pump shafts shall be subject to ultrasonic test. After finish machining, shaft shall be subject to 100% MPE or DPT.

c) Pump casings and impellers shall be subject to MPE or DPT. Finished pump rotor shall be subject to dynamic balancing.

d) Pump casings shall be subjected to hydraulic test at 1.5 times the shut off pressure or twice the maximum operating pressure, whichever is higher.

e) The heat exchangers shall be tested on both tube side and shell side. After hydro test, the heat exchangers shall be suitably dried.

f) Each pump shall be tested at supplier's works at full speed and load conditions to demonstrate successful operation and performance in accordance with the design requirements. Visual cavitation test shall also be carried out to demonstrate that pump shall be operating under all operating condition including blank off condition without any cavitation.

ii) The complete package shall be subjected to hydraulic pressure and leakage test and shop tested to check interlocks and functional requirements. The one complete unit shall also be subjected to demonstrate successful operation and performance testing, with saturated air conditions at condenser design vacuum point as well as vacuum pump design point with total minimum three points. The test shall be conducted with the respective motors to be supplied. The test shall include check for vibration and noise level also.

1.3.4 Feed water heaters, drain coolers, gland steam condenser and deaerator

1.3.4.1 Heaters, drain coolers and gland steam condensers

i) Tests shall be carried out on the materials of forgings, plates and tubes etc. to establish their mechanical properties, and chemical compositions.

ii) Plates shall be subject to 100% ultrasonic testing.

iii) Nozzle forgings shall be subject to suitable heat treatment and 100% ultrasonic testing and 100% MPE.

iv) Tubes (U-tubes)

a) a) Tubes shall be subject to dimensional check including U-bending (bend radius & Mockup), Check for flatness, Min. thickness at minimum radius of bend for each thickness

b) 100% eddy current test shall be carried out for tube thickness < 3.6 mm and 100% UT for tube thickness ≥ 3.6 mm, 100% DPT on bend areas.

c) Tubes shall be subject to 100% hydraulic test.

d) Heat treatment after cold bending, U- bend thickness check, Hardness after bending check.

e) Check for Residual Chloride contamination on inside & outside of the tube.

f) Flattening and flaring tests, IGC (Practice-E), microstructure, residual stress

measurement shall also be carried out for the tubes as per applicable codes.

g) Before tubes expansion in the tube sheets, the mockup test for expansions shall be carried out. Torque setting of expander shall be based on mock up tests. Joints shall be checked for tube thinning. Also, tube to tube sheet welding qualification tests (mock up) to check leak path.

v) Tube sheets

a) Tube sheets shall be subject to visual examination and dimensional check.

b) Impact test shall be carried out for the plate materials. Mechanical Properties of heat treated test coupon.

c) 100% UT and 100% DP test shall be carried out after overlay and machining. In case overlay is not applicable, only 100% UT shall be carried out.

d) For cladded plates, bonding shall be checked by UT. Drilled tube plates shall be checked for ovality of holes, ligaments, surface finish etc.

e) Tube to tube sheet weld joints shall be subject to 100% DP test. These joints shall also be subject to air test.

vi) Shell, dished ends and hemi heads

a) Impact test shall be carried out for the plate materials.

b) 100% UT shall be carried out on the finished and formed dished ends and hemi heads.

c) Dished ends shall be subject to dimensional check after dishing.

d) Knuckle portion shall be checked by 100% MPE or DPT for surface defects and check for thinning shall be carried out by UT.

e) Testing of production test coupons as applicable.

vii) Welding

a) Root run of butt welds shall be examined by 100% DPT or MPE.

b) Butt welded and full penetration joints and nozzle welds shall be checked by 100% RT or UT and 100% MPE or DPT.

c) Fillet welds shall be checked by 100% MPE or DPT.

d) All weldments shall be given suitable heat treatment.

viii) Visual check and dimensional measurement shall be carried out on the completed equipment. All compensating pads (RF pads) shall be pneumatically tested.

ix) Completed assembly shall be pressure tested with working-fluid using hydraulic and pneumatic method. The heat exchangers shall be tested on both tube side and shell side. After hydro test, the heat exchangers shall be suitably dried and nitrogen capped.

1.3.4.2 Deaerator

i) Tests shall be carried out on the materials of forgings, plates and tubes etc. to establish their mechanical properties, and chemical compositions.

ii) Plates shall be subject to 100% ultrasonic testing.

iii) Forgings shall be subject to suitable heat treatment and 100% ultrasonic testing and 100% MPE.

iv) Shell and dished ends

a) Impact test shall be carried out for the plate materials.

b) 100% UT shall be carried out on the finished/ formed plates.

c) Dished ends shall be subject to dimensional check after dishing.

d) Knuckle portion shall be checked by 100% MPE or DP test for surface defects and check for thinning shall be carried out by UT.

e) Testing of production test coupons as applicable.

v) Welding

a) Root run of the butt welds shall be examined by 100% DPT or MPE.

b) Butt welded and full penetration joints and nozzle welds shall be checked by 100% RT or UT and 100% MPE or DPT.

c) Fillet welds shall be checked by 100% MPE or DPT.

vi) Visual check and dimensional measurement shall be carried out on the completed equipment.

ix) Completed assembly shall be pressure tested with working-fluid using hydraulic method. After hydro test, same shall be suitably dried.

x) All weldments shall be given suitable heat treatment.

xi) All compensating pads (RF pads) shall be pneumatically tested

1.3.4.3 Valves on heaters and deaerator

i) Tests shall be carried out on the materials of forgings, plates and tubes etc. to establish their mechanical properties, and chemical compositions.

ii) 100% RT or UT shall be carried out on bodies, bonnets, nozzles and stem of valves of HP heaters.

iii) 100% DPT or MPE shall be carried out on machined surfaces of valve body, bonnet, stem, disc and springs.

iv) Valve body shall be subject to hydraulic testing.

v) Valve seat shall be subject to hydro leak test as per ANSI 16.34.

vi) Visual check and dimensional measurement shall be carried out on the completed valve assembly.

1.3.5 Boiler Feed Pumps

1.3.5.1 Main pump

i) Tests shall be carried out on the materials on various components to establish their mechanical properties and chemical composition. Further, heat treatment shall be given as required.

ii) 100% UT shall be carried out on barrel casing, casing cover, suction & discharge branches, shaft, ring sections, and wearing rings.

iii) 100% RT shall be carried out on suction branch, impellers and diffusers.

iv) 100% MPE shall be carried out on barrel casing, casing cover, suction & discharge branches, gland housing, shaft, diffusers, balancing drum and spring disc.

v) 100% DPT shall be carried out on welds and overlay preparation on barrel casing, and machined components after final machining.

vi) Hydraulic test shall be carried out on barrel casing, discharge cover, and suction and discharge branches.

vii) Individual impellers and completed rotor assembly shall be subject to dynamic balancing test. Rotor assembly shall be subject to run out test also.

viii) Hardness test shall be carried out on wearing rings.

ix) Visual check and dimensional measurement shall be carried out for all the components and completely assembled pump.

x) Final tests

a) Performance testing shall be carried out as per Hydraulic Institute Standards (HIS) on each pump to determine its characteristic curve at design speed and to ensure compliance with design requirements. Tests shall be carried out with loop water at specified design temperature. Soften quality water shall be used for the performance testing.

b) Vibration on all pumps shall be measured in transverse, horizontal and vertical direction at all measuring points.

c) Noise Level on each pump shall be measured at a distance of 1.5 m above floor level in elevation and 1 m horizontally from the nearest surface of the equipment as per HIS. The measurement shall be taken at six points around the equipment for each flow condition.

d) Type tests

1. NPSH (R) test shall be carried out on one pump using cold water at pump flows of 25%, 50%, 80%, 100% and 125% of design flow at design speed. This shall be preferably done at 1% and 3% head break by suction throttling procedure. In case, NPSH (R) test has alreadybeen carried out by the contractor for the offered frame of BFP, the testshall not be repeated and certificates of test carried out earlier shall be furnished for review of the purchaser. The validity of the type test carried out earlier shall be limited to five (5) years.

2. Pressure pulsation and axial thrust measurement shall be carried out onone boiler feed pump at all measuring points. Pressure pulsation shall be measured at suction as well as at discharge in the operating range.

3. Thermal shock test shall be carried out on one pump with measurements taken on all critical areas such as barrel, discharge branch, casing cover, casing cover stud.

4. Dry running withstand capability shall be demonstrated and establishedon one pump. The pump shall be capable of accepting complete loss of water and must be capable of being shut down in a controlled manner and brought down to rest after being tripped from design conditionwith simultaneous closure of suction valve. Coasting down time check to be done.

5. Visual cavitation test on one first stage production impeller shall be carried out to demonstrate absence of cavitation at design speed in coldwater. The test shall establish the cavitation characteristic to confirm that the cavity length under dynamically scaled site conditions corresponding to design point shall not exceed an acceptable size. This test shall be carried out at 25%, 50%, 80%, 100% and 125% of design flow.

e) Strip down test

Complete strip down of one feed pump which undergoes NPSH test, dry run test, thermal shock test etc. shall be done after completion of all the tests on it. The strip down shall check for the condition of thrust bearing and journal bearing, and problems such as internal rubbing damage, excessive wear on the components. For other feed pumps, strip down examination shall be restricted to inspection of bearings only. However,if excessive vibration,

high noise, high bearing temperature etc. is observed during performance test of any feed pump, complete strip down shall be done for such pumps also.

Note: Tested pump parameters shall be within following tolerances.

At design head	:	+ 10% of design capacity
At design capacity	:	+ 5% of design head (for < 152.4 m) + 3% of design head (for ≥ 152.4 m)

The results of the performance test must show no minus tolerance with regard to flow and head. No minus tolerance on efficiency or positive tolerance on power input at motor terminals shall be allowed.

1.3.5.2 Booster pump

i) Tests shall be carried out on the materials on various components to establish their mechanical properties and chemical composition. Further, heat treatment shall be given as required.

ii) 100% UT shall be carried out on shaft and wearing rings.

iii) 100% MPE shall be carried out on casing, impeller and seal cooling jacket.

iv) 100% DPT test shall be carried out on machined components after final machining.

v) Hydraulic test shall be carried out on pump casing at 1.5 times the shut off pressure or 2 times the working pressure whichever is higher.

vi) Impeller and completed rotor assembly shall be subject to dynamic balancing test. Rotor assembly shall be subject to run out test also.

vii) Visual check and dimensional measurement shall be carried out for all the components and completely assembled pump.

viii) Final tests

a) Performance testing shall be carried out as per Hydraulic Institute Standards (HIS) on each pump to determine its characteristic curve at design speed and to ensure compliance with design requirements. Tests shall be carried out with loop water at specified design temperature. Soften quality water shall be used for the performance testing.

b) Vibration on all pumps shall be measured in transverse, horizontal and vertical direction at all measuring points.

c) Noise Level on each pump shall be measured at a distance of 1.5 m above floor level in elevation and 1 m horizontally from the nearest surface of the equipment as per HIS. The measurement shall be taken at six points around

the equipment for each flow condition.

d) Type tests

- NPSH (R) test shall be carried out on one pump using cold water at pump flows of 25%, 50%, 80%, 100% and 125% of design flow at design speed. This shall be preferably done at 1% and 3% head break by suction throttling procedure. In case, NPSH (R) test has alreadybeen carried out by the contractor for the offered frame of booster pump, the test shall not be repeated and certificates of test carried out earlier shall be furnished for review of the purchaser. The validity ofthe type test carried out earlier shall be limited to five (5) years.

- Dry run withstand capability shall be demonstrated and established on one pump.

f) After performance testing, thrust bearing and journal bearing shall be subject to visual check.

Note: Tested pump parameters shall be within following tolerances.

At design head	:	+ 10% of design capacity
At design capacity	:	+ 5% of design head (for < 152.4 m) + 3% of design head (for ≥ 152.4 m)

The results of the performance test must show no minus tolerance with regard to flow and head. No minus tolerance on efficiency or positive tolerance on power input at motor terminals shall be allowed.

1.3.5.3 Gear box and hydraulic coupling

i) Tests shall be carried out on the materials on various components to establish their mechanical properties and chemical composition. Further, heat treatment shall be given to the internal components as required.

ii) Internal components such as gears, pinions, wheels and shafts shall be examined by 100% UT and 100% DPT or 100% MPE.

iii) Leak test shall be carried out for the casing.

iv) Dynamic balancing test shall be carried out for the assembled rotating component.

v) Full load speed and back to back locked rotor torque test shall be carried out on one gear box.

vi) Visual check and dimensional measurement shall be carried out for the completely assembled equipment.

1.3.5.4 Strainers

i) Tests shall be carried out on the materials on various components to establish their mechanical properties and chemical composition.

ii) In case of fabricated construction, the welds shall be examined for surface defects by 100% DPT.

iii) The strainer body shall be subject to hydraulic test.

iv) Pressure drop test shall be carried out for each type and size of the strainer assembly.

1.3.5.5 BFP drive turbine and associated equipment

The QA requirements for BFP drive turbine and associated auxiliaries shall be same as those applicable for main steam turbine and its auxiliaries described at clause 1.3.1 of this Section.

1.3.6 Condensate Extraction Pumps (CEPs)

1.3.6.1 Pump

i) Tests shall be carried out on the materials on various components to establish their mechanical properties and chemical composition. Further, heat treatment shall be carried out for materials of shaft and rotor.

ii) 100% UT shall be carried out on pump shaft.

iii) 10% RT shall be carried out for butt welds on fabricated components of thickness more than 10 mm.

iv) 100% MPE shall be carried out on pump shaft.

v) 100% DPT shall be carried out on welds on casing, suction bell, shaft, impeller and fabricated components.

vi) Hydraulic test shall be carried out on casing and pressure containing fabricated parts at 1.5 times the pump shut off pressure or 2 times the working pressure whichever is higher.

vii) Individual impellers and completed rotor assembly shall be subject to dynamic balancing test. Rotor assembly shall be subject to run out test also.

viii) Visual check and dimensional measurement shall be carried out for all the components and completely assembled pump.

ix) Final tests

a) Performance testing shall be carried out as per Hydraulic Institute Standards (HIS) on each pump to determine its characteristic curve atdesign speed and to ensure compliance with design requirements. Tests shall be carried out

using cold soften quality water.

b) Vibration on all pumps shall be measured in transverse, horizontal and vertical direction at all measuring points.

c) Noise Level on each pump shall be measured at a distance of 1.5 m above floor level in elevation and 1 m horizontally from the nearest surface of the equipment as per HIS. The measurement shall be taken at six points around the equipment for each flow condition.

d) NPSH test

NPSH (R) test shall be carried out on one pump using cold water at pump flows of 25%, 50%, 80%, 100% and 125% of design flow at design speed. This shall be preferably done at 1 % and 3% head break. In case, NPSH (R) test has already been carried out by the contractor for the offered frameof CEP, the test shall not be repeated and certificates of test carried out earlier shall be furnished for review of the purchaser. The validity of the type test carried out earlier shall be limited to five (5) years.

e) Strip down test

Complete strip down of one pump which undergoes NPSH test shall be done after completion of all the tests on it. The strip down shall check for the condition of bearings and problems such as internal rubbing, excessive wear. For other pumps, strip down shall be restricted to inspection ofbearings only. However, if excessive vibration, high noise etc. is observed during performance test of any pump, complete strip down shall be donefor such pumps also.

Note: Tested pump parameters shall be within following tolerances.

At design head	:	+ 10% of design capacity
At design capacity	:	+ 5% of design head (for < 152.4 m) + 3% of design head (for ≥ 152.4 m)

The results of performance test must show no minus tolerance with regard to flow and head. No minus tolerance on efficiency or positive tolerance on power input at motor terminals shall be allowed.

1.3.6.2 Strainers

The QA requirements for strainers at suction of the CEPs shall be same as those applicable for BFP strainers described at clause 1.3.5.4 of this Section.

1.3.7 Condensate Polishing Unit (CPU)

1.3.7.1 CPU service vessels

i) Tests shall be carried out on the materials of the vessels, internals and rubber used for lining to establish their mechanical properties, and chemical compositions. Heat treatment as required shall be done as per ASME code.

ii) Plates shall be subject to 100% ultrasonic testing.

iii) Impact test shall be carried out for the plate materials.

iv) 100% UT shall be carried out on the finished and formed dished ends and hemi heads. Knuckle portion shall be checked by 100% MPE or DP test for surface defects and check for thinning shall be carried out by UT.

v) Welding

a) Root run of butt welds shall be examined by 100% DPT or MPE.

b) Butt welds full penetration joints and nozzle welds shall be checked by 100% RT and 100% MPE or DPT.

c) Fillet welds shall be checked by 100% MPE or DPT.

vi) Rubber lining shall be subjected to following tests as per IS-4682 part-I or acceptable equivalent:

a) Tensile & Elongation, Specific Gravity, Ash content

b) Adhesion test

c) Measurement of thickness

d) Shore hardness test

e) Visual examination and spark test at 5 kV/mm of thickness

f) Bleeding resistance test with keeping the sample in 33% HCl, 48% NaOH and DM water for 72 hours.

g) Ozone resistance test: (50 PPHM) / 40° C / 20 % Strain /70 Hrs

h) Water Absorption Test, After ageing test & Compression Set test

i) Spark test for rubber lining

vii) Resin testing shall be carried out as per relevant IS.

viii) Visual check and dimensional measurement shall be carried out on the completed equipment.

ix) Internals of the vessel shall be subject to dimensional check and applicable tests as per relevant codes.

x) The fabricated vessel shall be hydraulically tested at 1.5 times the working pressure before the rubber lining and at the working pressure after the rubber lining.

1.3.7.2 Acid/ alkali handling tanks

i) Tests shall be carried out on the materials of the tanks to establish their mechanical properties, and chemical compositions

ii) Plates shall be subject to 100% ultrasonic testing.

iii) Welding

a) Root run of butt welds shall be examined by 100% DPT or MPE.

b) Butt welds, full penetration joints and nozzle welds shall be checked by 100% RT and 100% MPE or DPT.

c) Fillet welds shall be checked by 100% MPE or DPT.

iv) Rubber lining shall be subject to relevant tests as described for CPU vessels.

v) Visual check and dimensional measurement shall be carried out on the completed equipment.

vi) The fabricated tank shall be subject to water fill test to check for the leakage.

1.3.7.3 Dosing pumps/ metering pumps

i) Tests shall be carried out on the materials of the pumps to establish their properties, and chemical compositions

ii) Pump casings shall be subject to hydraulic test at 1.5 times the shut off pressure or 2 times the working pressure whichever is higher.

iii) 100% DPT or MPE shall be carried out for the screw set, shaft and machined surfaces of casing and impellers. UT on screw set, shaft (diameter greater than or equal to 50mm),

iv) Safety relief valve setting to be checked

v) Pumps shall be performance tested as per HIS, USA.

1.3.7.4 Horizontal centrifugal pumps

The QA requirements for horizontal centrifugal pumps shall be as per clause 1.5.1.1.17 of this Section.

1.3.7.5 Rotary blowers

i) Tests shall be carried out on the materials of the rotary blowers to establish their properties, and chemical compositions.

ii) 100% DPT or MPE shall be carried out for the rotor and machined surfaces of casing and impellers. UT on shaft (diameter greater than or equal to 50mm.

iii) The shaft and impellers shall be dynamically balanced.

iv) Assembly fit up check, and dimensional check shall be carried out for the completed blower assembly.

v) The blower casing shall be subject to hydraulic test at 1.5 times the shut off pressure or 2 times the working pressure whichever is higher.

vi) The blowers shall be performance tested as per relevant code/ standard for Free Air Delivery, Head, Power, Efficiency, Speed including Discharge Pressure and Temperature. The test shall include check for vibration and noise level also.

1.3.7.6 Valves

The QA requirements for high pressure valves such as for service vessels shall be as per clause 1.4.2 of this Section. The QA requirements for other valves shall be as per clause 1.4.6.2 of this Section.

1.3.8 Condenser On-Line Tube Cleaning System

1.3.8.1 Ball recirculation pump

i) All rotating parts shall be dynamically balanced.

ii) Pump casing shall be subjected to hydraulic test at 1.5 times the shut off head or twice the maximum working pressure whichever is higher.

iii) Complete pump assembly shall be subjected to shop performance test at supplier's works.

1.3.8.2 Ball sorter/ fabricated body (housing)

i) In the case of fabricated design, all butt welds shall be subject to 10% RT or UT. All welds shall also be subjected to 10% MPE to ensure freedom from surface and sub-surface defects.

ii) Body shall be subject to hydraulic pressure test at 1.5 times the design pressure.

iii) Performance test shall be carried out on ball sorter assembly.

1.3.8.3 Strainer

i) Tests shall be carried out on the materials on various components to establish their mechanical properties and chemical composition

ii) Strainer mesh shall be checked for chemical composition and mesh size.

iii) Strainer body shall be subject to hydraulic pressure test at 1.5 times the design pressure.

iv) Strainer assembly shall be checked for its functional performance.

1.3.8.4 Piping and fittings

i) Butt welds on piping shall be subject to 10% RT and 10% DPT. Butt welds on segmental flanges shall be checked by 100% RT and 100% DPT.

ii) Fillet welds with load transfer shall be subject to 100% MPE or DPT and fillet welds without load transfer shall be subjected to 10% MPE or DPT.

iii) Wrought and forged fittings shall be tested as per relevant codes or standards.

1.3.8.5 Coating/ lining

i) Coating shall be checked for DFT and adhesion. Further, Contractor shall furnish his practice for testing of coating to ensure the uniformity and freedom from pinholes

ii) Rubber lined items shall be hydraulically tested before rubber lining. All rubber lining shall be subjected to following tests as per IS-4682 part-I or acceptable equivalent:

a) Tensile & Elongation, Specific Gravity, Ash content

b) Adhesion test

c) Measurement of thickness

d) Shore hardness test

e) Visual examination and spark test at 5 kV/mm of thickness

f) Bleeding resistance test with keeping the sample in 33% HCl, 48% NaOH and DM water for 72 hours.

g) Ozone resistance test: (50 PPHM) / 40° C / 20 % Strain /70 Hrs.

h) Water Absorption Test, After ageing test & Compression Set test

1.3.8.6 Valves

The QA requirements for the valves shall be as per clause 1.4.6.2 of this Section.

1.3.9 Debris Filter

i) Body, strainer mesh and other components shall be checked for chemical

composition.

ii) Strainer element shall be checked for mesh size.

iii) Body shall be subject to hydraulic pressure test at 1.5 times the design pressure.

iv) Filter assembly shall be checked for its functional requirements.

v) Valves shall be tested as per relevant standards.

1.4 HIGH PRESSURE PIPING, VALVES, THERMAL INSULATION AND MISCELLANEOUS SYSTEMS/ EQUIPMENT

1.4.1 High Pressure Piping and Fittings

i) All raw materials used shall have co-related mill test certificate meeting mandatory and supplementary checks of material specification.

ii) The pipes and fittings shall be subject to visual examination, identification, correlation and stamping.

iii) For alloy steel pipes (SA 335, P11, P22, & P91), 25% pipes per lot shall be subject to the following tests:

a) Product analysis

b) Transverse tension test on pipes from one end for pipe size 200 mm and above.

c) Flattening test on pipe from one end.

iv) All pipe lengths shall be subjected to 100% UT.

v) All mother pipes used for fittings shall be subject to a hydraulic test or an ultrasonic test. Raw material of all forged fittings shall be ultrasonically tested. Forged fittings shall be ultrasonically tested.

vi) All alloy and carbon steel pipes shall be subject to 100% UT for pipe thickness ≥ 3.6 mm and 100% eddy current test for thickness < 3.6 mm as per material specification standard with acceptable notch depth of 5% of the selected wall thickness (1.5mm maximum)

vii) Thickness of all pipe bends (cold/ hot formed) shall be checked by ultrasonic or other acceptable methods on sample basis for high pressure applications. Further,outer surface of bends shall be subject to 100% MPE or DPT. Pipe bend shall be checked for ovality and thinning by ultrasonic or other acceptable methods on first off lot & on random samples for subsequent pieces for high pressure applications. Outer surface of bends shall be subjected to magnetic particle examination/LPI.

viii) Welded and cast fittings, if any, shall be subjected to suitable NDT as perapplicable standards. However, as a minimum, 100% RT shall be carried out on all alloy steel fittings and on carbon steel fittings for use above 71 bar design conditions.

ix) The edge preparation for stainless steel/ alloy steel shall be subject to a 100% DPT. For other piping, the edge preparation for the welds shall be checked by100% MPE or DPT.

x) Non-destructive examination of welds shall be carried out in accordance with the relevant design and/or manufacturing codes. However, as a minimum, the following requirements shall be met (except for oil piping):

a) For temperature > 400 ^{0}C and/or pressure exceeding 71 bar, the butt welds and full penetration branch welds shall be subject to 100% RT or UT and 100% MPE.

b) For temperature > 175^{0}C up to 400 ^{0}C and/or pressure exceeding 17 bar and up to 71 bar, the butt welds & full penetration branch welds shall be subject to NDTs as below:

- pipe diameter > 100 NB 100% RT or UT and 100% MPE

- pipe diameter ≤ 100 NB 10% RT or UT and 100 % MPE

In addition to above, statutory requirement, wherever applicable, shall also be complied with.

xi) Finished welding for alloy steel piping, BFP discharge piping, MS piping, HRH piping, CRH piping and associated piping shall be subject to the following NDTs:

a)	Butt welds	100% RT and 100% MT or DPT
b)	Welds for nozzle, branch connections of size > 100NB	100% RT and 100% MT or DPT
c)	Welds for all other attachments	100% MT or DPT
d)	Removal of weld defects	100% MT or DPT

xii) Finished welding for Carbon Steel Class- I piping having design temperature > 218 deg. C or design pressure for steam > 17.6 kg/ cm^2 (g) or design pressure for feed water > 24.6 kg/cm^2 (g) shall be subject to the following NDTs:

a)	Butt welds: pipe size > 100 NB	100% RT and 100% MPE or DPT
	pipe size ≤ 100 NB	10% RT and 10% MPE or DPT
b)	Welds for nozzle, branch connections of size > 100NB and thickness > 19 mm	100% RT and 100% MPE or DPT
c)	Welds for all other attachments	10% MPE or DPT
d)	Removal of weld defects/weld repair	100% MPE or DPT

xiii) Finished welding for carbon steel class- I piping having design temperature ≤ 218 deg. C or design pressure for steam ≤ 17.6 kg/ cm^2 (g) or design pressure for feed water ≤ 24.6 kg/cm^2 (g) shall be subject to the following NDTs:

a)	Butt welds:	
	pipe size > 100 NB	100% RT and 10% MPE or DPT
	pipe size ≤ 100 NB	10% MPE or DPT
b)	Welds for nozzle, branch attachments	10% MPE or DPT connections/
c)	Removal of weld defects	100% MPE or DPT

xiv) Non-destructive examination of welds shall be carried out after post weld heat treatment, if any.

xv) Pre- heating, stress relieving and post weld heat treatment as applicable shall be carried out as per requirements of ASME B 31.1. For welds in P91, X20 & X22 materials, only induction type of heating shall be deployed for heat treatment.

xvi) Hardness survey of welds shall be carried out on alloy steel/ stainless steel piping. (100% hardness survey of welds on P91, X20 & X22 material grade piping).

xvii) All other pipes not covered above (except oil piping) shall be subjected 100% MPE or DPT in case of underground piping and 10% MPE or DPT in case of over ground piping. Further, 10% of butt welds of underground piping shall be subjected to RT.

xviii) Oil piping shall be subjected to following NDTs.

a) Butt welds of Oil piping shall be subjected to 10% RT and 10% DP Test. For Jacking oil lines 100% RT and 100% DPT shall be carried out on butt welds.

b) Fillet welds with load transfer shall be subjected to 100% MPE or DPT and fillet welds without load transfer shall be subjected to 10% MPE or DPT.

xix) Rubber lined pipes shall be hydraulically tested before rubber lining. All rubber lining shall be subject to following tests as per IS-4682 part-I or acceptable equivalent:

a) Tensile & Elongation, Specific Gravity, Ash content

b) Adhesion test

c) Measurement of thickness

d) Shore hardness test

e) Visual examination and spark test at 5 kV/mm of thickness

f) Bleeding resistance test with keeping the sample in 33% HCl, 48% NaOH and DM water for 72 hours.

g) Ozone resistance test: (50 PPHM) / 40° C / 20 % Strain /70 Hrs.

h) Water Absorption Test, After ageing test & Compression Set test

1.4.2 Power Cycle Valves

1.4.2.1 Valves other than extraction line valves and butterfly valves

i) Bar stock/forging above 40mm diameter for valve trim shall be subjected to UT.

ii) Hardened/ stellitted valve disc and seat are to be subjected to LPI and hardness check.

iii) Colour matching of valve disc, plug and seat shall be carried out to ensure contact ensure min. 80% contact and no through passage.

iv) Hydraulic pressure test and seat leak test shall be carried out as per ANSI 16.34.

v) Air seat leak test shall be carried out as per applicable standards/ codes.

vi) Pressure retaining parts of valves shall be subject to NDTs as below:

Valve size NB in mm	**ANSI Class up to 300**	**ANSI Class above 300 up to 600**	**ANSI Class above 600 below 900**	**ANSI Class 900 & above & below 4500**
Less than 50	Visual	Visual	Visual	MPI
50 & above but below100	Visual	Visual	MPI	MPI & RT (on 10%of valves on 100% area)
100 & above but less than 300	Visual	MPI	MPI & RT (on 10% of valves on change of section & weld ends)	MPI & RT (on 100% area)
300 and above	MPI	MPI	MPI & RT (on change of sections & weld ends)	MPI, RT on100% area)

In the above NDTs, MPI may be replaced by DPT for austenitic steels.

vii) Weld edge preparations shall be subject to MPE or DPT.

viii) Functional testing shall be carried out on fully assembled valve to check the following:

a) Smooth operation

b) Valve travel, closing and opening time.

c) Current drawn by actuators.

d) Pressure resistance test of pneumatic actuator

e) CV test for control valve

ix) Springs for safety valves shall be tested with suitable NDT and for spring rate.

x) Safety and safety relief valves shall be tested for performance.

1.4.2.2 Extraction line valves

i) Surface crack examination and hardness check shall be carried out on all hard faced surfaces and stellieted surfaces, if any.

ii) As a minimum requirement of castings for all valves on cold reheat and extraction lines shall be subjected to 100% MPE on all areas and RT on butt weld ends and change of section. For forgings minimum requirement shall be 100% UT and 100% MPE.

iii) Bar stock for valves stem shall be subjected to UT. Finish machined valve stem shall be subjected to MPE or DPT.

iv) Wall thickness measurement by ultrasonic for critical and highly stressed zones of the casting and forging shall be carried out.

v) Colour matching of the valve disc and seat to ensure required contact area shall be carried out.

vi) Hydraulic pressure tests shall be carried out on each valve to check body and bonnet strength. Seat leakage and back seat leakage test (wherever applicable) shall be carried out. Air seat leakage test shall also be carried out. Minimum test requirements of pressure shall be as per ANSI B 16.34.

vii) Functional testing shall be carried out on each valve to check for freedom of movement, adherence to clearance, opening/ closing etc. Type tests for discharge co-efficient and pressure drop co-efficient, shall be carried out. In case the type tests have been carried out in the past and documents generated, the same shall be furnished to the purchaser for approval.

1.4.2.3 Butterfly Valves

i) Tests shall be carried out on the materials of body, disc etc. for determination of

chemical and mechanical properties.

ii) In case of fabricated valves, the plates used for body, disc and flanges shall be subject to 100% UT.

iii) Valve body, disc and shaft shall be checked for surface and sub-surface defects by 100% MPE.

iv) For sea water application valves, austenitic stainless steel welds shall be subject to 100% IGC (inter-granular corrosion) test.

v) All wetted SS 316 components shall be subject to Molybdenum check.

vi) Stubs and driving shafts shall be tested for internal defects by ultrasonic method.

vii) Dye penetration test shall be carried out on shafts, seat rings etc.

viii) For fabricated components of the valves, all the longitudinal/ circumferential weld seams shall be subject to 100% RT. Further, all welds on magnetic material shall be subject to 100% MPE, and welds on non-magnetic material shall be subject to 100% DPT.

ix) Test samples for rubber seal shall be subjected to tensile, elongation and hardness test for vulcanising and after ageing. Hydraulic stability test (Bleed Resistance) and ozone crack resistance tests also be carried out.

x) Valve shall be subjected to hydraulic pressure test for body and air seat leakage tests as per AWWA-C504/ BS- 5155.

xi) Proof of design tests for valves and actuator shall be carried out as per AWWA-C504/ BS- 5155. In case the test has already been carried out on previous supplies, the contractor may submit the test certification of same for approval of purchaser.

xii) Disc Strength test by Hydro (Forward and Backward) as per EN 12266-1

xiii) After complete assembly each valve with actuator shall be subject to the performance test by opening and closing the valve from fully closed to fully open position and the reverse, under no flow for at least 25 cycles to check the following:

a) Smooth uninterrupted movement of valve.

b) Closing and opening time.

c) Current drawn by actuator.

d) Operation of tripping switch and position indicator.

xiv) After assembly, one valve of each size with respective actuator shall be shop operated over the full range of movement in both the directions, with the body subjected to the full hydrostatic pressure conditions, to demonstrate that the unit is

in working order without any leakage through the joints and torque switches/clutches, limit switches are operating satisfactorily. During the test, hand wheel operation, opening and closing time and current drawn shall also be checked. The test shall be conducted for three consecutive cycles with valve shaft both in vertical and horizontal planes.

1.4.3 Metallic expansion bellows

i) All raw materials used shall have co-related mill test certificate meeting mandatory checks of material specification.

ii) Hydraulic pressure test shall be carried out on each pipe and expansion bellow.

iii) Longitudinal butt weld on bellow shall be subject to MPE or DPT before forming and after forming.

iv) All welds shall be subject to 100% MPE or DPT. Butt welds shall be subject to 100% RT.

v) All the bellows subjected to vacuum service shall be vacuum tested.

vi) The bellows shall be subjected to movement test to establish suitability to perform satisfactorily in site conditions. During this test, spring rate shall also be measured.

vii) Life cycle test, meridional yield rupture test and squirm test to be carried out on a prototype/ expansion bellow as per Sec. D clause 3.2 of standards of Expansion Joint Manufacturer Association (EJMA).

1.4.4 Hangers and Supports

i) All raw materials used shall have co-related mill test certificate meeting mandatory checks of material specification.

ii) Completed springs shall be tested for sagging test and load versus deflection test. For diameter more than 25mm, MPE shall also be carried out.

iii) Butt welds shall be tested for UT and fillet welds shall be tested for MPI.

iv) Dampers with viscous fluids shall be checked for viscosity of liquid used, damping resistance of the damper, stiffness of the damper etc.

v) Turn-buckle, pipe clamps and hangers of thickness greater than 25mm shall be checked by MPE or DPT on bent portions.

vi) One hanger of each type and size shall be checked for variation in deflection and travel versus load test.

1.4.5 Thermal insulation, refractory, lagging and cladding

i) Thermal insulation

a) Pre-formed fibrous pipe insulation and LRB mattresses/ sections of rock wool/ mineral wool from approved manufacturing sources conforming to and tested as per relevant standards shall be used.

b) For resin bonded mineral wool insulation, testing shall be carried out as per IS: 8183.

c) For resin bonded rock wool insulation, testing shall be carried out as per IS: 9842.

d) For sprayed mineral wool, testing shall be carried out as per IS: 9724.

e) For ceramic fiber blankets and block insulation, testing shall be carried out as per IS: 15402.

f) Type tests except thermal conductivity shall be regularly carried out once in three months.

g) Thermal conductivity (K value) shall be measured in line with IS: 3346.

h) Wire mesh of diameter 0.71mm (minimum) shall only be used.

ii) Castable refractory

Fire bricks or castable refractory from approved manufacturing sourcesconforming to and tested as per relevant standards shall be used. Castable refractory shall have proper identification, supplier name, customer name, batch no., date, material name and net weight in kg with proper instructions for handling.

iii) Lagging and cladding

All insulation shall be protected by means of an outer covering of aluminum sheeting conforming to ASTM B-209-1060 temper H14 from reputed manufacturer.

1.4.6 Low Pressure Piping, Valves and Fittings etc.

1.4.6.1 Pipes, fittings and mitre bends

i) Tests shall be carried out on the materials on various components to establish their mechanical properties and chemical composition. Further, heat treatment shall be carried out for materials as required.

ii) Dye penetration test of welds of pipes and fittings (including welds of rolled and welded pipes) shall be carried out.

iii) All pipes and fittings shall be tested as per applicable codes/ standards at manufacturer's works.

1.4.6.2 Valves

i) Tests shall be carried out on the materials on various components to establish their

mechanical properties and chemical composition. Further, heat treatment shall be carried out for materials as required.

ii) Shaft/ spindle of size ≥ 50 mm diameter shall be subjected to ultrasonic test.

iii) Machined surfaces of casing, disc and shaft shall be subjected to 100% MPI or DPT as applicable.

iv) All valves shall be hydraulically tested for body, seat and back seat (wherever provided) at 1.5 times the maximum pressure to which respective valves can be subjected during plant operation. Check valves shall also be tested for leak tightness test at 25% of the specified seat test pressure. For rubber lined valves, hydraulic test shall be carried out before rubber lining.

v) For butterfly valves, hydraulic test, seat and disc string test and proof of design test (if not carried out earlier) shall be carried out in accordance with latest edition of AWWA-C-504 standard.

vi) Visual and dimensional check shall be carried out for all valves as per relevant code/ approved drawing.

vii) Functional/ operational checks for and check for smooth opening and closing of the valves shall be carried out.

viii) Gate, globe and swing check valves

a) Machined surfaces of castings and butt welds shall be subjected to MPE or DPT.

b) Blue matching, wear travel for gates, valves, pneumatic seat leakage, reduced pressure test for check valves shall be done as per relevant standard.

ix) Diaphragm valves

a) Seat leakage test for actuator operated valves, shall be done with by closing the valves with actuator.
b) 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.

x) Cast butterfly valves

a) Machined surfaces of casing, disc and shaft shall be subjected to MPE or DPT.

b) 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.

xi) Fabricated butterfly valves (refer 1.4.2.3)

a) UT shall be carried out on plate material for body and disc.

b) Machined surfaces of casing, disc and shaft shall be subjected to MPE or DPT.

c) Butt welds of thickness above 30mm on body and disc shall be subject to 100% RT along with and post weld heat treatment for stress relieving.

d) 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.

xii) Dual plate check valves

a) Dry cycle test (spring cycle test) for one lakh cycles shall be carried out as a type test.

b) Machined surfaces of casing, disc and shaft shall be subjected to MPE or DPT.

1.4.6.3 Rubber lining of pipes and valves

i) For rubber lining, the following tests shall be carried out as per IS-4682 part-I or acceptable equivalent standard:

a) Tensile & Elongation, Specific Gravity, Ash content

b) Adhesion test

c) Measurement of thickness

d) Shore hardness test

e) Visual examination and spark test at 5 kV/mm of thickness

f) Bleeding resistance test with keeping the sample in 33% HCl, 48% NaOH and DM water for 72 hours.

g) Ozone resistance test: (50 PPHM) / 40° C / 20 % Strain /70 Hrs

h) Water Absorption Test, After ageing test & Compression Set test.

ii) Dimensional check shall be carried out as per relevant code/ approved drawing.

1.4.6.4 Coating and wrapping of pipes

Spark test/ Holiday test, adhesion test and material test for primer and enameled and coal tar tapes, as applicable, shall be carried out as per AWWA-C-203-91/ IS 15337/ IS 10221 as applicable.

1.4.6.5 Rubber expansion joints

i) Rubber compound test slab after valcanising shall be tested for tensile strength, elongation and shore hardness. Tests on rubber compound shall also include hydro

stability test as per ASTM D-3137, ozone resistance test as per ASTM D- 380 and kerosene dip test.

ii) Fabric strength of synthetic fiber for reinforcement shall be checked, and test for rubber to fabric adhesion as per IS: 3400 or ASTM D- 413, rubber to metal adhesion as per IS 3100 or ASTM D-429 shall be carried out.

iii) All expansion joints in assembled condition shall be subjected to vacuum test at 730 mm Hg under conditions to ensure its suitability to withstand deflection in each axial transverse and longitudinal direction. Duration of test shall be of minimum 10 minutes.

iv) All bare bellows shall be subjected to hydraulic pressure test in normal condition at twice the design pressure for a duration of 30 minutes. Additionally, all bare bellows shall be subjected to deflection tests under pressure, pressure being raised from zero to the design value in regular steps and deflection measured at each step.

v) All expansion joints in assembled condition along with control rod assembly shall be subjected to deflection test (axial compression & expansion test and lateral deflection) under design pressure.

vi) Either during the hydraulic test or during the vacuum test, change in circumference at the top position of the arch shall not exceed 1.5% of measured circumference at normal position.

vii) Twenty-four (24) hours after the above tests, the permanent set (variation in dimensions with respect to its original dimension) shall be measured and recorded. The permanent set shall not be more than 0.5%.

vii) Proof of Design (Life cycle test and burst test) shall be carried out on bellows of each type, design and size.

1.4.7 Equipment Cooling Water (ECW) System

1.4.7.1 Primary side and secondary side pumps

i) Tests shall be carried out on the materials on various components to establish their mechanical properties and chemical composition. Further, heat treatmentshall be carried out for materials of shaft and rotor.

ii) 100% UT shall be carried out on pump shaft.

iii) 10% RT shall be carried out for butt welds on fabricated components of thickness more than 10 mm.

iv) 100% MPE shall be carried out on pump shaft.

v) 100% DPT shall be carried out on welds on casing, suction bell, shaft, impellerand fabricated components.

vi) Hydraulic test shall be carried out on casing and pressure containing fabricated parts at 1.5 times the pump shut off pressure or 2 times the working pressure whichever is higher.

vii) Individual impellers and completed rotor assembly shall be subject to dynamic balancing test. Rotor assembly shall be subject to run out test also.

viii) Visual check and dimensional measurement shall be carried out for all the components and completely assembled pump.

ix) Final tests

a) Performance testing shall be carried out as per Hydraulic Institute Standards (HIS) on each pump to determine its characteristic curve atdesign speed and to ensure compliance with design requirements.

b) Vibration on all pumps shall be measured in transverse, horizontal and vertical direction at all measuring points.

c) Noise level on each pump shall be measured at a distance of 1.5 m above floor level in elevation and 1 m horizontally from the nearest surface of the equipment as per HIS.

d) NPSH(R) test shall be carried out on one pump at pump flows of 25%, 50%, 80%, 100% and 125% of design flow at design speed. In case, NPSH (R) test has already been carried out by the contractor for the offered frameof a pump, the test shall not be repeated and certificates of test carried out earlier shall be furnished for review of the purchaser.

e) Complete strip down of one pump shall be done after completion of all the tests on it. The strip down shall check for the condition of bearings and problems such as internal rubbing, excessive wear.

1.4.7.2 Plate heat exchangers

i) The material used for cover plates, heat exchange plates and tie rods shall be subject to chemical and mechanical tests on one per heat basis. For gasket, ageing test, shrinkage test and hardness to be carried out.

ii) Each plate after pressing shall be subject to light box test, vacuum test or air chamber test as per manufacturer's practice.

iii) UT shall be done for plates with thickness 25 mm or above.

iv) DPT shall be conducted for 10% of the lot of heat exchanger plates. However, in case of any defects, entire lot shall be tested and only defect free plates shall be accepted.

v) 100% DPT shall be conducted on all welds.

vi) Each heat exchanger shall be subjected to hydraulic test.

vii) Assembly fit up and dimensional checks shall be carried out for each heat exchanger.

1.4.7.3 Auto clean filters

i) Tests shall be carried out on the materials on various components to establish their mechanical properties and chemical composition.

ii) In case of fabricated construction, the welds shall be examined for surface defects by 100% DPT.

iii) The body shall be subject to hydraulic test at 1.5 times the design pressure.

ii) Pressure drop, flow and particle size tests shall be carried out for the filter assembly.

1.4.7.4 Pipes, Valves and fittings

The QA requirements for piping, valves and fittings shall be as per clause 1.4.6 of this Section.

1.4.8 EOT Cranes and Hoists

1.4.8.1 Hooks

i) All tests including proof load test as per relevant IS shall be carried out.

ii) MPE or DPT shall be done after proof load test.

1.4.8.2 Steels castings

Steel castings shall be subjected to DPT on machined surface.

1.4.8.3 Girders, end carriage, crab, gear-box and rope drum

i) The plates of thickness 25mm and above for girders, end carriage, crab, gear-box and rope drum shall be ultrasonically tested.

ii) NDT requirements on weldments shall be as follows:

i)	Butt welds in tension	: 100% RT and 100% DPT
ii)	Butt welds in compression	: 10% RT and 100% DPT
iii)	Butt weld in rope drum	: 100% RT and 100% DPT
iv)	Fillet welds	: 10% DPT (random)

1.4.8.4 Forgings

i) All forgings (wheel, gears, pinions, axles, hooks and hook trunnion) greater than or

equal to 50mm diameter or thickness shall be subjected to ultrasonic testing.

ii) DPT or MPE shall be done after hard facing and machining.

1.4.8.5 Wire rope

Wire rope shall be tested as per relevant standard including breaking force and no. of strands.

1.4.8.6 Reduction gear

Reduction gears shall be tested for reduction ratio, backlash and contact pattern. Gear box shall be subjected to no- load run test to check for oil leakage, temp. rise, noise and vibration.

1.4.8.7 Final testing

The cranes shall be completely assembled at shop for final testing. All tests for dimension, deflection, load, overload, hoisting motion, cross travel etc. as per IS-3177 shall be carried out at shop.

1.4.8.8 Electric hoists

All electric hoists shall be tested as per IS-3938 and chain pulley blocks shall be testedas per IS-3832.

1.4.9 Elevators

i) Reduction gears shall be checked for reduction ratio and backlash. Run outs of wheel shafts and work shafts, tooth contact and running test shall also be carried out.

ii) Breaking load test shall be carried out along with all other tests as per relevant standard for steel wire rope.

iii) Buffer springs shall be subjected to load test as per relevant specifications.

iv) All components prior to assembly shall be checked for dimensions.

v) All rotating components shall be tested for dynamic balancing.

vi) Car sling and car body in assembled condition shall be checked for position of all major components i.e. car sling, inside depth, width, height, positions of push box, indicator box lights, fans etc.

vii) Vibration level shall be determined on work geared machine.

viii) Mechanical balance test and determination of vibration level on lift and accessories shall be carried out.

ix) In case the lift is provided with pressurized unit, the fan shall be dynamically balanced and complete unit shall be performance tested.

1.4.10 Air Conditioning System

1.4.10.1 Refrigerant compressor (reciprocating/ screw/ centrifugal)

i) Hydraulic/ pneumatic test of castings for cylinder block, crank case and casings etc. shall be carried out. No leakage shall be permitted

ii) DPT on connecting rod, piston, crankshaft, screw, impeller with shaft, vanes, crank case, cylinder and casing after machining shall be carried out.

iii) All rotating parts of reciprocating/ screw and centrifugal compressor shall be statically and dynamically balanced to ISO 1940 Gr. 6.3.

iv) Leak tightness and vacuum check for chilling units and compressors inassembled condition shall be carried out. No leakage shall be permitted.

v) Performance test of assembled compressor shall be done to check for following:

a) Capacity test for oil pump for reciprocating compressor.

b) No load air run (free run) test of all types of compressors and chilling units to check FAD (free air delivery), noise, vibration and temperature rise of bearing and body.

c) Hydraulic/ leakage test for reciprocating compressor.

d) Functional run test and capacity control (for part load performance) check shall be carried out

1.4.10.2 Condenser and evaporator

i) DPT shall be carried out on finish welds.

ii) 10% RT of butt weld joints on shell shall be carried out.

iii) Dimensional check including tube hole diameter, ligament pitch etc. shall be carried out.

iv) Mock-up test for tube to tube sheet expansion shall be carried out. In case such a test is already conducted for similar tube/ tube sheet thickness and materials, record for the same shall be furnished for purchaser's review and approval.

v) Hydraulic/ pneumatic test of shell side and tube side of condenser and evaporator as applicable shall be carried out. No leakage shall be permitted.

1.4.10.3 Vapour absorption machine (VAM)

i) All materials used for fabrication shall be of tested quality. Mill test certificates for chemical and mechanical properties shall be furnished by the manufacturer. In absence of correlated mill test certificates, check test shall be carried out.

iii) Tubes for heat exchangers/ vessels and interconnecting pipes shall be tested as per the requirement of relevant code/standard.

iv) All welding shall be performed as per approved Welding Procedure Specification and IBR qualified procedure and welders.

v) Mock-up test for tube to tube sheet expansion shall be carried out. In case such a test is already conducted for similar tube/tube sheet thickness and materials, record for the same shall be furnished for purchaser's review.

vi) RT on butt weld joints of heat exchangers/ vessels shall be carried out as per the requirement of design code/approved drawing.

vii) DPT on Root run after back gouging and on finished welds shall be carried out.

viii) Vessels/ heat exchangers like high temperature and low temperature generator/ condenser/ high temperature and low temperature heat exchanger/ evaporator/ absorber shall be subjected to hydraulic pressure test and leakage test under vacuum with nitrogen gas and helium gas, both tube side and shell side as applicable for individual component prior to assembly. Helium leak test shall also be conducted on complete assembly under suitable cover to detect any leakage into the system.

viii) The complete assembled unit shall be performance tested in shop for capacity (TR) and steam consumption at the rated conditions and part load conditions. Manufacturer shall furnish a detailed procedure along with calculation for conducting such test for approval and in case of any limitation same shall be clearly brought out in the bids. All the controls shall be tested for proper functioning during the above test.

1.4.10.4 Air handling unit (AHU)

i) 20% DPT of welding on fan hub, blades, casing and impeller as applicable shall be carried out.

ii) UT of fan shafts (diameter greater than or equal to 50mm) shall be carried out.

iii) DPT of fan shafts after machining shall be carried out.

iv) DPT of welding on shaft (in case of fabricated shaft) shall be carried out.

v) Blower fan shall be statically and dynamically balanced to ISO 1940 Gr. 6.3.

vi) One fan of each type and size shall be performance tested as per AMCA / IS for air flow, static pressure, speed, efficiency, power consumption, noise and vibration.

vii) One per type of assembled AHU (AHU casing and fan assembly) shall be subject

to free run test. Noise, vibration and temperature rise of bearing shall be measured during run test.

viii) All cooling coil shall be pneumatically tested and no leakage shall be permitted.

1.4.10.5 Centrifugal pump

The QA requirements for centrifugal pumps shall be as per clause 1.4.12.2 of this Section.

1.4.10.6 Cooling towers

i) UT of fan shaft and drive shaft (diameter greater than or equal to 50mm) shall be carried out.

ii) DPT of fan hub and shafts shall be carried out after machining.

iii) Colors of fills shall be as per approved data sheet.

iv) Fan assembly shall be statically balanced.

v) Cooling towers being supplied to site in assembled condition shall be subjected to run test at shop to measure FAD, noise and vibration. For cooling towers being supplied in knocked-down condition, these tests shall be done at site.

1.4.10.7 Fans

i) 20% DPT of welding on fan hub, blades, casing and impeller as applicable shall be carried out.

ii) DPT of fan shafts shall be carried out after machining.

iii) UT of fan shafts (diameter greater than or equal to 50mm) shall be carried out.

iv) Rotating components of all fans shall be statically and dynamically balanced to ISO-1940 Gr. 6.3.

v) All centrifugal fans shall be subjected to run test for 4 hour or till temperature stabilization is reached. Vibration, noise level, temperature rise and current drawn shall be measured during the run test.

vi) One fan of each type and size will be performance tested as per corresponding IS code for airflow, static pressure, total pressure, speed, efficiency, power consumption, noise, vibration and temperature rise.

1.4.10.8 Low pressure air distribution system

i) Functional test for fire damper along with solenoid shall be done.

ii) Prototype tests for fire resistance rating as per UL-555 of each type and size of damper shall be carried out. In case prototype tests have already been done, the contractor shall submit the test report for verification and approval.

1.4.10.9 Insulation

i) Insulation material shall be tested for all mandatory tests only as per relevant code or standard.

ii) Thermal conductivity tests (for thermal insulation only) shall be done once in six months for insulation material manufactured during six months period for the same density, outer diameter and thickness of material as applicable as per IS:3346 or equivalent standard.

1.4.10.10 Air filters

Pre and fine filters shall be tested for initial and final pressure drop versus flow and average synthetic dust weight arrestance as per the requirement of BS 6540 or ASHARE-52-76 or EN779.

1.4.10.11 Packaged, split and window air conditioners

i) Compressor of packaged air conditioner (PAC) shall be tested as per relevant code/standard.

ii) PAC shall be subjected to production routine test in accordance with IS: 8148 for the following.

a) General running test.

b) Pressure or leakage test of refrigerant.

c) Insulation resistance test.

d) High voltage test.

e) Performance test on one PAC of each type/size at ambient condition to check for following.

- DBT and WBT of supply and return air.
- Air flow
- Current, voltage measurement and power consumption
- Noise and vibration measurement

ix) Manufacturer's standard test certificate or guarantee certificate shall be submitted for split and window air conditioners.

1.4.10.12 Pipes, valves and fittings

The QA requirements for piping, valves and fittings shall be as per clause 1.4.6 of this Section.

1.4.11 Ventilation System

The QA requirements for ventilation system equipment shall be same as those applicable similar equipment of air conditioning system equipment described at clause 1.4.10 of this Section.

1.4.12 Miscellaneous Items/ Equipment

1.4.12.1 Chemical dosing system

i) Pumps of chemical doing system shall be performance tested as per relevant codes.

ii) In case of diaphragm type of pumps, the life cycle test shall be done on pumps.

iii) Dosing skid shall be subjected to leakage test and functional test.

1.4.12.2 Centrifugal pumps

i) Tests shall be carried out on the materials of the pumps to establish their properties, and chemical compositions.

ii) 100% DPT or MPE shall be carried out for the rotor and machined surfaces of casing and impellers.

iii) UT on pump shaft (diameter greater than or equal to 50mm), MPI or DPT on pump shaft and impeller after machining shall be carried out.

iv) All rotating components of the pumps shall be statically and dynamically balanced to ISO-1940 Gr. 6.3.

v) Assembly fit up check, and dimensional check shall be carried out for the completed pump assembly.

vi) Pump casings shall be subject to hydraulic test at 1.5 times the shut off pressure or 2 times the working pressure whichever is higher for a minimum duration of 30 minutes.

vii) All pumps shall be tested at manufacturer's works for head, capacity, power and efficiency as per requirements of HIS, USA or equivalent standard.. Pump shall be given running test over the entire operating range covering from the shut-off head to the maximum flow. Acceptance shall be as per approved datasheet and HIS only.

viii) 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.

1.4.12.3 Blowers and exhausters

i) Tests shall be carried out on the materials of the rotary blowers to establish their properties, and chemical compositions.

ii) 100% DPT or MPE shall be carried out for the rotor and machined surfaces of casing and impellers.

iii) Rotors shall be dynamically balanced.

iv) Assembly fit up check, and dimensional check shall be carried out for the completed blower assembly.

v) The blower casing shall be subject to hydraulic test at 1.5 times the shut off pressure or 2 times the working pressure whichever is higher.

vi) Performance test including noise and vibration tests shall be carried out as per relevant standards and codes.

1.4.12.4 Filters and strainers

i) Tests shall be carried out on the materials on various components to establish their mechanical properties and chemical composition.

ii) In case of fabricated construction, the welds shall be examined for surface defects by 100% DPT.

iii) The body shall be subject to hydraulic test at 1.5 times the design pressure.

iv) Pressure drop, flow and particle size tests shall be carried out for the filter assembly.

1.4.12.5 Tanks and vessels

i) Tests shall be carried out on the materials on various components to establish their mechanical properties and chemical composition.

ii) UT shall be carried out on plate material used for fabrication of tanks and vessels.

iii) Hydraulic test for pressurised vessels and water fill test for atmospheric tanks shall be carried out as per relevant standards/ codes.

iv) Butt welds and full penetration welds shall be checked by suitable RT or UT. Fillet welds shall be checked by MPE or DPT.

1.4.12.6 Lube oil system/ hydraulic power pack

Lube oil system/ hydraulic power pack shall be tested for performance.

1.5 FGD SYSTEM

1.5.1 Wet lime stone FGD System:

1.5.1.1 Mechanical Systems

1.5.1.1.1 Flue Gas System

I. Booster fans

i) Rotor components shall be subjected to ultrasonic test at mill and magnetic particle examination/dye penetration examination after rough machining.

ii) Butt welds in rotor components shall be subjected to 100% UT and all welds shall be subjected to MPE or DPT after stress relieving.

iii) All rotating components of fans shall be dynamically balanced to quality grade 2.5 of ISO 1940.

iv) Test for natural frequency of all fan components, including fan blades shall be carried out for the fans.

v) Full range performance test shall be carried out on one fan as per BS 848, Part-1.

vi) Hydraulic coupling of booster fan shall be checked for string test i.e., operational check of one fan assembly using hydraulic coupling to check temperature rise, smooth operation, vibration and noise level. Dry run test shall preferably be carried out during string test.

II. Thermal insulation

i) Pre-formed fibrous pipe insulation and LRB mattresses/ sections of rock wool/ mineral wool from approved manufacturing sources conforming to and tested as per relevant standards shall be used.

ii) For resin bonded mineral wool insulation, testing shall be carried out as per IS: 8183.

iii) For resin bonded rock wool insulation, testing shall be carried out as per IS: 9842.

iv) Type tests except thermal conductivity shall be regularly carried out once in three months.

v) Type test for thermal conductivity shall be carried out by the manufacturer minimum once in six months. Thermal conductivity (K value) shall be measured in line with IS: 3346.

III. Dampers

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

ii) Gas tight dampers shall be subjected to shop leakage test to demonstrate the guaranteed tightness (minimum one damper of each type and size offered). In case such type test is already done, the reports of the same shall be submitted for review.

iii) All dampers shall be checked for sealing dimensions to establish guaranteed tightness.

IV. Structure, Ducts, Hoppers

i) All materials shall be tested for chemical and mechanical properties as per relevant standard. All plates above 40mm shall be 100% Ultrasonically tested.

ii) Visual inspection of all welds shall be performed in accordance with AWSDI .1.

iii) NDT requirements of structural steel welds shall be as under:

a) 100% RT/UT on butt-welds of plate thickness ≥ 32mm.

b) For plates of 25mm ≤ thickness<32mm: 10%RT and 100% MPI.

c) For plates of thickness <25mm: 10% MPI/LPI.

iv) Edge for shop and field weld shall be examined by MPI for plate thickness ≥ 32mm.

Cladding material and its application on the ducts shall be tested as per applicable standard.

1.5.1.1.2 Absorber

I. Metal Structures

i) Only material which has been identified against mill sheet or test certificates shall be used for construction. All plates above 40mm shall be 100% Ultrasonically tested**.**

ii) Visual inspection of all welds shall be performed in accordance with AWSDI .1.

iii) NDT requirements of structural steel welds shall be as under:

a) 100% RT/UT on butt-welds of plate thickness>= 32mm.

b) For plates of 25mm<=thickness<32mm-10%RT and 100% MPI.

c) For plates of thickness <25mm-10% MPI/LPI.

iv) Edge for shop and field weld shall be examined by MPI for plate thickness >= 32mm.

II. **Spray Nozzles**

i) Spray nozzles shall be tested for physical properties.

ii) Spray nozzles also shall be subjected to performance test.

III. **Agitators**

i) Rubber lining shall be tested for hardness and spark test.

ii) Impellers shall be tested for dimensional and balancing check.

iii) Gear Boxes shall be tested for run test as per standard practice.

IV. Other Critical Equipment

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

1.5.1.1.3 Limestone & Gypsum Handling System

I. Crushers

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.

i) All plates equal to or above 25mm thickness shall be ultrasonically tested.

ii) 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.

iii) Following minimum NDT requirements to be ensured for welds:

a) Butt welds - UT/RT and 100% MPI/DPT.

b) Fillet Welds - 10% MPI/DPT.

iv) Crusher rotor to be dynamically balanced. Procedure to be submitted for approval.

v) No-load trial run test to be carried out at shop to check for speed(RPM), temperature rise, noise level and vibration.

II. 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.

III. Belt Conveyor System

The details of the checks to be carried out in the various equipment 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.

IV. Idlers

i) Check for run out and free movement shall be carried out on idlers. Run out shall be restricted as per IS:8598

ii) 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.

V. Belting

i) 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.

ii) 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.

iii) Adhesion test between ply to ply and cover to ply shall be carried out.

iv) Troughability test and Test for fire resistance shall be carried out.

v) 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.

vi) There will be a limitation on the no. of repairs allowed on the belts. Following will be the acceptance norm for the cover repairs.

- 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.
- 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.
- The maximum number of patch repair shall not exceed 5 per 100 meter. However, the total number of patch and dough filling repairs shall not exceed 10 per 100 meters.

vii) In addition to above, Steel Cord belt shall be tested for following also:

- Cord dia and breaking strength
- Finished belt shall be tested for cord pull-out strength before and after ageing, peeling resistance.
- Dynamic cord pull out test
- Cord dia, pitch and number of cords

viii) In no case shall the cover thickness or the width of belt be less than that given in specification.

ix) For testing purpose, belt sample shall be taken from anywhere of the belt roll length offered.

VI. Belt vulcanizing machine

i) 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.

ii) Complete assembly shall be tested at shop for temp. and pressure developed.

VII. Pulleys

i) In addition to chemical, mechanical, hardness, microstructure as per applicable material specification, pulleys shaft forgings shall be subjected to ultrasonic testing.

ii) 100% MPI/DPT on all welds shall be conducted and RT/UT on butt welds shall be conducted.

iii) Static balancing of pulleys shall be carried out after rubber lagging.

iv) 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.

VIII. Pull chord & belt sway switches

The following tests shall be carried out:

i) Over all dimension and functional test.

ii) HV & IR test

iii) Degree of protection test report.

IX. Zero speed switch, under belt switch and chute blockage switch

The following tests shall be carried out:

i) Burn in test at 50 deg. C for 48 hours shall be done for electronic switches.

ii) Over all dimension and functional tests.

iii) HV & IR

iv) Degree of protection test

X. Drive Equipment

i) Gear Boxes

- 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

- MPI to be carried out on Gears/Pinions after machining. Case depth, hardness and MPI after hard facing shall be checked to ensure freedom from defects.

- 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.

ii) Flexible Coupling

- Ultrasonic testing shall be conducted on forgings for gear sleeve and gear hub, if gear coupling is provided.

- MPI shall be carried out after machining to ensure freedom from cracks.

iii) Fluid Coupling

- Dynamic balancing shall be carried out for the rotating parts.

- Check for leak tightness of the coupling shall be carried out.

- Functional test on fusible plug for each type of coupling shall be conducted at shop.

- All couplings to be run tested at shop on no load.

- 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.

XI. Belt Scales

The details of the checks to be carried out in the various equipment 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.

i) Mounting arrangement/Overall dimensional check shall be carried out on the Belt Scales.

ii) Belt scale shall be calibrated with test weight/test chain in static at works and with test weight for dynamic condition at site.

iii) All electronic modules shall be subjected to burn in test at 50 deg. C for 48 hours.

iv) General check for load cell shall be carried out.

v) Test report for degree of protection on enclosure shall be furnished.

vi) Accuracy/performance check shall be demonstrated at site.

1.5.1.1.4 Dust Control System

The tests etc. shall be carried out various components of dust extraction system offered by the bidder in line with standard industry practice. The details of the checks to be carried out on the various equipment are to be submitted by the Contractor for Purchaser's approval.

1.5.1.1.5 Bucket Elevator

i) All plates equal to or above 25 mm thickness shall be ultrasonically tested.

ii) 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.

iii) 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.

iv) Following minimum NDT requirements shall be followed for welds:

a) Butt Welds in Tension - 100% UT/RT and 100% MPI/DPT.

b) Butt Welds in Compression - UT/RT and MPI/DPT.

c) Fillet Welds - MPI/DPT.

v) For other items like drive system, motor, pulley, belt etc. relevant portion of specification shall be applicable.

vi) No load trial run test shall be carried out at shop on completely assembled Bucket Elevator to check for trouble free operation, temperature rise, Noise & vibration. The procedure for the No load trial run shall be submitted for approval.

1.5.1.1.6 Silos/ Bunkers

i) 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.

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

1.5.1.1.7 Ball Mills

i) Raw material for shaft, coupling, gears and pinions, top and bottom races and other rotating components shall be subjected to UT. MPI/LPI shall be carried out to check surface soundness.

ii) Wear-resistant parts shall be UT/RT tested to check soundness after suitable heat treatment. Check for chemical composition, hardness and microstructure shall be carried out.

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

iv) 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.

No load run test of the assembly shall be demonstrated at shop/site depending upon its design/feasibility

I. **Gravimetric Feeders**

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

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

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

iv) Calibration check shall be carried out on all feeders.

II. **Lubricating oil systems**

Complete lube oil system shall be checked suitably as per standard practice.

1.5.1.1.8 Vacuum Belt Filter System

i) 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.

ii) UT on shaft (if greater or equal to 40mm) and impeller shall be carried out.

iii) All vacuum pumps shall be tested at shop for capacity, power, pressure, efficiency, noise and vibration etc.

iv) Filter cloths and belts shall be tested for physical properties as per relevant standard

v) Hydro cyclones shall be checked by visual, dimensional etc.

1.5.1.1.9 Monorail and Hoists

I. Hooks

i) All tests including proof load test as per relevant IS shall be carried out.

ii) MPE or DPT shall be done after proof load test.

II. Steels castings

Steel castings shall be subjected to DPT on machined surface.

III. Forgings

i) All forgings (wheel, gears, pinions, axles, hooks and hook trunnion) greater than or equal to 50mm diameter or thickness shall be subjected to ultrasonic testing.

ii) DPT or MPE shall be done after hard facing and machining.

IV. Wire rope

Wire rope shall be tested as per relevant standard.

V. Electric hoists

All electric hoists shall be tested as per IS-3938 and chain pulley blocks shall be tested as per IS-3832.

1.5.1.1.10 Ventilation System

i) Fans

a) 20% DPT of welding on fan hub, blades, casing and impeller as applicable shall be carried out.

b) DPT of fan shafts shall be carried out after machining.

c) UT of fan shafts (diameter greater than or equal to 50mm) shall be carried out.

d) Rotating components of all fans shall be statically and dynamically balanced to ISO-1940 Gr. 6.3.

e) All centrifugal fans shall be subjected to run test for 4 hour or till temperature stabilization is reached. Vibration, noise level, temperature rise and current drawn shall be measured during the run test.

f) One fan of each type and size will be performance tested as per corresponding IS code for airflow, static pressure, total pressure, speed, efficiency, power consumption, noise, vibration and temperature rise.

1.5.1.1.11 Piping Valves and fittings- Refer clause 1.4.6

1.5.1.1.12 Packaged, split and window air conditioners

i) Compressor of packaged air conditioner (PAC) shall be tested as per relevant code/standard.

ii) PAC shall be subjected to production routine test in accordance with IS: 8148 for the following.

a) General running test.

b) Pressure or leakage test of refrigerant.

c) Insulation resistance test.

d) High voltage test.

e) Performance test on one PAC of each type/size at ambient condition to check for following:

- DBT and WBT of supply and return air.
- Air flow
- Current, voltage measurement and power consumption
- Noise and vibration measurement

iii) Manufacturer's standard test certificate or guarantee certificate shall be submitted for split and window air conditioners.

1.5.1.1.13 Elevators

i) The details of the checks to be carried out in the various equipment 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.

ii) All forgings shall be subjected to ultrasonic test to ensure free from internal defects in addition to check for chemical and mechanical properties.

iii) 10% of the welds selected at random shall be subject to DP test.

iv) All forged components shall be subjected to DPI/MPI after machining.

v) Gear Reducer shall be checked for gear ratio, backlash, contact pattern. No load shop trial run shall be conducted on gear boxes to check for oil leakage, temperature rise, noise and vibration.

vi) Buffer springs shall be subjected to load test as per relevant specifications. Material certificates for springs shall also be furnished

vii) All components prior to assembly shall be checked for dimensions.

viii) Car sling and car body in assembled condition shall be checked for position of all major components i.e. car sling, inside depth, width, height, positions of push box, indicator box lights, fans etc.

ix) Function test of Elevator assembly shall be carried out.

x) All electrical equipment shall be of proven quality.

xi) Galvanized components/parts shall be checked for weight of Zn coating, thickness of coating, uniformity of coating and adhesion test and visual examination as per IS 2633 and IS 2629.

1.5.1.1.14 Fire Detection & Protection System

i) **Hydrant System: Shop Tests**

a) Hydrant Valve:

- All valves shall be hydro tested for body and seat.
- Capacity test / flow test shall be done as per relevant standard.

b) Water Monitor, Hoses, Branch Pipes, Couplings and Nozzles:

- All tests including hydraulic test shall be done as per relevant Indian/ International standard.

ii) **High/ medium velocity water spray: shop tests**

a) For Pipes, Fittings, Valves and specialties, requirements are indicated separately.

b) Deluge Valves and Spray Nozzles

- All valves shall be hydro tested for body and seat.
- Performance test / functional test of 'Deluge Valves' and 'Spray Nozzles' shall be carried out.

iii) **Detectors**

All 'Detectors' shall be tested as per relevant Indian / International Standards. Detectors shall also meet the requirements of UL / FM / LPC/VDS etc.

iv) **Piping, valve and specialties**

Refer clause 1.4.6

v) **Portable & mobile fire extinguishers**

a. All fire extinguishers shall be tested as per relevant standard.

b. Performance / function test shall be carried out on sampling basis as per relevant code / standard.

vi) **Site tests.**

a) Fire Extinguishers: A performance demonstration test at site of five (5) percent or one (1) number, whichever is higher, of each type and capacity of the extinguisher shall be carried out by the contractor. All consumables and replaceable items require for the contractor without any extra cost to employer would supply this test would be supplied by the Contractor without any extra cost to employer.

b) Piping Protection:

- Thickness, Holiday by spark test, Adhesion test shall be carried out as per relevant standard.

- Complete piping shall be Hydro pressure tested, at 1.5 X DP or 2 X MWP whichever is higher, before protection.

c) Welding of Pipes:

- ERW Black / rolled welded:
  - 100% DPT on root of butt and finish weld of butt and fillet.
  - RT on 10% randomly selected joints shall be carried out (for underground piping).
- GI Pipes
  Welding on GI Pipes in general shall not be done. Welding of GI Pipes, if permitted by design, (butt / socket / fillet weld) shall be done strictly as per approved drawing and procedure approved by NTPC Engineering. For all such welds 100% DP test and random 1% RT shall be done.

1.5.1.1.15 Miscellaneous Equipment

I. Pressure Vessels

i) NDT on weld joint shall be as per respective code requirements or the minimum as specified as below:

a) 100% DPT on root run of butt weld, nozzle welds and finished fillet welds.

b) 10% DPT on all finished butt welds.

c) 10% RT (covering all 'T'/cross joints) of butt welds.

ii) Butt welds of dished ends shall be stress relieved and subjected to 100% RT.

iii) Each finished vessels shall be hydraulically tested to 150% of the design pressure for a duration of 30 minutes.

II. Tanks

i) Tests shall be carried out on the materials of the tanks to establish their mechanical properties, and chemical compositions

ii) Plates shall be subject to 100% ultrasonic testing.

iii) Welding

a) Root run of butt welds shall be examined by 100% DPT or MPE.

b) Butt welds, full penetration joints and nozzle welds shall be checked by 100% RT and 100% MPE or DPT.

c) Fillet welds shall be checked by 100% MPE or DPT.

iv) Rubber lining shall be subject to hardness and spark test, as applicable.

v) Visual check and dimensional measurement shall be carried out on the completed equipment.

vi) The fabricated tank shall be subject to water fill test to check for the leakage.

1.5.1.1.16 Low Pressure Piping, Valves and Fittings etc. Refer clause 1.4.6

1.5.1.1.17 Pumps & Blowers

I. Dosing pumps/ metering pumps

i) Tests shall be carried out on the materials of the pumps to establish their properties, and chemical compositions

ii) Pump casings shall be subject to hydraulic test at 1.5 times the shut off pressure or 2 times the working pressure whichever is higher.

iii) Pumps shall be performance tested as per HIS, USA.

II. Horizontal centrifugal pumps

i) Tests shall be carried out on the materials of the pumps to establish their properties, and chemical compositions.

ii) 100% DPT or MPE shall be carried out for the rotor and machined surfaces of casing and impellers.

iii) UT on pump shaft (diameter greater than or equal to 50mm), MPI or DPT on pump shaft and impeller after machining shall be carried out.

iv) All rotating components of the pumps shall be statically and dynamically balanced to ISO-1940 Gr. 6.3.

v) Assembly fit up check, and dimensional check shall be carried out for the completed pump assembly.

vii) Pump casings shall be subject to hydraulic test at 1.5 times the shut off pressure or 2 times the working pressure whichever is higher for a minimum duration of 30 minutes.

viii) All pumps shall be tested at manufacturer's works for head, capacity, power and efficiency as per requirements of HIS, USA or equivalent standard. Pump shall be given running test over the entire operating range covering from the shut-off head to the maximum flow. Acceptance shall be as per approved datasheet and HIS only.

ix) 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.

III. Vertical sump pumps

i) All materials should be of tested quality and test certificates to be provided.

ii) Shaft forgings to be subjected to ultrasonic testing. iii) DPT to be done on machined shaft and impeller. iv) Impellers to be dynamically balanced to ISO 1940 Gr.6.3.

v) 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.

vi) All pumps to be performance tested as per Hydraulic Institute Standard/ Indian Standard. Performance test to include check for noise, vibration level and bearing temperature rise.

IV. Blowers

i) Tests shall be carried out on the materials of the rotary blowers/ compressors to establish their properties, and chemical compositions.

ii) 100% DPT or MPE shall be carried out for the rotor and machined surfaces of casing and impellers.

iii) The shaft and impellers shall be dynamically balanced.

iv) Assembly fit up check, and dimensional check shall be carried out for the completed blower assembly.

v) The blower/ compressor casing shall be subject to hydraulic test at 1.5 times the shut off pressure or 2 times the working pressure whichever is higher.

vi) The blowers/ compressor shall be performance tested as per relevant code/ standard.

V. Air Compressors

i) All pressure parts shall be hydraulically tested at not less than 150% of design pressure for a duration of 30 minutes prior to painting.

ii) All other parts including inter-connecting piping shall be hydraulically tested wherever possible, as per relevant codes.

iii) 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.

iv) During assembly all clearances and alignments shall also be checked and recorded

v) Rotor shall be statically and dynamically balanced.

vi) 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.

vii) Vibration and Noise level measurement shall be done during shop performance test.

viii) 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:

- 100% DPT on root run of butt welds
- 100% DPT on all finished butt welds and fillet welds
- 10% RT on butt welds which shall include all T-Joints

1.5.1.1.17 Hangers and Supports

i) All raw materials used shall have co-related mill test certificate meeting mandatory checks of material specification.

ii) Completed springs shall be tested for sagging test and load versus deflection test. For diameter more than 25mm, MPE shall also be carried out.

iii) Butt welds of thickness 32mm and above shall be tested for UT, and for butt welds of thickness less than 32mm MPE shall be done. Fillet welds shall be tested for MPE.

iv) Dampers with viscous fluids shall be checked for viscosity of liquid used, damping resistance of the damper, stiffness of the damper etc.

v) Turn-buckle, pipe clamps and hangers of thickness greater than 25mm shall be checked by MPE or DPT on bent portions.

vi) One hanger of each type and size shall be checked for variation in deflection and travel versus load test.

1.5.2 Sea water based FGD System:

The testing and inspection requirements of major equipment of FGD system to be followed by the bidder over and above the respective code/ standard requirements are given hereunder:

1.5.2.1 MECHANICAL SYSTEMS

1.5.2.1.1 Flue Gas System

I. Booster fans

i) Rotor components shall be subjected to ultrasonic test at mill and magnetic particle examination/dye penetration examination after rough machining.

ii) Butt welds in rotor components shall be subjected to 100% UT and all welds shall be subjected to MPE or DPT after stress relieving.

iii) The rotor of fans shall be dynamically balanced to quality grade 6.3 of ISO 1940.

iv) Test for natural frequency and hardness of fan blades shall be carried out as per technical specification/ relevant standard.

v) Full range performance test shall be carried out on one fan as per BS 848, Part-1.

II. Thermal insulation

a) Pre-formed fibrous pipe insulation and LRB mattresses/ sections of rock wool/ mineral wool from approved manufacturing sources conforming to and tested as per relevant standards shall be used.

b) For resin bonded mineral wool insulation, testing shall be carried out as per IS: 8183.

c) For resin bonded rock wool insulation, testing shall be carried out as per IS: 9842.

d) Type tests except thermal conductivity shall be regularly carried out once in three months.

e) Type test for thermal conductivity shall be carried out by the manufacturer minimum once in six months. Thermal conductivity (K value) shall be measured in line with IS: 3346.

III. Dampers

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

ii) Gas tight dampers shall be subjected to shop leakage test to demonstrate the guaranteed tightness (minimum one damper of each type and size offered).

iii) All dampers shall be checked for sealing dimensions to establish guaranteed tightness.

IV. Structure, Ducts, Hoppers

i) All materials shall be of tested quality and test certificates for chemical and mechanical properties as per relevant standard shall be provided. All plates above 40mm shall be 100% Ultrasonically tested.

ii) Visual inspection of all welds shall be performed in accordance with AWSDI .1.

iii) NDT requirements of structural steel welds shall be as under:

a) 100% RT/UT on butt-welds of plate thickness ≥ 32mm.

b) For plates of 25mm ≤ thickness<32mm: 10%RT and 100% MPI.

c) For plates of thickness <25mm: 10% MPI/LPI.

iv) Edge for shop and field weld shall be examined by MPI for plate thickness ≥ 32mm.

1.5.2.1.2 Gas to gas heater (GGH)

i) Forged shafts for GGH like stub shaft, main rotor forging, housing hub shall be subjected to 100% UT at mill and magnetic particle examination after machining.

ii) Critical welds of rotor post shall be subjected to radiographic examination.

iii) Trial run of GGH drive assembly (gear box+pinion+electric motor+ air motor) shall be carried out at shop.

1.5.2.1.3 Scrubber

I. Metal Structures

i) 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. All plates above 40mm shall be 100% Ultrasonically tested**.**

ii) Visual inspection of all welds shall be performed in accordance with AWSDI .1.

iii) NDT requirements of structural steel welds shall be as under:

a) 100% RT/UT on butt-welds of plate thickness>= 32mm.

b) For plates of 25mm<=thickness<32mm-10%RT and 100% MPI.

c) For plates of thickness <25mm-10% MPI/LPI.

iv) Edge for shop and field weld shall be examined by MPI for plate thickness >= 32mm.

II. **Spray Nozzles**

i) Spray nozzles shall be tested for physical properties.

ii) Spray nozzles also shall be subjected to performance test.

III. **Other Critical Equipment**

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

1.5.2.1.4 Sea water pumps

i) All materials shall be of tested quality and test certificates for chemical and mechanical properties as per relevant standard shall be provided.

ii) Shaft forgings and thrust bearing to be subjected to ultrasonic testing.

iii) DPT/ MPI to be done on machined shaft, impeller, castings, column pipes, companion flanges and thrust bearing.

iv) RT to be done on impeller, column pipe discharge head assembly and flanges.

v) Impeller and shaft to be dynamically balanced to ISO 1940 Gr.6.3.

vi) Casing shall be hydraulically tested at 150% of the shut-off head for 30 minutes. No leakage is allowed.

vii) All pumps to be performance tested as per Hydraulic Institute Standard/ Indian Standard. The performance test shall be conducted to verify output (flow) against total head, power input, efficiency and to establish the characteristic curves of the pump. The performance test shall also include check for noise, vibration level and bearing temperature rise.

1.5.2.1.5 Monorail and Hoists

I. Hooks

i) All tests including proof load test as per relevant IS shall be carried out.

ii) MPE or DPT shall be done after proof load test.

II. Steels castings

Steel castings shall be subjected to DPT on machined surface.

III. Forgings

i) All forgings (wheel, gears, pinions, axles, hooks and hook trunnion) greater than or equal to 50mm diameter or thickness shall be subjected to ultrasonic testing.

ii) DPT or MPE shall be done after hard facing and machining.

IV. Wire rope

Wire rope shall be tested as per relevant standard.

V. Electric hoists

All electric hoists shall be tested as per IS-3938 and chain pulley blocks shall be tested as per IS-3832.

1.5.2.1.6 Ventilation System

i) Fans

a) 20% DPT of welding on fan hub, blades, casing and impeller as applicable shall be carried out.

b) DPT of fan shafts shall be carried out after machining.

c) UT of fan shafts (diameter greater than or equal to 50mm) shall be carried out.

d) Rotating components of all fans shall be statically and dynamically balanced to ISO-1940 Gr. 6.3.

e) All centrifugal fans shall be subjected to run test as per manufacturer's standard practice.

f) One fan of each type and size will be performance tested as per corresponding IS code for airflow, static pressure, total pressure, speed, efficiency, power consumption, noise, vibration and temperature rise.

ii) Piping, valves and fittings- Refer clause 1.4.6

1.5.2.1.7 Packaged, split and window air conditioners

i) Compressor of packaged air conditioner (PAC) shall be tested as per relevant code/standard.

ii) PAC shall be subjected to production routine test in accordance with IS: 8148 for the following.

a) General running test.

b) Pressure or leakage test of refrigerant.

c) Insulation resistance test.

d) High voltage test.

e) Performance test on one PAC of each type/size at ambient condition to check for following:

- DBT and WBT of supply and return air.
- Air flow
- Current, voltage measurement and power consumption
- Noise and vibration measurement

iii) Manufacturer's standard test certificate or guarantee certificate shall be submitted for split and window air conditioners.

1.5.2.1.8 Elevators

i) The details of the checks to be carried out in the various equipment 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.

ii) All critical forgings shall be subjected to ultrasonic test to ensure free from internal defects in addition to check for chemical and mechanical properties.

iii) 10% of the welds selected at random shall be subject to DP test.

iv) All forged components shall be subjected to DPI/MPI after machining.

v) Gear Reducer shall be checked for gear ratio, backlash, contact pattern. No load shop trial run shall be conducted on gear boxes to check for oil leakage, temperature rise, noise and vibration.

vi) Buffer springs shall be subjected to load test as per relevant specifications. Material certificates for springs shall also be furnished

vii) All components prior to assembly shall be checked for dimensions.

viii) Car sling and car body in assembled condition shall be checked for position of all major components i.e. car sling, inside depth, width, height, positions of push box, indicator box lights, fans etc.

ix) Function test of Elevator assembly shall be carried out.

x) All electrical equipment shall be of proven quality.

xi) Galvanized components/parts shall be checked for weight of Zn coating, thickness of coating, uniformity of coating and adhesion test and visual examination as per IS 2633 and IS 2629.

1.5.2.1.9 Fire Detection & Protection System

i) **Hydrant System: Shop Tests**

a) Hydrant Valve:

- All valves shall be hydro tested for body and seat.
- Capacity test / flow check shall be done as per relevant standard.

b) Water Monitor, Hoses, Branch Pipes, Couplings and Nozzles:

- All tests including hydraulic test shall be done as per relevant Indian/ International standard.

ii) **High/ medium velocity water spray: shop tests**

a) For Pipes, Fittings, Valves and specialties, requirements are indicated separately.

b) Deluge Valves and Spray Nozzles

- All valves shall be hydro tested for body and seat.
- Performance test / functional test of 'Deluge Valves' and 'Spray Nozzles' shall be carried out.

iii) **Detectors:** All 'Detectors' shall be tested as per relevant Indian / International Standards. Detectors shall also meet the requirements of UL / FM / LPC/VDS etc.

iv) **Piping, valve and specialties**

Refer clause 1.5.2.1.10 (IV).

v) **Portable & mobile fire extinguishers**

a. All fire extinguishers shall be tested as per relevant standard.

b. Performance / function test shall be carried out on sampling basis as per relevant code / standard.

vi) **Site tests.**

a) Fire Extinguishers: A performance demonstration test at site of five (5) percent or one (1) number, whichever is higher, of each type and capacity of the extinguisher shall be carried out by the contractor. All consumables and replaceable items require for the contractor without any extra cost to employer would supply this test would be supplied by the Contractor without any extra cost to employer.

b) Piping Protection:

- Thickness, Holiday by spark test, Adhesion test shall be carried out as per relevant standard.
- Complete piping shall be Hydro pressure tested, at 1.5 X DP or 2 X MWP whichever is higher, before protection.

c) Welding of Pipes:

- ERW Black / rolled welded:

- 100% DPT on root of butt and finish weld of butt and fillet.
- RT on 10% randomly selected joints shall be carried out (for underground piping).

1.5.2.1.10 Miscellaneous Equipment

I. Pressure Vessels

i) NDT on weld joint shall be as per respective code requirements or the minimum as specified below:

a) 100% DPT on root run of butt weld, nozzle welds and finished fillet welds.

b) 10% DPT on all finished butt welds.

c) 10% RT (covering all 'T'/cross joints) of butt welds.

ii) Butt welds of dished ends shall be stress relieved and subjected to 100% RT.

iii) Each finished vessels shall be hydraulically tested to 150% of the design pressure for a duration of 30 minutes.

II. Tanks

i) All materials shall be of tested quality and test certificates for chemical and mechanical properties as per relevant standard shall be provided.

ii) Plates above 40 mm thickness shall be subject to 100% ultrasonic testing.

iii) Welding

a) Root run of butt welds shall be examined by 100% DPT or MPE.

b) Butt welds, full penetration joints and nozzle welds shall be checked by 100% RT and 100% MPE or DPT.

c) Fillet welds shall be checked by 100% MPE or DPT.

iv) Rubber lining shall be subject to hardness and spark test, as applicable.

v) Visual check and dimensional measurement shall be carried out on the completed equipment.

vi) The fabricated tank shall be subject to water fill test to check for the leakage.

III. GRP/GRE Piping for Sea Water

i) The testing and quality inspection for GRP/ GRE pipe and piping materials shall be carried at manufacturer's works as per the approved quality assurance plan. The tests to be carried out, as a minimum, shall cover the following:

a) Raw materials

Raw materials for use in pipes covered in this specification shall be sampled and tested by the manufacturer prior to their use to ensure that they comply with the requirement of ASTM D 3517. The glass content in the GRP/GRE material used shall be determined in accordance with ASTM D2584 using ignition loss method.

b) Pipe stiffness

Samples of pipe shall be tested for compliance with the pipe stiffness in accordance with ASTM D2412, with the stiffness value rated at 3% deflection.

c) Load capacity (hoop and axial)

Tests will be performed in accordance with AWWA C950 and ASTM D3517 to check the load capacity (or strength) in both the hoop and axial directions.

d) Barcol hardness test

Barcol hardness tests will be conducted in accordance with ASTM D 2583. Pipes failing to reach the required level of cure will be rejected.

e) Critical dimensions

The pipes shall be measured for compliance with critical dimensions as specified in ASTM standards including diameter, thickness, end squareness and length. Measurements shall be made in accordance with ASTM D3567. Wall thickness should be measured as per ASTM D3567 once per every production lot.

f) *Visual acceptance*

Visual Inspection and classification of defects shall be carried out according to ASTM D2563 level III. The pipe should be free from all defects, including delamination, bubbles, pinholes, cracks, pits, blisters, foreign inclusions, and resin-starved areas. The pipe should be as uniform as commercially practicable in color, opacity, density and other physical properties.

ii) Field Hydro Testing

a) Hydrostatic test of the GRP/ GRE pipe for the entire length or on a segment of it shall be carried out to verify the hydraulic sealing of the system at the testing pressure and its structural integrity.

b) The hydro testing of the piping system shall be carried out before encasing or closing the trench covers. Permanent flanged spool pieces should be provided at the start and end point of the pipe to facilitate blinding of the line for hydro testing. The joints should be visible in order to allow for the inspection, unless otherwise stated by Owner & their representative.

c) Hydrostatic testing shall be carried out at 1.5 times the design pressure for a duration of minimum 2 hours after stabilization of the test pressure. The contractor shall submit the detailed plan indicating the methodology for hydro testing, blinding the ends, air venting, supply of sea water, pressurizing and draining. The test procedure shall be subject to purchase's approval.

d) The hydraulic testing shall be considered acceptable, if at the end of the 2 hours of testing, the following parameters are met:

- During the period of the hydraulic test, the pressure stays stable.
- No leakages are noticed in any point of the pipeline, or in the joints, or in the testing equipment.

e) In case of failure of the test, the reason for leakage shall be examined. Any pipes found defective or leaking (except at the butt joints) shall be replaced with a new one. Repair or patch work on pipes shall not be acceptable. The pipeline shall then be tested again according to the approved test procedure.

IV. Low Pressure Piping, Valves and Fittings etc. Refer Cl 1.4.6

V. Horizontal centrifugal pumps

i) Tests shall be carried out on the materials of the pumps to establish their properties, and chemical compositions.

ii) 100% DPT or MPE shall be carried out for the rotor and machined surfaces of casing and impellers.

iii) UT on pump shaft (diameter greater than or equal to 50mm), MPI or DPT on pump shaft and impeller after machining shall be carried out.

iv) All rotating components of the pumps shall be statically and dynamically balanced to ISO-1940 Gr. 6.3.

v) Assembly fit up check, and dimensional check shall be carried out for the completed pump assembly.

vi) Pump casings shall be subject to hydraulic test at 1.5 times the shut off pressure for a minimum duration of 30 minutes.

vii) All pumps to be performance tested as per Hydraulic Institute Standard/ Indian Standard. The performance test shall be conducted to verify output (flow) against total head, power input, efficiency and to establish the characteristic curves of the pump. The performance test shall also include check for noise, vibration level and bearing temperature rise.

viii) 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.

VI. Vertical pumps

i) All materials should be of tested quality and test certificates to be provided.

ii) Shaft forgings to be subjected to ultrasonic testing.

iii) DPT to be done on machined shaft and impeller.

iv) Impellers to be dynamically balanced to ISO 1940 Gr.6.3.

v) All pressure parts shall be hydraulically tested at 150% of the shut-off head for 30 minutes. No leakage is allowed.

vi) All pumps to be performance tested as per Hydraulic Institute Standard/ Indian Standard. The performance test shall be conducted to verify output (flow) against total head, power input, efficiency and to establish the characteristic curves of the pump. The performance test shall also include check for noise, vibration level and bearing temperature rise.

VII. Blowers

i) Tests shall be carried out on the materials of the rotary blowers/ compressors to establish their properties, and chemical compositions.

ii) 100% DPT or MPE shall be carried out for the rotor and machined surfaces of casing and impellers.

iii) The shaft and impellers shall be dynamically balanced.

iv) Assembly fit up check, and dimensional check shall be carried out for the completed blower assembly.

v) The casing shall be subject to hydraulic test at 1.5 times the shut off design pressure.

vi) The blowers shall be performance tested as per relevant code/ standard.

VIII. Air Compressors

i) All pressure parts shall be hydraulically tested at not less than 150% of design pressure for a duration of 30 minutes prior to painting.

ii) All other parts including inter-connecting piping shall be hydraulically tested wherever possible, as per relevant codes.

iii) 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.

iv) During assembly all clearances and alignments shall also be checked and recorded.

v) Rotor shall be statically and dynamically balanced.

vi) 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. Power consumption at motor input terminal at rated capacity as well as at fully unloaded condition of all the compressor shall be measured.

vii) Vibration and Noise level measurement shall be done during shop performance test.

viii) 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:
- 100% DPT on root run of butt welds
- 100% DPT on all finished butt welds and fillet welds
- 10% RT on butt welds which shall include all T-Joints

IX. Hangers and Supports

i) All raw materials used shall have co-related mill test certificate meeting mandatory checks of material specification.

ii) Completed springs shall be tested for sagging test and load versus deflection test. For diameter more than 25mm, MPE shall also be carried out.

iii) Butt welds of thickness 32mm and above shall be tested for UT, and for butt welds of thickness less than 32mm MPE shall be done. Fillet welds shall be tested for MPE.

iii) Dampers with viscous fluids shall be checked for viscosity of liquid used, damping resistance of the damper, stiffness of the damper etc.

iv) Turn-buckle, pipe clamps and hangers of thickness greater than 25mm shall be checked by MPE or DPT on bent portions.

v) One assembled hanger of each type and size in each lot shall be checked for variation in deflection and travel versus load test.

X. **EOT Crane, Semi Gantry Crane and Hoists**

i) **Hooks**

a) All tests including proof load test as per relevant IS/BS/DIN shall be carried out.
b) MPI/DPT shall be carried out after proof load test.

ii) **Steel casting**

DPT on machined surface shall be carried out.

iii) **Girders, end carriage, crab, gear box and rope drum**

a) The plates of thickness 25mm and above shall be ultrasonically tested.
b) NDT requirements on weldments shall be as follows:

- Butt welds in tension:-100% RT and 100% DPT
- Butt welds in compression:-10% RT and 100% DPT
- Butt welds in rope drum:-100% RT an 100% DPT
- Fillet welds:- 10% DPT

iv) Forging (wheel, gears, pinions, axle, hooks & hook trunnion)

a) All forgings greater than or equal to 50 mm diameter or thickness shall be subjected to ultrasonic testing.

b) DPT/MPI shall be done after hard facing and machined surfaces.

v) Wire rope shall be tested as per relevant standard.

vi) Reduction gears shall be tested for reduction ratio, backlash & contact pattern. Gear box shall be subjected to no-load run test to check for oil leakage, temperature rise, noise and vibration.

vii) The cranes shall be completely assembled at shop for final testing. All tests for dimension, deflection, load, overload, hoisting motion, cross travel etc. As per IS-3177 shall be carried out at shop.

viii) All electric hoists shall be tested as per IS-3938 and chain pulley blocks shall be tested as per IS-3832.

1.5A GENERAL REQUIREMENTS FOR FIELD ERECTION CHECKS AND TESTS

The QA requirements for raw materials, in-process tests and NDTs indicated for shop manufacture shall be applicable for site fabrication/erection of the respective item.

(a) Hydraulic Test of Pressure Parts

On completion of erection of pressure parts of each steam generator, the unit with its fittings and mountings in position shall be subjected to hydraulic test pressure in accordance with requirement of Indian Boiler Regulations. Water used for hydraulic test shall be made alkaline by addition of suitable chemical. After the test, all parts shall be drained and suitably preserved.

(b) Turbine Assembly

Bidder shall clearly indicate the extent of assembly to be carried out at site for steam turbine and BFP drive turbine(s). Accordingly, bidder shall submit elaborate erection and assembly inspection programme of turbines for purchaser's approval.

(c) Condenser Assembly

i) If the condenser sections calls for site assembly, care shall be taken in assembly of sections and correctness of alignment and fit up shall be checked. Site welding shall be carried out as per the procedure approved by the purchaser.

ii) All weld seams shall be subjected to magnetic particle examination. At least 10% of butt welds shall be subjected to radiographic examination.

iii) All welds between condenser neck and LP turbine shall be subjected to 100% radiographic and magnetic particle examination.

iv) Condenser tubes shall be visually examined for dents, mechanical damages or any other defects prior to insertion. Both tube ends shall be thoroughly cleaned to a length of 100mm to remove oil, grease etc. and shall be checked for freedom from burrs prior to insertion.

v) Tube expansion shall be carried out by electronic automatic torque control expanding unit, which shall be calibrated before use. Tube wall thinning and length of expansion shall be controlled and recorded.

vi) Hydrostatic testing of condenser steam space shall be carried out after connecting all the pipes with the condenser along with condenser vacuum systems by filling the steam space with water up to the tip of the last stages of blades of LP cylinder.

vi) Condenser water boxes shall be tested hydraulically at a minimum test pressure of 1.5 times the design pressure.

(d) General

i) All rotating equipment shall be checked for their direction of rotation and free

movement after placing on the respective foundations.

ii) Piping system shall be tested hydraulically or pneumatically as per application requirement.

iii) All valves shall be checked for their direction of flow.

iv) Insulation shall be carried out only after satisfactory inspection of leak test.

v) After complete installation of air conditioning and ventilation systems, all ducting system shall be tested for air leakage test or smoke tightness test.

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	

LEGEND: **M:** MANUFACTURER/SUB-SUPPLIER, **C:** MAIN SUPPLIER, **U:** CUSTOMER, **P:** PERFORM, **W:** WITNESS, **V:** VERIFICATION, **IR**-INSPECTION REPORT, **D:** DOCUMENT REQUIRED

Note:

1) '**W**' UNDER AGENCY COLUMN INDICATES THE CUSTOMER HOLD POINT (CHP), WHICH SHALL BE IDENTIFIED BY CUSTOMER.

2) RECORDS, INDENTIFIED WITH "TICK'' (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER UNDER COLUMN 'D'

MODEL QUALITY ASSURANCE PLAN (MQAP)

1.0 STEAM GENERATOR

1.1 Pressure Parts

1.0 Raw Material Inspection

1.1	Drums Plates	Chemical properties	Critical	Chemical Test	100 %	Minimum requirements of BS: 5996 grade LC3/ ASTM or equivalent standards, Approved Drawing/ Datasheet	MTC	√	P	V	V	See Note 3
		Mechanical properties	Critical	Mech. Tests	100 %			√	P	V	V	
		Elevated temp. tensile test on plate material	Critical	Tests	100 %	Approved Drawing/ Datasheet		√	P	V	V	
		UT (normal and shear UT at Mill)	Critical	UT	100 %	SA 577/ SA 578 level B		√	P	V	V	
1.2	Headers	Chemical properties, Mechanical Properties., Heat Treatment, Ultrasonic testing, Hardness test Grade 22 and above	Critical	Review of TC	100%	i) Ultrasonic Test ii)Transverse test on headers (greater than 8") iii) Flattening test on pipe from one end As per applicable material standard/code	MTC	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
							As per IBR or ASME E 213 or equivalent with the longitudinal calibration notch of depth 5% of wall thickness (0.3mm min. and 1.5mm max.)						
1.3	Tubes & Tube Elements	Chemical properties, Mechanical Properties., Heat Treatment, Ultrasonic testing, Hardness test Grade 22 and above	Critical	Tests	100%		As per applicable material standard/code As per IBR or ASME E 213 or equivalent with the longitudinal calibration notch of depth 5% of wall thickness (0.3mm min. and 1.5mm max.)	MTC	√	P	V	V	See Note 4
1.4	Piping	Chemical, Mechanical Properties, HT,UT & Hydro	Critical	Tests	100%		Approved Drawing/Datasheet	MTC	√	P	V	V	
1.4.1	Fittings	Chemical, Mechanical Properties, NDT	Critical	Ultrasonic Test	100%		Approved Drawing/Datasheet	Test Report	√	P	V	V	
1.5	Valves	Chemical, Mechanical Properties, HT,UT & Hydro	Critical	Test	100%		Approved Drawing/Datasheet	MTC	√	P	V	V	
1.6	Compensating Pads	Chemical, Mechanical properties	Critical	Tests	100%		Approved Drawing/Datasheet		√	P	V	V	
2.0	**In Process Inspection**												
2.1	Drum	Dimensional	Major	Measurement	100%		Approved Drawing/Datasheet	IR		P	-	-	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		Dished end pressing, Dished end HT after forming, Thickness,							√	P	V	V	
		Tensile test on cut out piece, WPS, PQR, Welder qualification records							√	P	V	V	
		Forming of Drum suspension Rod							√	P	V	V	
2.1.1		Visual	Major	Visual	100%		MANUFACTURING DRAWING		√	P	-	-	
2.1.2	a) Butt welds	NDT	Critical	Radiographic	100%		Approved Drawing/Datasheet	RT	√	P	V	V	RT Film review
	b) Butt welds	NDT	Critical	Ultrasonic testing & MPE	100%		Approved Drawing/Datasheet	UT REPORT	√	P	W	W	After stress relieving in the furnace of the entire drum
2.1.3	Full penetration welds	NDT	Critical	Ultrasonic testing & MPE	100%		Approved Drawing/Datasheet	UT REPORT	√	P	V	V	After stress relief
2.1.4	Mechanical testing of long seam & C-seam weld joint test coupon	Mechanical Test	Critical	Tensile test	100%		Approved Drawing/Datasheet	TC	√	P	W	W	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
2.1.5	Suspension rod weld joint UT	NDT	Critical	UT	100%		Approved Drawing/Datasheet	TC	√	P	W	W	
2.1.6	Heat treatment of Drum inside furnace	Heat Treatment	Critical	HT Chart	100%		Approved Drawing/Datasheet	HT Chart	√	P	V	V	
2.1.7	Dimension of drum, suspension rod, assembly of internal, nozzles	Visual & Dimensional	Critical	Measure ment	100%		Approved Drawing/Datasheet	TC	√	P	W	W	
2.2	**Headers**												
2.2.1	Forming, Heat Treatment	Manufacturing		Visual, HT Chart	100%		Approved Drawing/Datasheet		√	P	V	V	
2.2.2	Butt welds	NDT	Critical	a)Radiograp hic test (RT) b)Magnetic particle examinatio n (MPE)	100%		Approved Drawing/Datasheet	RT REPORT	√	P	V	V	Review of RT film
2.2.3	Full penetration nozzle & attachment welds	NDT	Critical	Ultrasonic testing & MPE	100%		Approved Drawing/Datasheet	UT REPORT	√	P	W	W	
2.2.4	Production weld test for L seam if welded	Tensile test	Critical	Measure ment	100%		Approved Drawing/Datasheet	TC	√	P	W	W	
2.2.5	WPS, PQR & welder qualification test	WPS,PQR & WTQ	Critical	Review	100%		ASME Sec.IX, IBR	WPS/PQ R	√	P	V	V	
2.2.6	Hydro test	Hydraulic Test	Critical	Measure ment	100%		Approved Drawing/Datasheet	TC	√	P	W	W	
2.3	Tubes and Tube Elements	NDT	Critical	MPI	100%		Approved Drawing/Datasheet	TC	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		Bending, sizing, swaging	Major	Visual				TC	√	P	V	V	
		Heat treatment	Major	HT				TC	√	P	V	V	
		Bend- First off inspection	Major	Visual				TC	√	P	W	W	
		WPS, PQR, Welder qualification	Major	WPS/PQR/WTQ				TC	√	P	V	V	
		Hardness test	Critical	Hardness				TC	√	P	W	W	
		Hydro Test	Critical	Measurement				TC	√	P	W	W	
		Steel ball and sponge ball test	Critical	Measurement				TC	√	P	W	W	
2.3.1	Butt Welds	NDT	Critical	RT and UT	100% (in case of random sampling – min. 20%)		Approved Drawing/Datasheet	TC	√	P	W	W	Review of RT Films
2.3.2	Fillet welds (including fins if any)	NDT	Critical	MPE or dye penetration test (DPT)	100%		Approved Drawing/Datasheet	TC	√	P	W	W	
2.4	Piping, Valves and Fitting	NDT	Critical	MPI	100%		Approved Drawing/Datasheet	TC	√	P	V	V	
2.4.1	Butt Welds	NDT All butt welds in alloy steel piping of P91, X20 and X 22 after stress relieving (SR). UT shall be of	Critical	RT or UT & MPE	100%		Approved Drawing/Datasheet	TC	√	P	V	V	Review of RT Films

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		digital recordable type											
2.4.3	All Weld joints	NDT 100% (Alloy steel piping of P91, X20 and X 22) (3% hardness on welds of other alloy steel piping.)	Critical	Hardness	100%				√	P	V	V	For preheating and post weld heat treatment (PWHT) induction heating shall be deployed. However, PWHT can be done in furnace also.
2.4.4	HP Piping	NDT	Critical	Examination of welds	100%		Approved Drawing/Datasheet	TC	√	P	V	V	See Note 5
2.4.5	Any other pipe not covered	NDT	Critical	MPE/ DPT/ RT	100% / 10%		Approved Drawing/Datasheet	Test Reports	√	P	V	V	See Note 6
2.5	Valves	NDT	Critical	MPI	100%				√	P	V	V	
2.5.1	Pressure retaining parts	NDT	Critical	MPE/ RT	100%/ 105								See Note 7
2.5.2	Stem	NDT	Critical	UT	100%		Dia 500mm or more		√	P	V	V	
2.5.3	Body & Bonnet	NDT	Critical	a) UT b) MPE	100% 100%		a) 1500 class or above b) 600 class or above		√	P	V	V	
2.6	Compensating Pads												
3.0	**Final Inspection**												
3.1	Drum	Hydraulic Pressure Test, Dimension	Major	Measurement	100%		Approved Drawing/Datasheet	TC	√	P	W	W	See Note 8
3.1.1	Compensating Pads	Pneumatic test	Major	Measurement					√	P	W	W	See Note 9
3.2	Complete closed end headers	Hydraulic Pressure	Major	Measurement					√	P	W	W	See Note 8

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		Test, dimension											
3.3	Tubes and Fabricated, panels, coils	Hydraulic Pressure Test, Steel Ball and sponge ball test, dimension, trail assembly of spiral wall assembly	Major	Measure ment					√	P	W	W	See Note 8
3.4	Valves	a) Hydraulic Pressure Test b) Seat leak test c) Back Seat test	Critical	Measure ment	100%		a) ANSI 16.34 or IBR b) As per applicable standards or codes c) approved drawing/datasheet	TC	√	P	W	W	See Note 8
		Visual & Dimension	Critical	Measure ment	100%		Approved drawing/datasheet	TC	√	P	W	W	
		Functional Test	Critical	Measure ment	100%								
3.5	Non pressure bearing attachments	NDT, UT and MPE for Load bearing welds after stress relieving. MPE for Non load bearing welds after stress relief.	Major	UT/ MPE	100%		Approved drawing/datasheet	TC	√	P	W	W	The toes of the welds adjoining the drum shall be ground smooth prior to stress relieving before carrying out this examination.

NOTE -

1	INSPECTION / NDT / TEST CERTIFICATE / REPORT FOR UT, MPI, BALANCING, PRESSURE TEST SHALL INDICATE REFERENCE OF ITEM SERIAL NUMBER & MODEL FOR CO-RELATION.
2	MATERIAL TEST CERTIFICATE / REPORT FOR TEST SUCH AS CHEMICAL & MECHANICAL TEST ETC. SHALL INDICATE REFERENCE OF ITEM SERIAL NUMBER & ENGINE MODEL FOR CO-RELATION AS PER SAMPLING NORMS.
3	ONLY THOSE MATERIALS SHALL BE USED IN THE MANUFACTURE OF PRESSURE PARTS WHICH CAN BE IDENTIFIED AGAINST MILL SHEET OR MANUFACTURER TEST CERTIFICATES. MATERIAL SHALL MEET ALL THE MANDATORY REQUIREMENTS (AND SUPPLEMENTARY CHECKS, IF ASKED FOR) OF SPECIFIED SPECIFICATION, INDIAN BOILER REGULATIONS (IBR), AND RELEVANT

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	

	CODE/STANDARD. ALL NON-DESTRUCTIVE TESTING AS DETAILED AGAINST RELEVANT EQUIPMENT SHALL MEET THE REQUIREMENT OF ASTM SECTION 3 VOL. 3.03 OR EQUIVALENT BIS STANDARD
4	RAW MATERIAL FOR TUBES FOR WATER WALL, SUPERHEATER, REHEATER, ECONOMIZER, RISER, SUPPLY AND CONNECTING TUBES INCLUDING NOZZLE/STUBS, CONNECTIONS FOR DRUM, HEADERS, PIPE WORK ETC., SHALL BE SUBJECTED TO 100% UT PRIOR TO FABRICATION
5	a) Temperature > 400^{0}C and/ or pressure exceeding 71 bar ' 100% RT or UT on butt welds and full penetration branch welds. ' 100% MPE. b) Temperature > 175^{0}C up to 400^{0}C and/or pressure exceeding 17 bar adopt 71 bar ' 100% RT or UT on butt welds and full penetration branch welds for pipe diameter more than 100NB. ' 10% RT or UT on butt welds and full penetration branch welds for pipe diameter up to 100NB. ' 100% MPE.
6.	100% MPE or DPT for underground pipes and 10% MPE or DPT for above ground piping. RT for 10% of butt welds of underground piping.`
7.	

Valve size NB in mm	ANSI Class up to 300	ANSI Class above 300 up to 600	ANSI Class above 600 below 900	ANSI Class 900 and above but below 4500
Less than 50	Visual	Visual	Visual	MPE (for special class valves)
50 & above but below	Visual	Visual	MPE (for special class valves)	MPE and RT on10% of valves on 100% area
100 & above but less than 300	Visual	MPE	MPE and RT on 10% of valves on change of section and weld ends	MPE and RT on100% area
300 and above	MPE	MPE	MPE and RT on change of sections	MPE and RT on100% area

8.	a. The drum and all components which are to be subjected to fluid pressure shall be tested to minimum of 150% of the design pressure. The duration of the pressure tests shall be sufficient, as approved by the purchaser, to show any leakage paths and to permit a thorough examination of the component whilst under pressure. b. The temperature of the fluid used for the pressure test shall be such as to avoid any possibility of brittle fracture at a low temperature and the same shall be modified and submitted to the purchaser for approval, before commencing the test. c. The fluid used shall be of a sufficient purity and where relevant, suitable inhibits shall be used to avoid excessive corrosion and /or damage to temporary parts either during the test or prior to drying and cleaning.
9.	All compensating pads shall be provided with two-threaded weep holes to test welds at 0.5kg/cm^2 (g) with soap solution and no leakage shall be ensured.

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
10.	Chemical requirements: For T91: C- 0.08-0.12 wt%, Cr - 8.5wt% min , P-0.015 wt% max, S- 0.005 wt% max, Si-0.20-0.40 wt%, Ni– 0.2 wt% max , Al-0.02 wt% max, N-0.035-0.070 wt%, Cu-0.1 wt% max, As-0.010 wt% max, Sn-0.010 wt% max, Sb-0.003 wt% max, Pb-0.001 wt% max, C+N >0.12 wt%, As+Sn+Sb+Pb <0.015 wt%; N/AI ratio - 4 min. For T92: C- 0.08-0.12 wt% min, S – 0.005 wt% max, Si – 0.20 wt% max, Cb – 0.04 – 0.07 wt%, B – 0.001-0.004 wt%, N – 0.035-0.060 wt%, Ni – 0.2 wt% max Al – 0.02 wt% max, Cu – 0.1 wt% max, As – 0.010 wt% max, Sn – 0.010 wt% max, Sb – 0.003 wt% max, Pb – 0.001 wt% max C+N >0.12 wt%, As+Sn+Sb <0.015 wt%												
11.	For supercritical unit The design of all pressure parts (tubes, headers, separators, vessels etc.) shall meet the requirements of Indian Boiler Regulations (IBR).												

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.2	**BOILER WATER CIRCULATION PUMPS**												
1.0	**Raw Material Inspection**												
1.1	Casing Pump , Discharge nozzle, Heat Barrier, Motor frame (casing), pipes, Thrust bearing case,	Chemical, Mechanical, Heat treatment, Hardness, High temperate physical properties, UT	Critical	Review of TC	100%		Apart from mandatory and supplementary check of material specification. Approved Drawing/Datasheet	MTC	√	P	V	V	
1.2	Shaft, Stud bolt	Mechanical Properties, Chemical, Heat treatment, Impact, High temp physical, Run out, Dimension, DPT	Critical	Review of TC	100%		Apart from mandatory and Supplementary check of material specification. Approved Drawing/Datasheet	MTC	√	P	V	V	
1.3	Impeller	Mechanical Properties, Chemical, Heat treatment, Impact, High temp physical, Dimension, DPT	Critical	Review of TC	100%		Apart from mandatory and supplementary check of material specification. Approved Drawing/Datasheet	MTC	√	P	V	V	
2.0	**In Process Inspection**												
2.1	Welding Documents	WPS, PQR, Welder qualification	Major	Review	100%		ASME SECIX,IBR	WPS/PQR	√	P	V	V	
2.2	Butt welds on pressure parts for these pumps	NDT	Critical	UT or RT and MPE or DPT	100%		Approved Drawing/Datasheet	MTC	√	P	V	V	
3.0	**Final Inspection**												

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
3.1	Boiler water circulation pumps	a) Hydraulic Test b) Dimension	Critical	Measurement	100%		Approved Drawing/Datasheet	TC	√	P	W	W	The pump casing to be tested to minimum of 150% of the design pressure
		Performance	Critical	Measurement	100%		Approved Drawing/Datasheet	TC	√	P	W	W	
		Electrical checks like Winding Resistance, HV,IR	Critical	Measurement	100%		Approved Drawing/Datasheet	TC	√	P	W	W	
		NPSH test, Temp. rise test, under voltage test, function of pump at operating temp. & pressure and hot standstill & start test	Critical	Measurement	One no.		Approved Drawing/Datasheet	TC	√	P	W	W	Documents will be submitted for review and approval of the purchaser
1.3	**AIR PREHEATERS, STEAM COIL AIR PRE-HEATER AND FUEL OIL HEATERS**												
1.0	**In Process Inspection**												
1.1	Forged shafts like stub shaft, main rotor forging, housing hub	Mechanical Properties	Critical	UT at mill MPE	100%		Magnetic particle examination after machining.		√	P	W	W	
1.2	Critical welds of rotor	Mechanical	Critical	Radiography	100%				√	P	W	W	
	post	Properties											
2.0	**Final Inspection**												
2.1	Heating coils	Hydraulic pressure test	Critical	Measurement	100%		As per applicable standard		√	P	W	W	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
2.2	All pipes, valves, steam traps and mountings	hydraulic test	Critical	Measurement	100%		As called for under IBR, BS or other approved codes.		√	P	W	W	
1.4 SOOT BLOWERS													
1.0	**Raw Material Inspection**												
1.1	Casing, Tubes	Chemical & Mechanical, UT	Major	Review of TC	100%		Approved Drawing/Datasheet	MTC	√	P	V	V	
1.2	Welding Documents	WPS, PQR, Welder qualification	Major	Review	100%		ASME SECIX,IBR	WPS/PQR	√	P	V	V	
2.0	**In-Process Inspection**												
2.1	Soot blowers : Butt weld	NDT	Critical	Radiography	100%		Approved Drawing/Datasheet	TC	√	P	V	V	Review of RT Films
2.2	Leakage Test	Hydraulic	Critical	Measurement	100%		Approved Drawing/Datasheet	TC	√	P	W	W	
3.0	**Final Inspection**												
3.1	Soot blowers	Operational checks & Dimension	Critical	Measurement	100%		Approved Drawing/Datasheet	TC	√	P	W	W	For Long tube travel, closing and opening time and current drawn
1.5 ID, FD AND PA FANS: ROTATING PARTS & STATIONARY PARTS													
1.0	**Raw Material Inspection**												
1.1	Shaft, Hub, Impeller, Blades, Disc, Servo motor, Bearing Housing, Static Parts	Chemical & Mechanical Properties, HT & NDT(UT)	Major	Review of TC	100%		Approved Drawing/Datasheet	TC	√	P	V	V	
2.0	**In-Process Inspection**												

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
2.1	Rotor components	NDT	Critical	MPI/PT	100%		Approved Drawing/Datasheet	TC	√	P	W	W	
2.2	WPS, PQR, welder qualification PWHT Shaft dimension, Impeller assembly & bearing housing dimensions, Balancing, Blades moment sorting, blade natural frequency test	Visual, Dimensional, Balancing	Critical	Review/ Measurement	100%		Approved Drawing/Datasheet	TC	√	P	V	V	
2.3	Function test – for shaft with bearing assembly for temp rise, Impeller assembly with servomotors for blade shaft movement, assembly of blades- no fouling at fully close condition, Static parts assembly- dimensions	Functional Test	Critical	Measurement	100%		Approved Drawing/Datasheet	TC	√	P	W	W	
2.4	Butt welds in Rotor components	NDT	Major	UT/ MPE	100%		UT for Butt welds All welds MPE after stress relief.		√	P	W	W	
3.0	**Final Inspection**												
3.1	Hydraulic coupling of ID fan	Operational checks String test for coupling to check temperature	Critical	Measurement	One fan assembly		Approved Drawing/Datasheet	TC	√	P	W	W	Dry run test to be carried out during string test.

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		rise, smooth operation, vibration and noise level											
1.6	**COAL MILLS**												
1.0	**Raw Material Inspection**												
1.1	Shaft, coupling, gears and pinions, top and bottom races and other rotating components Plates, casting like bearing housing, forgings, gear box	Chemical & Mechanical, HT, NDT(UT)	Critical		100%		Approved Drawing/Datasheet	MTC	√	P	V	V	
2.0	**In Process Inspection**												
2.1	Butt welds in body casing and separator of mill	NDT	Major	RT/ MPE/ DPT	100%		RT for Butt welds All welds MPE or DPT		√	P	W	W	
2.2	WPs, PQR, Welder qualification Dimensions, NDT-RT on butt weld, PMI after machining	Visual, Dimensional, NDT	Critical	Review/ Measurement	100%		Approved Drawing/Datasheet	TC	√	P	V	V	
3.0	**Final Inspection**												
3.1	Gearboxes	Operational checks Check rise in oil temperature, noise level and vibration.	Critical	Measurement	100%		Approved Drawing/Datasheet	TC	√	P	W	W	Check for leak tightness of gear case also to be done.
3.2	Burner Assembly	Assembly	Critical	Measurement	100%		Approved Drawing/Datasheet	TC	√	P	W	W	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
3.3	Trial assembly of mill & No load trial run	No Load Trial	Critical	Measure ment	At least one no.		Approved Drawing/Datasheet	TC	√	P	W	W	
1.7	**COAL FEEDERS**												
1.0	**Raw Material**												
1.1	Plates, Pipes, Forging etc.	Chemical & Mechanical, NDT, Properties	Major	Review of TC	100%		Approved Drawing/Datasheet	TC	√	P	V	V	
1.2	Welding Documents	WPS, PQR, Welder qualification	Major	Review	100%		ASME SEC IX	WPS/PQ R	√	P	V	V	
2.0	**In-Process Inspection**												
2.1	Welds in the casing and pulley fabrication	NDT	Major	MPE RT on Butt Joints	100%		Approved Drawing/Datasheet	TC	√	P	V	V	Review of RT Films
3.0	**Final Inspection**												
3.1	Feeder casing Leak tightness check, endurance test for Load,, Dimension, Feeder body hydro test, gear box run test, dimension, function performance & calibration test	Visual, Dimensional, Functional	Major	Measure ment	100%		Approved Drawing/Datasheet	TC	√	P	W	W	
1.8	**BOILER STRUCTURE, DUCTS, HOPPERS, DAMPERS ETC.**												
1.0	**Raw Material Inspection**												
1.1	Plates, casting, forging, tubes/ pipes, rounds, belts	Mechanical Properties, chemical, HT, UT	Major	Review of TC	100%		Approved Drawing/Datasheet	TC	√	P	V	V	
2.0	**In Process Inspection**												

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
2.1	Welding Documents	WPS, PQR, Welder qualification	Major	Review	100%		ASME SEC IX	WPS/PQR	√	P	V	V	
2.2	Butt and fillet welds for built up plate girders	NDT	Critical	MPE	100%		Approved Drawing/Datasheet	TC	√	P	W	W	
2.3	Butt welds in body casing and separator of mill	NDT	Major	a. RT/ UT b. MPE c. MPE/ DPT	a. 100% b. 100% c. 10%		a. RT or UT for Butt welds of thickness 32mm and above b. For thickness below 32mm and up to 25mm c. For thickness below 25mm	TC	√	P	W	W	
3.0	**Final Inspection**												
3.1	Dimension, Trial assembly, NDT (RT & DPT)	Visual, Dimensional & NDT	Critical	Measurement/Visual	100%		Approved Drawing/Datasheet	TC	√	P	W	W	
3.2	Dampers	Operational checks	Critical	MEASUREMENT	One no. each type and size offered		Gas tight dampers for shop leakage test to demonstrate the guaranteed tightness		√	P	W	W	In case such type test is already done, reports of the same to be submitted for review
1.9	**Electro- Static Precipitators (ESPs)**												
1.0	**IN PROCESS INSPECTION**												
1.1	All welds in ESP structure	Mechanical properties	Critical	MPE	100%		Visual check in accordance with AWS D.1.1		√	P	W	W	
1.2	Butt and fillet welds for built up plate columns	Mechanical properties	Critical	MPE	100%		Visual check in accordance with AWS D.1.1		√	P	W	W	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.3	Butt welds	Mechanical properties	Critical	Radiography	100%		Visual check in accordance with AWS D.1.1		√	P	W	W	
1.4	Tension flange (bottom flange) welds of all beams & columns	Mechanical properties	Critical	Radiography	100%		The minimum length of welds for spot radiography and acceptance criterion shall be as per AWS D 1.1		√	P	W	W	Spot radiography on all joints in compression n flange (top flange)
2.0	**FINAL INSPECTION**												
2.1	Discharge & collecting electrodes	Work test (for the wire type electrodes)	Major	Measurement	100%		• Chemical and tensile test • Metallographic • Surface purity from chloride ions • Spring back and surface finish after coiling (applicable to helical discharge electrodes		√	P	W	W	
2.2	Collecting electrodes and rigid discharges electrode	Work tests	Major	Measurement	100%		• Chemical and mechanical properties • Profile and straightness • Cupping test for deep drawn sheets		√	P	W	W	
NOTE -													
1	INSPECTION / NDT / TEST CERTIFICATE / REPORT FOR UT, MPI, BALANCING, PRESSURE TEST SHALL INDICATE REFERENCE OF ITEM SERIAL NUMBER & MODEL FOR CO-RELATION.												
2	MATERIAL TEST CERTIFICATE / REPORT FOR TEST SUCH AS CHEMICAL & MECHANICAL TEST ETC. SHALL INDICATE REFERENCE OF ITEM SERIAL NUMBER & ENGINE MODEL FOR CO-RELATION AS PER SAMPLING NORMS.												
2. STEAM TURBINE GENERATOR AND AUXILIARIES													
2.1 Steam Turbine - High Pressure (HP) and Intermediate pressure (IP) Enclosures													
1.0 Raw Material Inspection													

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.1	Casting material	Chemical properties, Heat Treatment.	Major	Chemical composition, Review of HT charts, Defectogram etc.	100%		OEM Standard	MTC	√	P	V	V	Creep data in case of New or Non-established vendor
1.2	Test pieces of the material and condition of the casting	Chemical & Mechanical properties, Micro structure	Critical	Chemical & Mechanical testing	100%		OEM Standard	MTC	√	P	W	W	
2.0	**In Process Inspection**												
2.1	Casting material	Final NDT after HT	Critical	MPE	100%		OEM Standard & NDE plan	MTC	√	P	W	W	Both inside & outside surface
			Critical	UT or RT	100%			MTC	√	P	W	W	
2.2	Welds of stub pipes and transition pieces to the main body of an enclosure	NDT	Critical	RT and MPE or DPT RT/UT/MPE of finished welds	100%		OEM Standard & NDE plan	MTC	√	P	V	V	After stress relieving
2.3	Casting material	Dimensional control, Hardness survey	Critical	Dimension check, UT, Hardness check	100%		OEM Standard	MTC	√	P	W	W	
2.4	Casting material-machining	Machining of Horizontal Joint surface, Groves & other parts	Critical	Dimension check	100%		OEM Standard	MTC	√	P	W	W	Random for Customer
3.0	**Final Inspection**												

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
3.1	Cast enclosure	Hydraulic Test	Critical	Measure ment	100%		OEM Standard	TC	√	P	W	W	
3.2	Cast enclosure	Box up of upper & lower half(Contact check)	Critical	Measure ment	100%		OEM Standard	TC	√	P	W	W	
2.2 Steam Turbine - Low pressure (LP) enclosures (fabricated)													
1.0	**Raw Material Inspection**												
1.1	Plates, Piping & Fittings, Casing Casting (if applicable)	Chemical, Mechanical & NDT	Major	TC Review	100%		Approved Drawing/Datasheet	MTC	√	P	V	V	Co-related MTC from approved sources, UT more than 25mm for Plates
2.0	**IN PROCESS INSPECTION**												
2.1	Welds of an enclosure	Stress Relieving after completion of all welding	Major	Heat Treatment	100%		OEM Standard	IR	√	P	V	V	
		Welding & NDT	Critical	RT and MPE or DPT RT/UT/MPE of finished welds	100%		OEM Standard	IR	√	P	V	V	See Note 3 for NDT, Welding as per approved WPS/PQR/WTQ
3.0	**Final Inspection**												
3.1	Fabricated enclosure	Hydraulic Test	Major	Mech. Tests /Measure ment	100%		OEM Standard	IR/TC	√	P	W	W	After stress relieving

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		Box up of upper & lower half (Contact check)	Critical	Measure ment	100%		OEM Standard	IR/TC	√	P	W	W	
		Visual & Dimensional	Critical	Visual, Measure ment	100%		Approved drawing/datasheet	IR/TC	√	P	W	W	
2.3	**TURBINE ROTORS - FORGING AND COMPLETE ROTOR**												
1.0	**Raw Material Inspection**												
1.1	Forging material	Chemical properties, Heat Treatment,	Major	Chemical composition, Review of HT charts etc.	100%		OEM Standard	MTC	√	P	V	V	Creep data in case of New or Non-established vendor
1.2	Test pieces of the material	Chemical & Mechanical Properties, Microstructure	Critical	Chemical & Mechanical testing	100%		OEM Standard	MTC	√	P	W	W	
1.3	Forging material	Overlay Welding & its NDT	Critical	WPS/PQR review	100%		OEM Standard	MTC	√	P	V	V	
1.4	Forging material	NDT	Critical	UT	100%		OEM Standard & NDE Plan	MTC	√	P	W	W	
2.0	**In Process Inspection**												
2.1	Rotor Welds, if applicable	NDT	Critical	RT and MPE or DPT	100%		OEM Standard & NDE Plan	MTC	√	P	W	W	Ultrasonic examination with normal and angular probes of the weld • Run out of rotor before and after welding • MPE on finish welds

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
													• Hardness survey on the welds • Stress relieve annealing
				RT/UT/MPE of finished welds									
2.2	Forging material	Residual Stress Measurement	Major	Residual Stress	100%		OEM Standard	TC/IR	√	P	W	W	
2.3	Forging material	Machining of Shaft	Critical	Measurement	100%		Approved drawing/datasheet	TC/IR	√	P	W	W	Witness of Critical dimensions
3.0	**Final Inspection**												
3.1	HP and IP rotor forgings	Thermal stability tests	Critical	Measurement	100%		OEM Standard	TC/IR	√	P	W	W	Thermal stability of the rotors in service and at over speed
3.2	Each Rotor	NDT on Journal areas	Critical	MPE	100%		OEM Standard	TC/IR	√	P	W	W	After final machining and before gashing on other areas
3.3	Each Rotor	Blades Assembly (Throat check, Blade to blade at Shroud & Root)	Critical	Measurement	100%		Approved drawing/datasheet	TC/IR	√	P	W	W	Random check by Customer
3.4	Complete Rotor	i) Axial & radial run-outs before and	Critical	Measurement	100%		OEM Standard/Technical Specification		√	P	W	W	See Note 4

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		after blading and after over speed tests. ii) dynamically balancing at rated speed iii) An over speed test to withstand over speed of 120% for five continuous minutes or 125% for two continuous minutes. iv) Vibration tests to determine natural frequencies in various vibration modes to ensure that the ranges are outside operating frequencies v) Lock Blade Lift check											
2.4 TURBINE ROTORS – STATOR AND ROTOR BLADES AND SHROUD BANDS													
1.0	**Raw Material Inspection**												

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.1	Blades Material Each bar stock	Chemical & Mechanical Properties, Heat Treatment, Hardness	Critical	Measurement	100%		OEM Standard/Technical Specification	MTC	√	P	V	V	Creep data in case of New or Non-established vendor
		Mechanical properties, chemical composition, and microstructure	Critical	Measurement	Per Heat/Batch		OEM Standard	MTC	√	P	W	W	On softest & Hardest Bar
1.2	Each bar stock	NDT	Critical	UT	100%		OEM Standard	MTC	√	P	V	V	Random check by Customer
2.0	**In Process Inspection**												
2.1	Erosion shield and blade joint	NDT	Critical	Radiography, Visual check PT	100%		OEM Standard	IR/TC	√	P	W	W	Shall be done prior to fitting to the wheel and after over speed tests
2.2	Shroud bands after punching and after riveting	NDT	Critical	DPT	100%		OEM Standard	IR/TC	√	P	W	W	Random check by Customer
3.0	**Final Inspection**												
3.1	Dimensional Inspection after machining & polishing	Dimensions check (Total Length, Throat, Min. & Max. Thickness etc.)	Critical	Measurement	100%		OEM Standard	IR/TC	√	P	W	W	Random check by Customer
3.2	Machined Blades	NDT	Critical	MPI	100%		OEM Standard	IR/TC	√	P	W	W	Random check by Customer
3.3	Moving blades of over 225mm active length	Moment weighed	Critical	Measurement	100%		OEM Standard	IR/TC	√	P	W	W	Random check by Customer

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
3.4	LP turbine blades	Natural Frequency Test	Critical	Measure ment	100%		OEM Standard	IR/TC	√	P	W	W	Random check by Customer
3.5	Cast blades (if provided)	Chemical analysis and mechanical properties, Heat Treatment, NDT	Critical	Measure ment	100%		OEM Standard	IR/TC	√	P	W	W	Random check by Customer, Note-5
2.5 DIAPHRAGMS													
1.0	**Raw Material Inspection**												
2.0	**In-Process Inspection**												
2.1	Welded and Fabricated diaphragms	NDT	Critical	UT/ MPE	100%		OEM Standard	MTC	√	P	V	V	
3.0	**FINAL INSPECTION**												
2.6 EXHAUST HOOD													
1.0	**Raw Material Inspection**												
1.1	Castings, Plates (if fabricated construction)	Chemical analysis and mechanical properties	Major	Review of TC	100%		As per drawing/datasheet	MTC	√	P	V	V	
2.0	**In-Process Inspection**												
2.1	Butt welds of Fabricated construction (if provided)	NDT	Critical	RT/ DPT	10%/ 100%		OEM Standard	TC/IR	√	P	V	V	
3.0	**Final Inspection**												
3.1	Finished hood	Pressure test	Critical	Measure ment	100%		As per drawing/datasheet		√	P	W	W	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
3.2	Exhaust hood parting planes	Blue matching	Critical	Measure ment	100%		As per applicable standard		√	P	W	W	
2.7 STOP, CONTROL AND BYPASS VALVES, ACTUATORS/ SERVO-MOTORS AND STEAM STRAINERS													
1.0	**Raw Material Inspection**												
1.1	Raw material of valve body, bonnet, valve disc, seat & spindle	Chemical & Mechanical properties, Heat Treatment, NDT,IBR Forms	Major	Review of TC	100%		Approved drawing/ datasheet, OEM Standard	MTC	√	P	V	V	Creep data in case of New or Non-established vendor
2.0	**In Process Inspection**												
2.1	Stellited and nitrided areas of components and on stellite components in the finish ground or honed condition	NDT	Major	Visual check/ DPT	100%		OEM Standard	TC/IR	√	P	V	V	Random check for Customer
2.2	Valve body and bonnet castings or forgings	Mechanical properties	Critical	RT/ UT MPE	100%		Body and bonnet shall also be subjected to 100% MPE on entire surface		√	P	W	W	
2.3	All pressure containing welds in body and bonnet	NDT	Critical	RT/ UT, MPE	100%		OEM Standard	TC/IR	√	P	V	V	Random check for Customer
2.4	Bar stock of 50 mm and above size for valve stem	NDT	Critical	UT, MPE/ DPT	100%		OEM Standard	TC/IR	√	P	V	V	Random check for Customer
3.0	**Final Inspection**												

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
3.1	Each valve body and bonnet	Pressure test, Seat Leakage Test	Critical	Measure ment	100%		As per drawing/ datasheet/ IBR requirements (if applicable)	TC/IR	√	P	W	W	At min.1.5 times the max. working pressure after applying temp. corrections for min. 30 minutes
3.2	All the actuating cylinders and servomotors	Operational checks	Critical	Measure ment	100%		Approved drawing/ datasheet, Manufacturer Standard	TC/IR	√	P	W	W	
3.3	Functional Testing with Actuator	Operational checks	Critical	Measure ment	100%		Approved drawing/ datasheet, Manufacturer Standard	TC/IR	√	P	W	W	
2.8	**CAST AND FORGED STEEL COMPONENTS**												
1.0	**Final Inspection**												
1.1	LP casing- in case of cast design, inlet, extraction and exhaust connections, shaft seal covers and rings, governor shaft, breach nut, threaded ring, angle ring, U- ring, servomotor parts such as body, piston, cover, yokes; turning gear casing	Chemical analysis and mechanical	Major	Measure ment	100%		Approved drawing/ datasheet, Manufacturer Standard	MTC	√	P	V	V	Including other items
2.9	**BOLTS AND NUTS FOR PRESSURE RETAINING ENCLOSURES AND ROTOR COUPLINGS**												
1.0	**Raw Material**												

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.1	Bar stock for bolts	Chemical & Mechanical, NDT	Major	Review of TC	100%		Approved drawing/ datasheet, Manufacturer Standard	MTC	√	P	V	V	
2.0	**Final Inspection**												
2.1	Finish machined bolts	NDT	Major	MPE or DPT	100%			TC/IR	√	P	V	V	
		Visual & Dimensional	Major	Measure ment	100%			TC/IR	√	P	V	V	
2.10	**GOVERNING AND PROTECTION SYSTEM EQUIPMENT**												
1.0	**FINAL INSPECTION - Electro-hydraulic controller, hydraulic amplifier, hydraulic controller, electro hydraulic convertors, hydraulic convertors, hydraulic speed governor, trip devices etc.**												
1.1	Pressure retaining parts	Hydraulic testing	Critical	Measure ment	100%		Approved drawing/ datasheet, Manufacturer Standard	TC/IR	√	P	W	W	
1.2	All the main assemblies and sub-assemblies	Functional test	Critical	Measure ment	100%			TC/IR	√	P	W	W	
1.3	All control equipment	Rig testing	Critical	Measure ment	100%			TC/IR	√	P	W	W	
1.4	Nitrided, stellite components in the finish ground	NDT, Hardness properties	Critical	DPT, Hardness	100%			TC/IR	√	P	W	W	
2.11	**INSPECTION OF COMPLETED TURBINE**												
2.11.1	**HP and IP turbines**												
1.0	**Final Inspection**												
1.1	Complete turbine	Various checks and measurement:	Critical	Measure ment	100%		OEM Standard/ Technical Specification/approved drawing & datasheet	TC/IR	√	P	W	W	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		▪ Clearance between shaft seal casing and shaft seal ring ▪ Clearance in anti- rotational device in shaft seal casing joint ▪ Axial and radial alignments of inner and outer casings ▪ For radial and axial blade clearances in blading section ▪ For axial and radial clearances in shaft seal ▪ Min. axial clearances and min. radial clearances in completely assembled steam turbine ▪ Alignment of over speed governor ▪ Axial distances for shroud bands for casings											
1.2	Steam turbine	No load running test	Critical	Measurement	100%		OEM Standard/ Technical Specification	TC/IR	√	P	W	W	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
	control and emergency control equipment												
1.3	Pre- dispatch inspections	Visual including clearance check for transportation device	Major	Measure ment	100%		OEM Standard/ Technical Specification	TC/IR	√	P	V	V	
2.11 INSPECTION OF COMPLETED TURBINE													
2.11.1 HP and IP turbines													
1.0	**Final Inspection**												
1.1	Complete turbine	Various checks and measurement: • radial and axial blade clearance in blading section • min. axial clearances and min. radial clearances in completely assembled steam turbine • alignment of stationary blade carriers	Critical	Measure ment	100%		OEM Standard/ Technical Specification/approved drawing & datasheet	TC/IR	√	P	W	W	
1.2	Steam turbine control and emergency control equipment	No load running test	Critical	Measure ment	100%		OEM Standard/ Technical Specification	TC/IR	√	P	W	W	
1.3	Pre- dispatch inspections	Visual including clearance check for	Major	Measure ment	100%		OEM Standard/ Technical Specification	TC/IR	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		transportation device											
2.12	**INTEGRAL AUXILIARIES OF STEAM TURBINE**												
1.0	**Raw Material - Bearing Pedestals, Housings And Bearings**												
1.1	Bearing Pedestal, Housings & Bearings	Chemical & Mechanical properties, NDT	Major	Review of TC	100%		Approved Drawing/Datasheet	MTC	√	P	V	V	
2.0	**In-Process Inspection**												
2.1	Pedestals	Leakage test	Critical	Measure ment	100%		OEM/Manufacturer's standard	TC/IR	√	P	V	V	
2.2	Butt Welds (for fabricated pedestals and housing)	NDT	Critical	RT or UT	10%		OEM/Manufacturer's standard	TC/IR	√	P	V	V	after stress relieving
2.3	Bearing shell	NDT	Critical	RT or UT	100%		OEM/Manufacturer's standard	TC/IR	√	P	V	V	
3.0	**Final Inspection**												
3.1	Bearing oil inlet piping and jacking oil piping	Hydraulic Test	Major	Measure ment	100%		OEM/Manufacturer's standard	TC/IR	√	P	V	V	
3.2	UT & DPT of bonding of lining to Shell/Liner & Thrust Bearing Pads	NDT	Critical	UT & DPT	100%		OEM/Manufacturer's standard	TC/IR	√	P	W	W	
3.3	Parting Plane tightness check	Feeler Gauge tightness of parting planes of bearing shell	Major	Measure ment	100%		OEM/Manufacturer's standard	TC/IR	√	P	V	V	
3.4	Colour Contact	Colour contact of joint plane for Journal	Major	Measure ment	100%		OEM/Manufacturer's standard	TC/IR	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		bearing/combined Thrust & Journal bearing											
3.5	Visual & Dimensional	Verification of Dimension & Visual inspection	Major	Measure ment	100%		OEM/Manufacturer's standard	TC/IR	√	P	V	V	
2.12.1 Lubricating oil, jacking oil and control oil systems													
2.12.1.1 Pumps													
1.0	**Raw Materials - Bearing pedestals, housings and bearings**												
1.1	Pumps Impeller, Shaft, Casing	Chemical & Mechanical Properties, NDT	Major	Review of TC	100%		Approved drawing/datasheet	MTC	√	P	V	V	
2.0	**In-process Inspection**												
2.1	Oil pump shaft	NDT	Critical	UT	100%		OEM/Manufacturer's Std.	TC/IR	√	P	V	V	
2.2	Pump impeller	NDT	Critical	MPE or DPT	100%		OEM/Manufacturer's Std.	TC/IR	√	P	V	V	
		Over speed test, if applicable for Main Oil Pump	Critical		100%		OEM/Manufacturer's Std.	TC/IR	√	P	V	V	
		Impeller Balancing	Critical	Balancing	100%		OEM/Manufacturer's Std.	TC/IR	√	P	V	V	
2.3	Pump casing	Hydraulic pressure test	Major	Measure ment	100%		Approved drawing/datasheet	TC/IR	√	P	V	V	
3.0	**FINAL INSPECTION**												
3.1	Pumps	Performance Test	Critical	Measure ment	100%		Approved drawing/ datasheet, OEM/ Manufacturer's Std.	TC/IR	√	P	V	V	
3.2	Coolers and	Pressure test(Tube & Shell side)	Critical	Measure ment	100%		Approved drawing/datasheet,	TC/IR	√	P	W	W	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
	lubricating oil tanks												
3.3	Atmospheric tanks	Performance (leakage test) By water fill test for at least 12 hrs.	Critical	Measure ment	100%		Approved drawing/datasheet,	TC/IR	√	P	W	W	
3.4	Functional Test of Lube Oil Skid	Skid Functional Test for Pump discharge, Pressure, Noise, Vibration & current	Critical	Measure ment	100%		Approved drawing/datasheet, OEM/Manufacturer's Std.	TC/IR	√	P	W	W	
2.12.1.2 Oil purifiers													
1.0	**Raw Materials**												
1.1	Major components like Bowl Body, Bowl Hood, Top Disc, Distributor, Shafts, Impeller etc.	Chemical & Mechanical properties	Major	Review of TC	Per Heat/Batch		Manufacturer 'Standard	TC/IR	√	P	V	V	
2.0	**Final Inspection**												
2.1	All pressure parts	Hydraulic Pressure test	Critical	Measure ment	100%		Approved drawing /datasheet, OEM/ Manufacturer's Std.	TC/IR	√	P	V	V	
2.2	Bowl Complete	Unbalance	Major	Balancing	100%		Manufacturer's Standard	TC/IR	√	P	V	V	
2.3	Complete purifier	Performance Test at manufacturer's works for capacity, mechanical running, sequential operation and interlocks,	Critical	Measure ment	100%		Approved drawing/ datasheet, OEM/ Manufacturer's Std.	TC/IR	√	P	W	W	See Note 6

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		moisture content, vapour tightness, vibration, noise level, quality improvements etc.											
2.4		Particle Size at Inlet & Outlet of Centrifuge	Critical	Measure ment	01/Type		Approved drawing/ datasheet, OEM/ Manufacturer's Std.	TC/IR	√	P	W	W	
2.13.4 Boiler Feed Pumps													
2.13.4 Boiler Feed Pumps													
1.0	**Raw Material**												
1.1	Barrel casing, casing cover, suction & discharge branches, shaft, Impeller, Diffusers ring sections, and wearing rings	Chemical & Mechanical Properties, Heat Treatment & NDT	Major	Review of TC	100%		Approved Drawing/ Datasheet	MTC	√	P	V	V	
2.0	**In-Process Inspection**												
2.1	On machined components	NDT	Critical	DPT	100%		Manufacturer Standard	MTC	√	P	V	V	
2.2	Rotor Assembly	Runout Checking Dynamic Balancing	Critical	Measure ment	100%		Manufacturer Standard, Relevant Std.	TC/IR	√	P	W	W	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
2.3	Pump Assembly	Radial & Axial Running Clearances	Critical	Measure ment	100%		Drawing, Manufacturer Standard.	TC/IR	√	P	W	W	
3.0	**Final Inspection**												
3.1	On barrel casing, discharge cover, and suction and discharge branches	Hydraulic testing	Critical	Measure ment	100%		Drawing/Datasheet	TC/IR	√	P	W	W	
3.2	Overall Visual & Dimensional Check	Visual & Dimensional	Critical	Measure ment	100%		Drawing/Datasheet	TC/IR	√	P	W	W	
3.3	Complete unit	Operation and performance testing -Performance testing as per Hydraulic Institute Standards (HIS) to determine its characteristic curve at design speed and to ensure compliance with design requirement. - Vibration to be Measured in transverse, horizontal and vertical direction at all measuring points	Critical	Measure ment	100%		Drawing/Datasheet/Technical Specification, Manufacturer Standard, HIS/ASME	TC/IR	√	P	W	W	Tests shall be carried out with loop water at specified design temperature. Soften quality water shall be used for the performance testing

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		· Noise Level as per HIS. -Strip down test											
2.13.4.2 Booster pump													
1.0	**Raw Materials**												
1.1	Casing, Casing cover, Shaft, Impeller, and wearing rings	Chemical & Mechanical Properties, Heat Treatment & NDT	Major	Review of TC	100%		Approved Drawing/Datasheet	MTC	√	P	V	V	
2.0	**In-process Inspections**												
2.1	On machined components	NDT	Critical	DPT	100%		Manufacturer Standard	MTC	√	P	V	V	
2.2	Rotor Assembly	Runout Checking	Critical	Measurement	100%		Manufacturer Standard, Relevant Std.	TC/IR	√	P	W	W	
2.3	Pump Assembly	Radial & Axial Running Clearances, Dimensional	Critical	Measurement	100%		Drawing, Manufacturer Standard,	TC/IR	√	P	W	W	
3.0	**Final Inspection**												
3.1	On pump casing	Hydraulic testing	Critical	Measurement	100%		Drawing, Manufacturer Standard,		√	P	W	W	
3.2	Impeller and completed rotor assembly	dynamic balancing test	Critical	Measurement	100%		Manufacturer Standard, Relevant Std.		√	P	W	W	
3.3	Complete unit	Operation and performance testing	Critical	Measurement	100%		Drawing/Datasheet/Technical Specification, Mfg. Std., HIS/ASME	TC/IR	√	P	W	W	Tests shall be carried out with loop water at specified design temperature. Soften quality water shall

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		Performance testing as per (HIS) to determine its characteristic curve at design speed and to ensure compliance with design requirement. Vibration to be Measured in transverse, horizontal and vertical direction at all measuring points Noise Level as perHIS. Strip down test											be used for the performance testing
2.13.4.2 Booster pump													
1.0	**Raw Materials Inspections**												
1.1	Casing, Casing cover, Shaft, Impeller, and wearing rings	Chemical & Mechanical Properties, Heat Treatment & NDT	Major	Review of TC	100%		Approved Drawing/Datasheet	MTC	√	P	V	V	
2.0	**In-process Inspections**												
2.1	On machined components	NDT	Critical	DPT	100%		Manufacturer Standard	MTC	√	P	V	V	
2.2	Rotor Assembly	Runout Checking	Critical	Measure ment	100%		Manufacturer Standard, Relevant Std.	TC/IR	√	P	W	W	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
2.3	Pump Assembly	Radial & Axial Running Clearances, Dimensional	Critical	Measure ment	100%		Drawing, Manufacturer Standard,	TC/IR	√	P	W	W	
3.0	**Final Inspection**												
3.1	On pump casing	Hydraulic testing	Critical	Measure ment	100%		Drawing, Manufacturer Standard,		√	P	W	W	
3.2	Impeller and completed rotor assembly	dynamic balancing test	Critical	Measure ment	100%		Manufacturer Standard, Relevant Std.		√	P	W	W	
3.3	Complete unit	Operation and performance testing Performance testing as per (HIS) to determine its characteristic curve at design speed and to ensure compliance with design requirement. Vibration to be measured in transverse, horizontal and vertical direction at all measuring points Noise Level as perHIS.	Critical	Measure ment	100%		Drawing/Datasheet/Technical Specification, Mfg. Std., HIS/ASME	TC/IR	√	P	W	W	Tests shall be carried out with loop water at specified design temperature. Soften quality water shall be used for the performance testing

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		Strip down test											
2.13.4.3 Gear box and hydraulic coupling													
1.0	**Raw Materials**												
1.1	Gears, pinions, wheels and shafts	Chemical & Mechanical Properties, NDT, Hardenability Test	Major	Review of TC	100%		Drawing, Manufacturer Standard	MTC	√	P	V	V	
2.0	**In-process Inspection**												
2.1	Gears, pinions, wheels and shafts	NDT on machined components	Major	PT/MPT	100%		Manufacturer Standard	TC/IR	√	P	V	V	
2.2	Assembled rotating component	Dynamic balancing test	Critical	Measure ment	100%		Manufacturer Standard	TC/IR	√	P	V	V	
3.0	**Final Inspection**												
3.1	Gear box Assembly	Full load speed and back to back locked rotor torque test	Critical	Measure ment	01 Gear Box/ Model		Manufacturer Standard	TC/IR	√	P	W	W	
		Visual & Dimensional Static Tooth Contact, Backlash	Critical	Measure ment	100%		Manufacturer Standard	TC/IR	√	P	W	W	
		Mechanical Run Test	Critical	Measure ment	100%		Manufacturer Standard, AGMA Std.	TC/IR	√	P	W	W	
3.2	Hydraulic Coupling Assembly	Visual & Dimensional	Critical	Measure ment	100%		Approved Drawing	TC/IR	√	P	W	W	
		Performance test at No-Load	Critical	Measure ment	100%		Manufacturer Standard	TC/IR	√	P	W	W	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
2.13.5 Condensate Extraction Pumps (CEPs)													
2.13.5.1 Pump													
1.0	**Raw Materials**												
1.0	Casings, Diffuser, Shafts, Impeller	Chemical & Mechanical Properties, Heat Treatment, NDT	Major	Review of TC	100%		Approved Drawing/Datasheet	MTC	√	P	V	V	
2.0	**In-Process Components**												
2.1	Machined components	NDT	Major	PT/MPI	100%		Manufacturer Standard	TC/IR	√	P	V	V	
2.2	Pump shaft	NDT Runout	Major	UT Measurement	100%		Manufacturer Standard	TC/IR	√	P	V	V	
2.3	Pump Impeller	NDT	Major	RT	100%		Manufacturer Standard	TC/IR	√	P	V	V	Review of RT Films
2.4	Butt welds on fabricated components of thickness more than 10 mm	NDT	Major	RT	10%		Manufacturer Standard	TC/IR	√	P	V	V	Review of RT Films
2.5	Welds on Casing, suction bell, shaft, impeller and fabricated components	NDT	Major	DPT	100%		Manufacturer Standard	TC/IR	√	P	V	V	
3.0	**Final Inspection**												
3.1	On pump casing and pressure containing fabricated parts	Hydraulic testing	Critical	Measurement	100%		Drawing/Datasheet, Manufacturer Standard	TC/IR	√	P	W	W	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
3.2	Individual Impeller and completed rotor assembly	Dynamic balancing Test, Runout	Critical	Measure ment	100%		Manufacturer Standard, Relevant Std.	TC/IR	√	P	W	W	
3.3	Complete unit	Operation and performance testing • Performance testing as per Hydraulic Institute Standards (HIS) to determine its characteristic curve at design speed and to ensure compliance with design requirements • Vibration to be Measured in transverse, horizontal and vertical direction at all measuring points Noise Level as per HIS. Strip down test	Critical	Measure ment	100%		Drawing/Datasheet/Technic al Specification, Manufacturer Standard, HIS	TC/IR	√	P	W	W	Tests shall be carried out using cold soften quality water.
2.13.6 Condensate Polishing Unit (CPU)													
2.13.6.1 CPU service vessels													
1.0	**RAW MATERIAL**												

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.1	Plates for Shell & Dish Ends, Pipes	Chemical & Mechanical, HT & NDT	Major	Review of TC	100%		Approved drawing/datasheet	MTC	√	P	V	V	UT for plates thickness more than 25mm
1.2	Rubber	Chemical & Mechanical	Major	Review of TC	100%		Approved drawing/datasheet, Mfg. Std.	MTC	√	P	V	V	
2.0	**In-Process Inspection**												
2.1	Finished and formed dished ends and hemi heads	NDT Knuckle portion shall be checked by 100% MPE or DP test	Critical	DP/ MPE	100%		Manufacturer Standard	MTC	√	P	V	V	
2.2	Butt welds full penetration joints and nozzle welds	NDT	Critical	RT & MPE or DPT	100%		Manufacturer Standard	MTC	√	P	V	V	Review of RT Films
2.3	Rubber lining	Mechanical Properties (Tests as per IS-4682 part-I) • Tensile & Elongation, Specific Gravity, Ash content • Adhesion test • Shore hardness test • Ozone resistance test: (50 PPHM) / 40° C / 20 % Strain /70 hrs.	Critical	Measure ment	100%		Technical Specification, Relevant std.	TC/IR	√	P	V	V	Water Absorption Test, After ageing test & Compression Set test

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		' Water Absorption Test .Spark Test											
3.0	**FINAL INSPECTION**												
3.1	Fabricated vessel	Hydraulic testing	Critical	Measure ment	100%		Drawing/datasheet, Manufacturer Standard	TC/IR	√	P	W	W	
3.2	Visual & Dimensional	Dimensional Conformity	Critical	Measure ment	100%		Drawing/datasheet	TC/IR	√	P	W	W	
2.13.6.2 Acid/ Alkali Handling Tanks													
1.0	**Raw Materials**												
1.1	Plates for Shell & Dish Ends, Pipes	Chemical & Mechanical, HT & NDT	Major	Review of TC	100%		Approved drawing/datasheet	MTC	√	P	V	V	UT for plates thickness more than 25mm
1.2	Rubber	Chemical & Mechanical	Major	Review of TC	100%		Approved drawing/datasheet, Mfg. Std.	MTC	√	P	V	V	
2.0	**In-process Inspection**												
2.1	Butt welds full penetration joints and nozzle welds	NDT	Critical	RT & MPE or DPT	100%		Manufacturer Standard	TC/IR	√	P	V	V	
2.2	Rubber lining	Mechanical Properties (Tests as per IS-4682 part-I)	Critical	Measure ment	100%		Technical Specification, Relevant std.	TC/IR	√	P	V	V	Tests are same as applicable for CPU
3.0	**Final Inspection**												
3.1	Fabricated tank	Leakage testing	Critical	Measure ment	100%		Drawing/Datasheet	TC/IR	√	P	V	V	Random check by Customer
2.13.6.3 Dosing Pumps/ Metering Pumps													

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.0	**Raw Materials**												
1.1	Casing, Shaft, Impeller	Chemical & Mechanical Properties, NDT	Major	Review of TC	100%		Drawing/Datasheet	MTC	√	P	V	V	
2.0	**Final Inspection**												
2.1	Pump casing	Hydraulic testing (at 1.5 times the shut off pressure or 2 times the working pressure whichever is higher)	Critical	Measure ment	100%		Drawing/Datasheet	TC/IR	√	P	V	V	Random check by Customer
2.2	Complete unit	Operation and performance testing	Critical	Measure ment	100%		Relevant HIS, Mfg. Std.	TC/IR	√	P	V	V	
2.13.7 Condenser On-Line Tube Cleaning System													
2.13.7.1 Ball recirculation pump													
1.0	**Raw Material**												
1.1	Casing, Impeller & Shaft	Chemical & Mechanical Properties, NDT	Major	Review of TC	100%		Drawing/Datasheet	MTC	√	P	V	V	
2.0	**Final Inspection**												
2.1	Pump casing	Hydraulic testing	Critical	Measure ment	100%		Drawing/Datasheet, Mfg. Std.	TC/IR	√	P	V	V	
2.2	Complete pump	Performance test	Critical	Measure ment	100%		Drawing/Datasheet, Mfg. Std.	TC/IR	√	P	V	V	
2.13.7.2 Ball sorter/ fabricated body (housing)													
1.0	**Raw Materials**												

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.1	Housing Shell, Nozzle Flanges, Pipes, Screen Shaft, Gear Boxes	Chemical & Mechanical Properties, NDT	Major	Review of TC	100%		Drawing/Datasheet	MTC	√	P	V	V	
2.0	**Final Inspection**												
2.1	Body	Hydraulic testing	Critical	Measure ment	100%		Drawing/Datasheet	TC/IR	√	P	W	W	
2.2	Ball sorter assembly	Performance test	Critical	Measure ment	100%		Drawing/Datasheet, Manufacturer Standard	TC/IR	√	P	W	W	
2.13.7.3 Coating/ lining													
1.0	**Final Inspection**												
1.1	Rubber lining	Mechanical properties	Critical	Tests as per IS-4682 part-I	100%		• Tensile & Elongation, Specific Gravity, Ash content • Adhesion test • Shore hardness test • Ozone resistance test: (50 PPHM) / 40° C / 20 % Strain /70 Hrs • Water Absorption Test.		√	P	V	V	Water Absorption Test, After ageing test & Compression Set test
2.13.7.4 Debris Filter													
1.0	**Raw Material**												
1.1	Body, strainer mesh and other components	Chemical & Mechanical Properties	Major	Review of TC	100%		Drawing/Datasheet, Manufacturer Standard	MTC	√	P	V	V	
2.0	**Final Inspection**												
2.1	Body	Hydraulic testing	Critical	Measure ment	100%		Drawing/Datasheet, Manufacturer Standard	TC/IR	√	P	W	W	
2.2	Filter assembly	Performance test	Critical	Measure ment	100%		Drawing/Datasheet, Mfg.Std.	TC/IR	√	P	W	W	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	

NOTE -	
1	INSPECTION / NDT / TEST CERTIFICATE / REPORT FOR UT, MPI, BALANCING, PRESSURE TEST SHALL INDICATE REFERENCE OF ITEM SERIAL NUMBER & MODEL FOR CO-RELATION.
2	MATERIAL TEST CERTIFICATE / REPORT FOR TEST SUCH AS CHEMICAL & MECHANICAL TEST ETC. SHALL INDICATE REFERENCE OF ITEM SERIAL NUMBER & ENGINE MODEL FOR CO-RELATION AS PER SAMPLING NORMS.
3	a) Butt welds & full penetration welds : 10% RT or UT and 10% MPE or DPT 00%) b) Fillet welds : 10% MPE or DPT (100%) c) Nozzle welds : 10% MPE or DPT (100%) d) Lifting lug and other load bearing fillet welds : 100% MPE or DPT e) Site weld edge preparations : 10% MPE or DPT
4	' Run out examination shall be carried out at blade shrouds also ' In case, bidder's practice is different, the same shall be furnished for purchaser's approval. During over speed test, vibration measurement and analysis shall also be carried out. ' In case impulse stage and or blade discs are fitted on the rotor, fit up between such disc and rotor shall be checked up beforere and after over speed test ' Lock blade lift after the over speed test shall be checked and record for same shall be maintained.
5.	Before starting mass productions, following technological tests shall be carried out on the first lot of 10 to 15 blades: ' 100% RT and 100% MPE on blades ' 100% hardness testing. ' Mechanical testing and metallurgical testing. ' Weld repair shall not be permitted
6.	' Sample shall be drawn from inlet and outlet of purifier after works test and tested for moisture content, chemical tests and particle size of impurities

3. HIGH PRESSURE PIPING, VALVES, THERMAL NSULATION AND MISCELLANEOUS SYSTEMS/ EQUIPMENT

3.1 High pressure Piping and Fitting

1.0	**Raw Material**											
1.1	All pipe lengths, Fittings	Chemical & Mechanical	Major	Review of TC	100%	Drawing/Datasheet, Technical Specification, IBR requirement	MTC	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		Properties, Heat Treatment, NDT											
1.2	Review of WPS,PQR & WTQ	Verification, Validity	Major	Review of documents	100%		Drawing, ASME Sec IX,IBR	WPS,PQR, IBR Cert./ WTQ	√	P	V	V	
2.0	**In-Process Inspection**												
2.1	All mother pipes used for fittings	Hydro/NDT	Critical	hydraulic test or ultrasonic test	100%		Drawing, Technical Specification,	IR/TC	√	P	V	V	
2.2	All alloy and carbon steel pipes	NDT	Critical	UT	100%		Drawing, Technical Specification,	IR/TC	√	P	V	V	Random Check by Customer
2.3	Longitudinal welds	Hydro/NDT	Critical	UT or hydraulic tests	100%		Drawing, Technical Specification,	IR/TC	√	P	V	V	Random Check by Customer
2.4	Pipe bends (cold/ hot formed)	Bend Angle, Radius, Thinning, ,Surface Defect, Hardness	Critical	Visual, Measure ment, Hardness, PT/MT	100%		Drawing, Technical Specification, Mfg. Std.	IR/TC	√	P	V	V	Random Check by Customer
2.5	Welds	NDT, Visual (after HT, if applicable)	Critical	RT/UT & PT/MPI,	100%		Drawing, Technical Specification, Mfg. Std.	IR/TC, Review of RT Films	√	P	V	V	Random Check by Customer, See Note 3
2.6	Finished welding for alloy steel, BFP discharge, MS, HRH, CRH piping and associated piping	NDT, Visual (after HT, if applicable)	Critical	RT/UT & PT/MPI	100%		Drawing, Technical Specification, Mfg. Std.	IR/TC, Review of RT Films	√	P	V	V	Random Check by Customer, See Note 4

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
2.7	Finished welding for Carbon Steel Class- I piping	NDT, Visual (after HT, if applicable)	Critical	RT/UT & PT/MPI	100%		Drawing, Technical Specification, Mfg. Std.	IR/TC, Review of RT Films	√	P	V	V	Random Check by Customer, See Note 5,6 &7
2.8	Oil piping	NDT, Visual (after HT, if applicable)	Critical	RT/UT & PT/MPI	100%		Drawing, Technical Specification, Mfg. Std.	IR/TC, Review of RT Films	√	P	V	V	Random Check by Customer, See Note 8
2.9	Hardness of Alloy Steel Butt Joint (Weld & HAZ)	Metal properties	Critical	Hardness	100% for P91 material only, 3% for Other Alloy steel		Drawing, Technical Specification, Manufacturer Standard	IR/TC,	√	P	V	V	Random Check by Customer
3.0	**Final Inspection**												
3.1	Final Dimensional & Visual Inspection	Weld Visual, Dimensional, PMI	Critical	Visual, Measurement, Chemical	100%		Drawing, Technical Specification, Manufacturer Standard	IR/TC	√	P	V	V	Random Check by Customer
3.2	**Power Cycle Valves**												
3.2.1	**Valves including extraction line valves**												
1.0	**Raw Materials**												
1.1	Body, Bonnet, Disc, Seat	Chemical & Mechanical Properties, Heat Treatment, NDT	Major	Review of TC	100%		Drawing/Datasheet, IBR if applicable	MTC	√	P	V	V	
1.2	Actuators (if applicable)	Compliance with Specification	Major	Review of TC	100%		Drawing/Datasheet	TC/IR	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.3	Gear Box	MTC, Run Test	Major	Review of TC	100%		Drawing/Datasheet	TC/IR	√	P	V	V	Run Test-Noise, Vibration, Gear Ratio, DOR
2.0	**In-Process Inspection**												
2.1	Weld Overlay Inspection	Surface Defect Overlay Hardness	Major	PT, Hardness	100%		Drawing/Datasheet, Manufacturer Standard	TC/IR	√	P	V	V	Performed on Test coupon
2.2	Pressure retaining parts of valves	NDT	Critical	RT/UT & MPI/PT	100%		Drawing/Datasheet, Technical Specification, Manufacturer Standard	TC/IR	√	P	V	V	Random Check by Customer , See Note 9
2.3	Colour Matching of Disc/Plug/Seat	Surface contact of mating parts	Major	Visual	100%		Manufacturer Standard	TC/IR	√	P	V	V	Min.80% contact & no through passage
3.0	**Final Inspection**												
3.1	Assembled Valves	Hydraulic testing- Shell Seat leak test-Hydro Seat leak test-Air	Critical	Visual & Measurement	100%		Drawing/Datasheet, Technical Specification, Applicable. Std., IBR if applicable	TC/IR	√	V	V	V	Random check by Customer
3.2	Fully assembled valve	Functional testing with actuator • Valve travel, closing and opening time • Current drawn by actuators	Critical	Measurement	100%		Drawing/Datasheet	TC/IR	√	V	V	V	Random check by Customer
3.2.2	**Butterfly Valve**												
1.0	**Raw Material Inspection**												
1.1	Plates for body, disc and flanges (for fabricated valves),	Chemical & Mechanical Properties, Heat Treatment, NDT	Major	Review of TC	100%		Drawing/Datasheet	MTC	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
	Body & Disc Castings for Casted Valve, Drive & Stub Shafts												
1.2	Actuators (if applicable)	Compliance with Specification	Major	Review of TC	100%		Drawing/Datasheet	TC/IR	√	P	V	V	
1.3	Gear Box	MTC, Run Test	Major	Review of TC	100%		Drawing/Datasheet	TC/IR	√	P	V	V	Run Test-Noise, Vibration, Gear Ratio, DOR
2.0	**In-Process Inspection**												
2.1	Austenitic stainless steel welds	Material property for sea water application valves	Critical	IGC (inter-Granular corrosion)test	100%		Manufacturer Standard	TC/IR	√	P	V	V	
2.2	Shafts, seat rings etc.	NDT	Critical	Dye Penetration test	100%		Manufacturer Standard	TC/IR	√	P	V	V	
2.3	Rubber seal	Mechanical Properties, Hardness, Hydraulic stability test (Bleed Resistance) and ozone crack resistance tests	Critical	tensile, elongation and hardness test for vulcanising	Sample from lot		Relevant Std., Technical Specification	MTC	√	P	V	V	
3.0	**Final Inspection**												
3.1	On each valve	Hydraulic testing ' To check body and bonnet strength	Critical	Measurement	100%		As per AWWA-C504/C516/ BS-5155	TC/IR	√	P	W	W	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		▪ Air seat leakage test											
3.2	Disc Strength test	Hydro (Forward and Backward)	Critical	Measure ment	100%		as per EN12266-1/ AWWA-C516	TC/IR	√	P	W	W	
3.3	Proof of Design (POD) Test	Type Test	Critical	Review	01 per design/rating		AWWA C-516	POD Report	√	P	V	V	
3.4	On each valve with actuator	Performance test Opening and closing the valve from fully closed to fully open position and the reverse, under no flow for at least 25 cycles to check the following : ▪ Closing and opening time ▪ Operation of tripping switch and position indicator	Critical	Measure ment	100%		Approved drawing/datasheet	TC/IR	√	P	W	W	See Note 10
3.2.3	**Metallic expansion bellow**												
1.0	**Raw Material**												
1.1	Bellows/Pipe Ends/Plates	Chemical & Mechanical properties	Major	Review of TC	100%		Approved drawing/datasheet	MTC	√	P	V	V	
2.0	**In-Process Inspection**												
2.1	Longitudinal butt weld on bellow	NDT Before forming and after forming	Critical	MPE or DPT	100%		Manufacturer Standard	TC/IR	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
2.2	Butt/Groove Welds	NDT	Critical	RT, MPE or DPT	100%		Technical Specification, Manufacturer Standard	TC/IR	√	P	V	V	Review of RT Films
3.0	**Final Inspection**												
3.1	Visual & Dimensional	Dimensions	Critical	Measure ment	100%		Approved drawing/datasheet	TC/IR	√	P	W	W	
3.2	On each pipe and expansion bellow	Hydraulic testing & Vacuum Test (for vacuum applications)	Critical	Measure ment	100%		Approved drawing/datasheet	TC/IR	√	P	W	W	
3.3	On prototype/ expansion bellow	Type Test	Critical	Life cycle test, Squirm Test, Yield & Rupture	01/Type		Approved drawing/datasheet	TC/IR	√	P	W	W	
3.4	Routine Test	Deflection Test, Spring Rate(Only Axial)	Critical	Measure ment	01/Type		Mfg. Std.	TC/IR	√	P	W	W	
3.2.4	**Hangers and Support**												
1.0	**Raw Materials**												
1.1	Round Bar, Plate, Coil Spring	Chemical & Mechanical Load Deflection, HT, Hardness, scragging test for Spring	Major	Review of TC	100%		Drawing/Datasheet, Technical Specification	MTC	√	P	V	V	
2.0	**In-Process Inspection**												
2.1	Welds	NDT • Butt welds of thickness	Critical	• UT • MPE	100%		Mfg. Std.	TC/IR	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		32mm and above ' Butt welds of thickness less than 32mm & Fillet welds											
2.2	Turn-buckle, pipe clamps and hangers of thickness greater than 25mm	NDT	Critical	MPE/ DPT	100%		Manufacturer Standard	TC/IR	√	P	V	V	On bent portions
3.0	**Final Inspection**												
3.1	Completed springs	Performance test (Sagging test and load versus deflection test)	Critical	MEASU REMENT	100%		Drawing/Datasheet, Manufacturer Standard	TC/IR	√	P	V	V	Random check by Customer
3.2.5 Thermal insulation, refractory, lagging and cladding													
3.2.5.1 Thermal insulation													
1.0	**Final Inspection**												
1.1	Resin bonded mineral wool insulation	Performance test	Critical	Measure ment	100%		As per IS: 8183,Technical Specification	MTC	√	P	V	V	Random check by Customer
1.2	Resin bonded rock wool insulation	Performance test	Critical	Measure ment	100%		As per IS: 9842, Technical Specification	MTC	√	P	V	V	
1.3	Sprayed mineral wool	Performance test	Critical	Measure ment	100%		As per IS: 9724, Technical Specification	MTC	√	P	V	V	
1.4	Ceramic fiber blankets and block insulation	Performance test	Critical	Measure ment	100%		as per IS: 15402, Technical Specification	MTC	√	P	V	V	
3.2.5.2 Refractory													

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.0	**Final Inspection**												
1.1	Fire bricks or castable refractory	Performance test Castable refractory shall have proper identification, supplier name, customer name, batch no., date, material name and net weight in kg with proper instructions for handling	Critical	Measure ment	100%		Manufacturer Standard, Technical Specification	TC/IR	√	P	W	W	
3.2.5.3	**L agging and cladding**												
1.0	**Final Inspection**												
1.1	Aluminum sheeting	Chemical & Mechanical Properties	Major	Review of TC	100%		Manufacturer Standard, Technical Specification	MTC	√	P	V	V	
3.3	**Low Pressure Piping, Valves And Fittings Etc.**												
3.3.1	**Pipes, fittings and mitre bends**												
1.0	**Raw Material Inspection**												
1.1	Steel strip/sheet	Mechanical & Chemical Properties	Major	Review of TC	1 sample/heat		Approved Drg/ Data sheet/Tech Spec/ IS 1239/IS 3589	MTC	√	P	V	V	
2.0	**In-Process Inspection**												
2.1	Welds of pipes and fittings Including welds of	NDT	Critical	Dye penetration test	100%		ASTM E 165	TC/IR	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
	rolled and welded pipes												
3.0	**Final Inspection**												
3.1	Pipe (Black)	Surface defect, Finish & End connection Dimensions, Straightness, Ovality, Bend removal Tensile, Elongation, Bend & Flattening	Critical	Visual Measurement Physical	Sampling as per IS 4711		Approved Drg/Data sheet/Tech Spec/ IS 1239/IS 3589	Inspection report	√	P	W	W	
3.2	Galvanizing (If applicable)	Surface defect, Finish	Critical	Visual	Sample as Per IS 4736		IS:2633	Inspection report	√	P	W	W	
		Uniformity of Zinc coating	Critical	Dip test	Sample as Per IS 4736		IS 4736	Inspection report	√	P	W	W	
		Thickness of coating, Thickness of Zn coating, Adhesion of Zn coating, Free Bore test	Critical	Measurement				Inspection report	√	P	W	W	
3.3.2	**Valves**												
1.0	**Raw Material Inspection**												
1.1	Shaft/ spindle of size ≥ 50 mm diameter	Mechanical properties	Critical	▪ UT ▪ MPE or DPT	100%		Machined surfaces of casing, disc and shaft for MPE or DPT to check surface soundness.	MTC	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
2.0	**Final Inspection**												
2.1	All valves	Hydraulic testing	Critical	Measure ment	100%		Body, seat and back seat (wherever provided) at 1.5 times the maximum pressure to which respective valves can be subjected during plant operation.		√	P	W	W	Check valves shall also be tested for leak tightness test at 25% of the specified seat test pressure. For rubber lined valves, hydraulic test shall be carried out before rubber lining
2.2	Butterfly valves	Hydraulic testing, seat and disc string test	Critical	AWWA-C-504 standard	100%				√	P	W	W	
3.3.3	**Rubber lining of pipes and valves**												
1.0	**Final Inspection**												
1.1	Rubber lining of pipes and valves	Mechanical properties	Critical	Tests as per IS-4682 part-I	100%		' Tensile & Elongation, Specific Gravity, Ash content ' Adhesion test ' Shore hardness test ' Ozone resistance test: (50 PPHM) / 40° C / 20 % Strain /70 hrs. ' Water Absorption Test		√	P	V	V	Water Absorption Test, After ageing test & Compression Set test
3.3.4	**Coating and wrapping Material**												
1.0	Raw Material												
1.1	Coal tar based synthetic Primer	Viscosity Drying time	Major	Chemical &	IS 15337/AWWA C203		Approved Data sheet/ IS 15337/AWWA C203	TC	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		Flash Point Volatile matter		Physical test									
1.2	Fabric	Pliability Heat Resistance Breaking load in longitudinal direction Porosity	Major	Physical test	IS 15337/AWWA C203/ASTM D 146		Approved Data sheet/ IS 15337/AWWA C203/ASTM D 146	TC	√	P	V	V	
2.0	**Final Inspection**												
2.1	Coal tar tape	Thickness Width Softening point Penetration Filler content Service temperature Breaking load in longitudinal direction Adhesion test Holiday test Direct Impact test Petrol solubility test	Critical	Measurement & Physical test	IS 15337/AWWA C203		Approved Data sheet/ IS 15337/AWWA C203	Inspection report	√	P	W	V	Note: Cathodic disbondment test to be carried out by Mfrs as per IS 15337 and report to be submitted for review.
3.3.5	**Rubber expansion joints**												
1.0	**Raw Materials**												
1.1	Neoprene Rubber	Chemical & Mechanical, Shore Hardness, Ozone resistance test, Hydro stability test, Flame resistance	Major	Review of TC	01 Sample/Batch		As per relevant IS	MTC	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		test, Kerosene Dip Test											
1.2	Rubber compound test slab after valcunising	Tensile strength, elongation, shore hardness	Major	Review of TC	01 Sample/Batch		As per relevant IS	MTC	√	P	V	V	
1.3	Fabric strength of synthetic fiber for reinforcement	Rubber to fabric adhesion Rubber to metal adhesion	Major	Review of TC	01 Sample/Batch		As per relevant IS	MTC	√	P	V	V	
2.0	**Final Inspection**												
2.1	Bare Bellows/ Expansion joints in assembled condition	1.Visual & Dimensional 2. Hydro Test 3.Vacuum Test 4.Combined Movement Test 5.Deformation Check	Critical	Measure ment	100%		Drawing/Datasheet, Technical Specification	TC/IR	√	P	V	V	Random check by Customer Proof of design (POD) test documents verification.
3.4	**Equipment Cooling Water (ECW) System**												
3.4.1	**Primary side and secondary side pumps**												
1.0	**Final Inspection**												
1.1	Pump casing and pressure containing fabricated parts	Hydraulic testing	Critical	Measure ment	100%		At 1.5 times the shut off head or 2 times the working pressure whichever is higher		√	P	W	W	
1.2	Complete unit	Operation and	Critical	Measure ment	100%		Drawing/Datasheet		√	P	W	W	Other tests shall also be conducted

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		Performance testing as per Hydraulic Institute Standards (HIS) to determine its characteristic curve at design speed and to ensure compliance with design requirements Vibration to be measured in transverse, horizontal and vertical direction at all measuring points. Noise Level as per HIS. Strip down test											in line with details given above for other pumps
3.4.2	**Plate heat exchangers**												
1.0	**Raw Material Inspection**												
1.1	Material used for cover plates, heat exchange plates and tie rods	Mechanical and chemical	Critical	Mechanical and chemical	On one per heat basis		Approved Data sheet/ Drg/Tech Spec	MTC	√	P	V	V	For gasket, ageing test, shrinkage test and hardness to be carried out
1.2	Plates With thickness 25 mm or above	Internal soundness	Critical	UT	100%		ASTM A 435	UT REPORT	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.3	Welds	NDT	Critical	DPT	10%		ASTM E165/IS 3658	DPT REPORT	√	P	W	V	In case of any defects, entire lot shall be tested and only defect free plates shall be accepted
1.4	HT Plates	Chemical & Mechanical	Critical	Chemical & Mechanical	1 sample per heat		Approved drg/data sheet	TC	√	P	V	V	
1.5	Gaskets	Make, hardness	Critical	Visual & Measurement	100%		Approved drg/data sheet	TC	√	P	V	V	
2.0	**Final Inspection**												
2.1	Each heat exchanger	Hydraulic testing	Critical	Measurement	100%		Approved drg/data sheet/Mfrs procedure	Inspection report	√	P	V	V	Random check by Customer
2.2	Plates	NDT	Critical	DPT	100%		Approved drg/data sheet/Mfrs procedure	Inspection report	√	P	V	V	
	Plates	Surface defect	Critical	Vacuum chamber test/light box test	10%		Approved drg/data sheet/Mfrs procedure	Inspection report	√	P	V	V	
	Complete Assembly	Dimension	Critical	Measurement	100%		Approved drg	Inspection report	√	P	V	V	
3.4.3	**Auto clean filters**												
1.0	**Final Inspection**												
1.1	The body	Hydraulic testing	Critical	Measurement	100%		at 1.5 times the shut off head or 2 times the working pressure whichever is higher		√	P	W	W	
1.2	Complete filter assembly	Performance test	Critical	Pressure drop,	100%				√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
				flow and particle size tests									
3.5	**EOT Cranes and Hoists**												
3.5.1	**Hooks**												
1.0	**Final Inspection**												
1.1	Hooks	Performance test	Critical	All tests including proof load test	100%		as per relevant IS	TC/IR	√	P	V	V	MPE or DPT shall be done after proof load test
3.5.2	**Girders, end carriage, crab, gear-box and rope drum**												
1.0	**Raw Material Inspection**												
1.1	Plates for girders, end carriage, crab, gear-box and rope drum	Chemical & Mechanical Properties, HT & NDT	Critical	Review of TC	100%		Approved drawing /datasheet, Technical Specification	MTC	√	P	V	V	UT of Plates with thickness more than 25mm
2.0	**In Process Inspection**												
	Butt Welds in tension, compression and rope drum	NDT	Critical	RT and DPT	100%		Manufacturer Standard	TC/IR	√	P	V	V	
3.5.3	**Forgings**												
1.0	**Raw Material Inspection**												
1.1	All forgings (wheel, gears, pinions, axles, hooks and hook trunnion)	Chemical & Mechanical Properties, HT & NDT	Critical	Review of TC	100%		Approved drawing/datasheet, Technical Specification	MTC	√	P	V	V	DPT or MPE shall be done after hard facing and machining
3.5.4	**Cranes, Hoists and Lifting Equipment**												
1.0	**Final Inspection**												

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.1	Assembled cranes	Performance test All tests for deflection, load, overload, hoisting motion, cross travel etc.	Critical	Visual & Measure ment	100%		As per IS-3177, Approved drawing/datasheet	TC/IR	√	P	V	V	Random check by customer
1.2	Electric hoists & Chain pulley	Performance test	Critical	All tests	100%		Hoists as per IS-3938 Chain pulley blocks as per IS-3832	TC/IR	√	P	V	V	
1.3	Elevators	Performance test	Critical	Breaking load test	100%		All other tests as per relevant standard for steel wire rope	TC/IR	√	P	V	V	
3.6	**Air Conditioning System**												
3.6.1	**Refrigerant compressor (reciprocating/ screw/ centrifugal)**												
1.0	**Raw Material**												
1.1	Raw materials	Chemical & Mechanical	Major	Chemical & Mechanical	1/heat		Approved Drg/ Data sheet	TC	√	P	V	V	
2.0	**Final Inspection**												
2.1	Castings for cylinder block, crank case and casings	Operation and performance testing	Critical	Hydraulic / pneumati c test	100%		Approved Drg/ Data sheet	Inspection Report	√	P	V	V	
2.2	Oil pump for reciprocating compressor			Capacity test	100%		Approved Drg/ Data sheet	Inspection Report	√	P	V	V	
	Assembled compressor :												
2.3	Compressors and chilling units	Performance testing to check FAD (free air	Critical	No load air run (free run)	100%		Approved Drg/ Data sheet	Inspection Report	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		delivery), noise, vibration and temperature rise of bearing and body		test									
2.4	Reciprocating compressor	Performance testing	Critical	Hydraulic/ leakage test	100%		Approved Drg/ Data sheet	Inspection Report	√	P	V	V	
2.5	Compressors	Performance testing	Critical	Functional run test	100%		Approved Drg/ Data sheet	Inspection Report	√	P	V	V	Also capacity control (for part load performance) check
3.6.2	**Condenser and evaporator**												
1.0	**Final Inspection**												
1.1	Shell side and tube side of condenser and evaporator	Operation and performance testing	Critical	Hydraulic / pneumatic test	100%		No leakage shall be permitted		√	P	V	V	
3.6.3	**Vapour absorption machine (VAM)**												
1.0	**Final Inspection**												
1.1	Complete assembled unit	Operation and performance testing	Critical	Capacity (TR) and steam consumption	100%		Approved Drg / Data Sheet	Inspection report	√	P	W	W	All the controls shall be tested for proper functioning during the above test
1.2	N2 testing	leakage	Critical	Leakage	100%		Mfrs std	Inspection report	√	P	W	V	
1.3	Helium spray test	leakage	Critical	Leakage	100%		Mfrs std	Inspection report	√	P	W	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.4	Helium shroud test	leakage	Critical	Leakage	100%		Mfrs std	Inspection report	√	P	W	W	
1.5	Hydro testing	leakage	Critical	Leakage	100%		Mfrs std/ Approved Drg / Data Sheet	Inspection report	√	P	W	V	
3.6.4	**Air handling unit (AHU)**												
1.0	**Final Inspection**												
1.1	Fan	Operation and performance testing	Critical	As per AMCA / IS	One of each type and size		for air flow, static pressure, speed, efficiency, power consumption, noise and vibration		√	P	V	V	
1.2	Assembled AHU (AHU casing and fan assembly)	Operation and performance testing	Critical	As per IS	One per type		free run test. Noise, vibration and temperature rise of bearing		√	P	V	V	
3.6.5	**Cooling tower (Air Conditioning)**												
1.0	**Raw Material**												
1.1	Hub Plates, Gear Boxes, Fan Shaft	Chemical & Mechanical Properties, NDT	Major	Review of TC	100%		Approved drawing/datasheet	MTC	√	P	V	V	
2.0	In-Process Check												
2.1	Fan Static Balancing, Drive Shaft Dynamic Balancing Gear Assembly Run Test	Balancing Run Test	Critical	Visual/ Measurement	100%		Approved drawing/datasheet, Manufacturer Standard	TC/IR	√	P	V	V	
3.0	**Final Inspection**												

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
3.1	Assembled Cooling towers	Operation and performance testing Free run test at shop to measure FAD, noise and vibration Visual & Dimensional	Critical	Measure ment	100%		Approved drawing/datasheet, Manufacturer Standard	TC/IR	√	P	W	W	For cooling towers being supplied in knocked- down condition, these tests shall be done at site
3.7	**VACUUM PUMP**												
1.0	**Raw Material Inspection**												
1.1	Pump components	Chemical, Physical properties & Hardness	Major	Chemical, Physical & Hardness	1/heat		Approved Drg/Data sheet	TC	√	P	V	V	
1.2	Separator	UT of forgings like shaft, couplers etc.	Major	UT	100%		ASTM A 388	UT Report	√	P	V	V	Note-1
1.3	Heat Exchanger	Chemical, Physical properties	Critical	Chemical, Physical	1/heat		Approved Drg/Data sheet	TC	√	P	V	V	
		Hydraulic test	Critical	Leakage test	100%		Approved Drg/Data sheet	TC	√	P	V	V	
1.4	Gear Box	Chemical, Physical properties	Critical	Chemical, Physical	1/heat		Approved Drg/Data sheet	TC	√	P	V	V	
1.5	Valves	Hydraulic test of tube side & shell side	Critical	Leakage test	100%		Approved Drg/Data sheet	TC	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.6	Instruments	Performance test	Critical	Performance test	100%		Approved Drg/Data sheet	TC	√	P	V	V	No load condition, backlash, no. of gear train etc.
2.0	**In Process Inspection**												
2.1	Rotor	NDT Of machined portion	Critical	DPT	100%		ASTM E 165/no relevant indication	Inspection report	√	P	V	V	
		Dynamic Balancing, Run out check	Critical		100%		ISO 1940 Gr.6.3 or better	Inspection report	√	P	V	V	
3.0	**Final Inspection**												
3.1	Pump Assembly	Major dimensions	Critical	Measurement	100%		Approved Drg/Data sheet	Inspection report	√	P	W	W	
		Hydrostatic test	Critical	Leakage Test	100%		Approved Drg/Data sheet	Inspection report	√	P	W	W	
		Performance test	Critical	Measurement	100%		Approved Drg/Data sheet	Inspection report	√	P	W	W	
		Noise level check, Vibration check, Bearing temp. rise check	Critical	Measurement	100%		Approved Drg/Data sheet	Inspection report	√	P	W	W	
3.8	**OXIDATION BLOWER**												
1.0	**Raw Material Inspection**												
1.1	Body/ casing, End plate/ Cover, Rotor	Chemical, Physical properties & Hardness	Major	Review of TC	100%		Approved Drawing/datasheet	MTC	√	P	V	V	
1.2	Shaft	Chemical, Physical properties	Major	Review of TC					√	P	V	V	
		NDT	Major	UT					√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.3	Timing gears	Chemical, Physical properties	Major	Review of TC					√	P	V	V	
		Hardness	Major						√	P	V	V	
		Mechanical properties	Major	UT after proof machining					√	P	V	V	
1.4	Base frame, Pipe & fitting, Foundation bolts	Chemical, Physical properties	Major	Review of TC					√	P	V	V	
1.5	Coupling/ Gear box, Valves, Filter, Silencer, Bearings etc.	Functional & Performance check	Major	Review of TC					√	P	V	V	
1.6	Actuators	Functional & Performance check	Major	Review of TC					√	P	V	V	
2.0	**In-Process Inspection**												
2.1	Body/ Casing	Hydro test	Critical	Measurement	100%		Approved Drawing/datasheet	TC	√	P	V	V	
2.2	Shaft, Gears, End plate after machining	NDT	Critical	DPT	100%		Mfg.Std,	TC	√	P	V	V	
2.3	Rotor assembly (shaft with lobe)	Balancing	Critical	Visual	100%		Mfg.Std,	TC	√	P	V	V	
3.0	**Final Inspection**												
3.1	Complete blower assembly with motor	Performance Run • Overall major dimensions • Free air delivery	Critical	Measurement	100%		Approved Drawing/datasheet	TC	√	P	W	W	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		' Head Power ' Efficiency, speed ' Discharge Pressure & temp. ' Noise & Vibration ' Oil temp. rise test											
NOTE -													
1	INSPECTION / NDT / TEST CERTIFICATE / REPORT FOR UT, MPI, BALANCING, PRESSURE TEST SHALL INDICATE REFERENCE OF ITEM SERIAL NUMBER & MODEL FOR CO-RELATION.												
2	MATERIAL TEST CERTIFICATE / REPORT FOR TEST SUCH AS CHEMICAL & MECHANICAL TEST ETC. SHALL INDICATE REFERENCE OF ITEM SERIAL NUMBER & ENGINE MODEL FOR CO-RELATION AS PER SAMPLING NORMS.												
3	However, as a minimum, the following requirements shall be met (except for oil piping) : ' For temperature > 400 ^{0}C and/or pressure exceeding 71 bar, the butt welds and full penetration branch welds shall be subject to 100% RT or UT and 100% MPE ' For temperature > 1750C up to 400 0C and/or pressure exceeding 17 bar and up to 71 bar, the butt welds & full penetration branch welds shall be subject to NDTs as below: ' pipe diameter > 100 NB100% RT or UT and 100% MPE ' pipe diameter ≤ 100 NB10% RT or UT and 100 % MPE ' In addition to above, statutory requirement, wherever applicable, shall also be complied with												
4	' Butt welds 100% RT and 100% MT or DPT ' Welds for nozzle, branch 100% RT and 100% MT or DPT connections of size > 100NB ' Welds for all other attachments 100% MT or DPT ' Removal of weld defects 100% MT or DPT												
5.	i) Butt welds: pipe size > 100 NB 100% RT and 100% MPE or DPT												

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
	pipe size ≤ 100 NB — 10% RT and 10% MPE or DPT ii) Welds for nozzle, branch and thickness > 19 mm — 100% RT and 100% MPE or DPT connections of size > 100NB iii) Welds for all other attachments — 10% MPE or DPT iv) Removal of weld defects/weld repair — 100% MPE or DPT												
6.	a) Butt welds: pipe size > 100 NB — 100% RT and 10% MPE or DPT pipe size ≤ 100 NB — 10% MPE or DPT b) Welds for nozzle, branch — 10% MPE or DPT connections/ attachments c) Removal of weld defects — 100% MPE or DPT												
7.	All other pipes not covered above (except oil piping) shall be subjected 100% MPE or DPT in case of underground piping and 10% MPE or DPT in case of over ground piping. 10% of butt welds of underground piping shall be subjected to RT												
8.	a) Butt welds of Oil piping shall be subjected to 10% RT and 10% DP Test. For Jacking oil lines 100% RT and 100% DPT shall be carried out on butt welds. b) Fillet welds with load transfer shall be subjected to 100% MPE or DPT and fillet welds without load transfer shall be subjected PE												
9.	a) Valve size < 50 NB ' Visual examination for rating below ANSI Class 900 ' MPE for rating above ANSI Class above 900 b) Valve size ≥ 50 NB and < 100 NB ' Visual examination for rating up to ANSI Class 600 ' MPE for rating above ANSI Class above 600 and below 900 ' 100% MPE and 100% RT on 10% of valves for rating above ANSI Class above 900 and below 4500 c) Valve size ≥ 100 NB and < 300 NB ' Visual examination for rating up to ANSI Class 300 ' MPE for rating above ANSI Class above 300 and below 600 ' 100% MPE and 100% RT on 10% of valves on change of section and weld ends for rating above ANSI Class above 600 and below 900 ' 100% MPE and 100% RT on valves for rating above ANSI Class 900 and below 4500 d) Valve size ≥ 300 NB ' MPE for rating up to ANSI Class 600 ' 100% MPE and 100% RT on all valves in the areas of change of section and weld ends for rating above ANSI Class 600 and below Class 900 ' 100% MPE and 100% RT on valves for rating above ANSI Class 900 and below Class 4500 Note : In the above NDTs, MPE may be replaced by DPT for austenitic steels												

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms		Format of Record	D	Agency			Remarks
					M	C/U					M	C	U	
10.	After assembly, one valve of each size with respective actuator shall be shop operated over the full range of movement in both the directions, with the body subjected to the full hydrostatic pressure conditions. During the test, hand wheel operation, opening and closing time and current drawn shall also be checked. The test shall be conducted for three consecutive cycles with valve shaft both in vertical and horizontal planes													
3.9	**COOLING WATER PUMP**													
1	**Raw Material**													
1.1	Shaft (SS Forgings)	Chemical Analysis	Critical	Chem.	Each melt		App. Drg/ Data sheet	App. Drg/ Data sheet	MTC	√	P	V	V	
		Mech. Properties	Critical	Mech.	Each melt & HT batch		App. Drg/ Data sheet	App. Drg/ Data sheet	MTC	√	P	V	V	
		Heat Treatment	Major	HT	Each melt		App. Drg/ Data sheet	App. Drg/ Data sheet	MTC	√	P	V	V	
1.2	Impeller (Casting)	Chemical Analysis	Critical	Chem.	Each melt		App. Drg/ Data sheet	App. Drg/ Data sheet	MTC	√	P	V	V	
		Mech. Properties	Critical	Mech.	Each melt & HT batch		App. Drg/ Data sheet	App. Drg/ Data sheet	MTC	√	P	V	V	
		Heat Treatment	Major	HT	Each melt		App. Drg/ Data sheet	App. Drg/ Data sheet	MTC	√	P	V	V	
1.3	a. Pump Casing b. Suction Bell mouth	Chemical Analysis	Critical	Chem.	Each melt		IS 210 FG260 (AA 19703 + 2% Ni)	IS 210 FG260 (AA 19703 + 2% Ni)	MTC	√	P	V	V	
		Mech. Properties	Critical	Mech.	Each Heat & HT Batch		IS 210 FG260 (AA 19703 + 2% Ni)	IS 210 FG260 (AA 19703 + 2% Ni)	MTC	√	P	V	V	
		Stress Relieving	Major	SR	Each PC		App. Drg/ Data sheet	App. Drg/ Data sheet	TC	√	P	V	V	
		Hardness Test	-DO-	Mech.	Each PC		App. Drg/ Data sheet	App. Drg/ Data sheet	MTC	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms		Format of Record	D	Agency			Remarks
					M	C/U					M	C	U	
1.4	Thrust cum Journal Bearing	Compliance Certificate	Major	Visual	All Pieces		Catalogue	Catalogue	MTC	√	P	V	V	
1.5	Discharge Elbow, Column Pipes, Suction Liner	Material Test Certificates (CC)	Major	Visual	100%		App. Drg/ Data sheet	App. Drg/ Data sheet	MTC	√	P	V	V	
1.6	Motor Pedestal	Compliance Certificate	Major	Visual	100%		App. Drg/ Data sheet	App. Drg/ Data sheet	Compliance Certificate	√	P	V	V	
2	**In Process Inspection**													
2.1	Bowl	Dimensional Check	Major	Measurement	100%		App. Drg	App. Drg	Internal Test Report	√	P	V	V	
		Surface Quality	Major	LPT/DPT/ UT	100%		Relevant Standard	Relevant Standard	Internal Test Report	√	P	V	V	
		Hydrostatic Test	Crtical	Pressure test	1000%		Relevant Standard	Relevant Standard	Internal Test Report	√	P	V	V	
2.2	Shaft (Including intermediate shafts after machining)	Dimensional Check	Major	Measurement	100%		App. Drg	App. Drg	Internal Test Report	√	P	V	V	
		Surface Quality	Major	LPT/DPT/ UT	100%		Relevant Standard	Relevant Standard	Internal Test Report	√	P	V	V	
2.3	Impeller (After final Machining)	Dimensional Check	Major	Measurement	100%		App. Drg	App. Drg	Internal Test Report	√	p	w	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms		Format of Record	D	Agency			Remarks
					M	C/U					M	C	U	
		Surface Quality	Major	LPT/DPT	100%		Relevant Standard	Relevant Standard	Internal Test Report	√	p	w	V	
		Dynamic Balancing	Major	Testing	100%		ISO 1940	ISO 1940 Gr. 6.3	Internal Test Report	√	p	w	v	
2.4	Pump Casing (After Machining)	Dimensional Check	Major	Measurement	100%		App. Drg	App. Drg	Internal Test Report	√	P	W	V	
		Hydrostatic test (1.5 X Design Pr.)	Major	Testing	100%		App. Drg	No Leakage	Internal Test Report	√	P	W	V	
		Surface Quality	Major	LPT/DPT	100%		Relevant Standard	Relevant Standard	Internal Test Report	√	P	W	V	
2.5	a. Discharge Elbow b. Column Pipes c. Suction Liners	Heat Treatment (as applicable)	Major	HT	100%		App. Drg	App. Drg	HT Chart	√	P	W	V	
		All welds	Major	RT	100%		Relevant Standard	Relevant Standard	NDT Report	√	P	W	V	
		Hydrostatic Test (a,b,c) (1.5 x Design Pr.)	Major	LPT/DPT	100%		App. Drg	No Leakage	Inspection Report	√	P	W	V	
		Dimensional	Major	Hydrostatic Test	100%		App. Drg	App. Drg	Log Sheet	√	P	W	V	
2.6	Column, Discharge Pipe, Motor Pedestal, Flanges	Dimensional	Major	Measurement	100%		App. Drg	App. Drg	Log Sheet	√	P	W	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms		Format of Record	D	Agency			Remarks
					M	C/U					M	C	U	
		WPS and Welder Qualification	Major	Measurement	100%		ASME SEC IX		Log Sheet	√	P	W	V	
		Weld Quality	Major	RT, DPT	10% of butt welds (on all pieces		ASME Sec VIII Div. 1	ASME Sec VIII Div. 1	Inspection Report	√	P	W	V	
3.0	**Final Inspection**													
3.1	Pump Assembly/ Bowl Assembly	Assembly Checks, Free rotation of assembly	Major	Measurement	100%		App. Drg	App. Drg	Log Sheet	√	P	W	W	
		Performance Testing, Noise Level, Vibration, Bearing Temp	Critical	Testing	100%		Approved Test Procedure	Approved Test Procedure	Test Repot	√	P	W	W	
		Post test inspection(Up to Journal & Thrust bearings only)	Major	Visual	100%		App. Drg	No Damages	Inspection Report	√	P	W	W	
3.2	Painting & Packing	Verification of completeness & Packing	Major	Visual	100%		App. Drg/ Data sheet	App. Drg/ Data sheet	Inspection Report	√	P	W	W	
3.3	QA Documentation	All Reports	Major	Review	100%		Approved QAP	Approved QAP	Report	√	P	V	V	
3.10	**ASH HANDLING PLANT**													
3.10.1	**Bag Filter For Buffer Hopper & Vent Filter Of FA Silo**													
1	**Raw Material**													
1.1	Dish end, Plenum casing flanges & Tube, MS	Visual & Dimension	Major	Visual/ measurement	20% random		IS:2062 & IS 1079/ Approved Drg/ DS		Mfg. TC/QCR	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
	Sheets/plates and Std section												
		Chemical & Mechanical	Major	Chemical & Mechanical	Sample/Lot		IS:2062 & IS 1079/ Approved Drg/DS	Mfg. TC/QCR	√	P	V	V	
1.2	Pipe for air manifold and pulsing pipe	Chemical & Mechanical	Major	Chemical & Mechanical	Sample/Lot		IS:1239 & IS 3589/ Approved Drg/DS	Mfg. TC/QCR	√	P	V	V	
1.3	Wire cages	Visual & Dimension	Major	Visual/ measurement	5%		Approved Drg/DS	Mfg. TC/QCR	√	P	V	V	
1.4	Venture	Visual & Dimension Tensile & Hardness	Major	Visual/ Measurement & Mechanical Test	10% random		Approved Drg/DS	Inspection report	√	P	V	V	
1.5	Sequential controller, gauges as applicable	Visual & review of MTC, review of calibration certificate & Functional test	Major	Verification	100%		Approved Drg/DS	Test & guarantee certificate from mfc	√	P	V	V	
1.6	Pulse valve & solenoid Valves	Visual & review of MTC and Functional Test	Major	Visual/ Measurement & Testing	100%		Approved Drg/DS	Test & guarantee certificate from mfc	√	P	V	V	
1.7	Filter bags	Visual review of MTC	Major	Visual/ measurement	5%		Approved Drg/DS	Test & guarantee	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
								certificate from mfc					
2	**In Process Control**												
2.1	Marking and Cutting	Visual & Dimension	Major	Visual/ measurement	100%		Approved Drg./DS	IR	√	P	V	V	
2.2	Set up & truck welding	Visual & Dimension	Major	Visual/ measurement	100%		Approved Drg./DS	IR		P	V	V	
2.3	Welding Qualification	WPS & PQR	Major	Verification	100%		ASME SEC IX	WPS/PQR		P	V	V	
2.4	Welding (by approved welder)	Weld quality	Major	Visual & DP	100%		Approved Drg/ASTM E-165	IR	√	P	V	V	
2.5	Air Manifold/ reservoir	Leak tightness	Major	Hydro	100%		Approved Drg./DS	IR	√	P	V	V	
3	**Final Inspection**												
3.1	Assembly surface, Cleaning & painting	Visual	Major	Visual	100%		Approved GA DRG	IR	√	P	W	W	
		Dimensional, quality	Major	Measurement	100%		Approved GA DRG	IR	√	P	W	W	
		Painting	Minor	Visual	random		Approved painting Schedule/ Mfd Std.	IR	√	P	V	V	
3.2	QA Documentation	Visual	Major	Review	100%		Approved QAP	Report	√	P	V	V	
3.10.2 **BAH Feed Gate**													
1	**Raw Material**												

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.1	Housing	Chemical Composition	Major	Chemical	1 /heat		Approved DRG/Approved Specification	MTC/Lab TC	√	P	V	V	
		Mechanical Test	Major	Mechanical	1 /heat		Approved DRC/Approved Specification	MTC/Lab TC	√	P	V	V	
		Visual and Dimension	Major	Visual & Measurement	100%		Approved DRG/Approved Specification	IR	√	P	V	V	
1.2	Wear Strip/Liner	Chemical Composition	Major	Chemical	1 /heat		Approved DRG/Approved Specification	MTC/Lab TC	√	P	V	V	
		Mechanical Test	Major	Mechanical	1 /heat		Approved DRG/Approved Specification	MTC/Lab TC	√	P	V	V	
		Visual and Dimension	Major	Visual & Measurement	100%		Approved DRG/Approved Specification	IR	√	P	V	V	
1.3.1	Rollers	Mechanical Test/HT Chart	Major	Mechanical	1 /heat		Approved DRG/Approved Specification	MTC/Lab TC	√	P	V	V	
		Chemical Composition	Major	Chemical	1 /heat		Approved DRG/Approved Specification	MTC/Lab TC	√	P	V	V	
		Hardness	Major	Mechanical	1 /heat		Approved DRG/Approved Specification	MTC/Lab TC	√	P	V	V	
		Visual and Dimension	Major	Visual & Measurement	100%		Approved DRG/Approved Specification	IR	√	P	V	V	
1.3.2	Roller wedges	Chemical Composition	Major	Chemical	1 /heat		Approved DRG/Approved Specification	MTC/Lab TC	√	P	V	V	
		Mechanical Test	Major	Mechanical	1 /heat		Approved DRG/Approved Specification	MTC/Lab TC	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		Visual and Dimension	Major	Visual & Measurement	100%		Approved DRG/Approved Specification	IR	√	P	V	V	
1.4	Door and Door Frame	Chemical	Major	Chemical	1 /heat		Approved DRG/Approved Specification	MTC/Lab TC	√	P	V	V	
		Mechanical Test	Major	Mechanical	1 /heat		Approved DRG/Approved Specification	MTC/Lab TC	√	P	V	V	All bolts and nuts are Galvanized
		Visual and Dimension	Major	Visual & Measurement	100%		Approved DRG/Approved Specification	IR	√	P	V	V	
1.5	Pneumatic Cylinder	Visual and Dimension & Operation Test	Major	Documents Review	100%		As per Approved Drg./ DS	MTC/Lab TC	√	P	V	V	
1.6	Shafts	Chemical Composition	Major	Chemical	1 /heat		Approved DRG./ Specification	MTC/Lab TC	√	P	V	V	
		Visual and Dimension	Minor	Visual & Measurement	100%		Approved DRG./ Specification	IR	√	P	V	V	
		Mechanical Properties	Major	Mechanical	One sample/lot		Approved DRG./ Specification	MTC/Lab TC	√	P	V	V	
		Sub surface Defect (above 40min dia)	Major	UT	100%		Approved DRG./ Specification/ ASTM A 388	IR	√	P	V	V	NOTE-1
		Surafce Defect after machining	Major	OPT	100% on final weld		ASME SEC V	IR	√	P	V	V	
2.0	**In Process Inspection**												

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
2.1	Gate & Flame, Cylinder Mounting pedestal, Follower, Wear Plates, Body for access door & inspection window	Casting Defects	Major	Visual	100%		Approved DRG/ Specification	IR	√	P	V	V	
		Visual & Dimensional	Major	Visual & Measurement	100%		Approved DRG./ Specification	IR	√	P	V	V	
2.2	Marking, Cutting, Edge Preparation, tacking, Drilling, Assembly of liner plates for Fabrication of Housing	Visual & Dimensional	Major	Visual & Measurement	100%		Approved DRG/ Specification	Shop Record	√	P	V	V	
		DP Test	Major	DPT	100%		ASME SEC V	IR	√	P	V	V	
	Welding Documents for Fabrication of Housing.	WPS & PQR, WPQ	Major	Review	100%		ASME Sec. IX	WPS & PQR, WPQ	√	P	V	V	
	Welding (Final) Housing Joints only for Fabrication of Housing.	Weld Quality	Major	Visual & DPT	100%		ASME SEC V	IR	√	P	V	V	
2.3	Wear Strip, Roller Wedge, Rollers & Roller Axiel	Visual & Dimensional	Major	Visual & Measurement	100%		Manufacturing Drg.	IR	√	P	V	V	
2.4	Assy. With Pneumatic Cylinder	Matching of Door 7 Frame movement of door clearance	Major	Operation, Measurem	100%		Approved DRG. Approved Specification	IR	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
				ent, Hydro test									
3.1	Gate way along with Pneumatic Cylinder	Fitment Dimensions Completeness	Major	Visual & Measurement	100%		As per Approved Drg.	IR	√	P	W	W	PMI test to be done for alloy materials.
		Leakage test of Sealing area of feed gate	Major	Water Fill test	100%		As per Approved Drg..	IR	√	P	W	W	
		Functional test	Major	Open and close operations for free movement	100%		As per Approved Drg.	IR	√	P	W	W	
3.2	Painting	Final Finish & DFT	Minor	Visual & Measurement	100%		Approved Painting Schedule/Data sheet.	IR	√	P	V	V	
3.3	QA Documentation	Visual	Minor	Review	100%		Approved QAP	IR	√	P	V	V	
NOTE-1 : UT SHALL BE CARRIED OUT BY USING SUITABLE FREQUENCY PROBE. USING THIS PROBE, THE BACK WALL ECHO SHALL BE SET AT 100% OF FULL SCALE HEIGHT (FSH) IN SOUND AREA. AT THIS SENSITIVITY LEVEL, ANY DEFECT ECHO EXCEEDING 20% OF FSH IS NOT ACCEPTABLE. ALSO LOSS OF BACK WALL ECHO MORE THAN 20% AT ANY LOCATION IS NOT ACCEPTABLE													
3.10.3 **Clinker Grinder**													
1.0	**Raw Material Inspection**												
1.1	Housing	Chemical Composition	Major	Chemical	1 Sample /heat		Approved DRG. Specification	MTC/Lab TC	√	P	V	V	
		Mechanical Test	Major	Mechanical	1 Sample /heat		Approved DRC/ Specification	MTC/Lab TC	√	P	V	V	
		Dimensional conformity	Major	Measurement	100%		Approved DRG. Specification	IR	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.2	Driving Gear	Chemical Composition	Major	Chemical	As per Approved DRG/ Specification		Approved DRG/ Specification	MTC/Lab TC	√	P	V	V	
		Mechanical Test	Major	Mechanical	Approved DRG/ Specification		Approved DRG/ Specification	MTC/Lab TC	√	P	V	V	
1.3	Grinder Rolls	Chemical Composition & Mechanical properties	Major	Chemical & Mechanical	1 Sample/heat		Approved DRG/ Specification	MTC/Lab TC	√	P	V	V	
		Dimensional conformity	Major	Measurement	100%		Approved DRG/ Specification	IR	√	P	V	V	
		Heat Treatment	Major	Review of HT chart	100%		Approved DRG/ Specification	IR	√	P	V	V	
		Bend Test	Major	Mechanical	1 Sample/heat		Approved DRG/ Specification	MTC/Lab TC	√	P	V	V	
		Hardness	Major	Measurement	1 Sample/heat		Approved DRG/ Specification	MTC/Lab TC	√	P	V	V	
		Casting Defects	Major	Visual	100%		Approved DRG/ Specification	MTC/Lab TC	√	P	V	V	
1.4	Shaft	Chemical Composition	Major	Chemical	1 Sample /heat		Approved DRG/ Specification	MTC/Lab TC	√	P	V	V	
		Dimensional conformity	Minor	Measurement	100%		Approved DRG/ Specification	IR	√	P	V	V	
		Mechanical Properties	Major	Mechanical	1 Sample /heat		Approved DRG/ Specification	MTC/Lab TC	√	P	V	V	
		Sub surface Defect (above 40mm dia)	Major	UT	100%		Approved DRG/ Specification/ASTM A 388	IR	√	P	v	v	NOTE-1

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		Surface Defect after Ma	Major	DPT	100% on final weld		ASME SEC V	IR	√	p	V	V	
1.5	Shaft Sleeve	Chemical Composition & Mechanical properties	Major	Chemical & Mechanical	On 10% sample		Approved DRG/ Specification	MTC/Lab TC	√	P	V	V	
		Hardness	Minor	Measurement	100%		Approved DRG/ Specification	MTC/Lab TC	√	P	V	V	
		Dimensional conformity	Minor	Measurement	100%		Approved DRG/ Specification	IR	-	P	V	V	
1.6	Wear Plate	Chemical Composition	Major	Chemical	1 Sample /heat		Approved DRG/ Specification	MTC/Lab TC	√	P	V	V	
		Hardness	Major	Measurement	1 Sample /heat		Approved DRG/ Specification	IR	√	P	V	V	
1.7	Bearing, Screws, Flexible hose pipes and other items	Verification of Make/Model no.	Major	Visual	100%		Approved DRG/ Specification	MTC/Lab TC	√	P	V	V	
2.0	**In Process Inspection**												
2.1	Big Support	Casting Defect	Major	Visual	100%		Approved DRG/ Specification	IR	√	P	V	V	
			Major	DPT	100% on final weld		ASME SEC V	IR	√	P	V	V	
		Dimensional Conformity	Major	Measurement	Critical dimensions		Approved Drg.	IR	√	P	V	V	
2.2	Fabrication of Housing	Dimensional conformity	Major	Measurement	Critical dimensions		Approved Drg.	IR	√	P	V	V	
2.3	Welding Qualification	WPS, PQR, WQR	Major	Verification	100%		ASME SEC IX	IR	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
2.4	Welding of Housing, Shaft & Rolls	DPT on final weld	Major	DPT	100% on final weld		ASME SEC V	IR	√	P	V	V	
2.5	Alignment of Clinker grinder	Alignment of fire movement	Major	Visual & by manual operation	100%		Approved Drg.	IR	√	P	V	V	
3.0	**Final Inspection**												
3.1	Check for Completeness, appearance, drilled holes, straightness, diameter, no. of holes verification, Cleanliness & dimension	Fitment Dimension	Major	Measurement/Visual	100%		Approved Drg./Data sheet	IR	√	P	W	W	
3.2	No Load running test at least for 2hours with shop drive	Free Rotation	Critical	Visual	100%		Approved Drg	IR	√	P	W	W	
		Bearing Temp rise & Vibration	Major	Measurement	100%		Approved Drg ./DATA SHEET	IR	√	P	W	W	Temp rise ambient +30° Vibration below B5 Micron
3.3	Painting	Paint shade, DFT	Minor	Visual & Measurement	100%		Approved painting Schedule	IR	√	P	V	V	
3.4	QA Documentation	Visual	Major	Review	100%		Approved QAP	Report	√	P	V	V	
3.10.4 Air Oil Converter Tank													

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.0	**Raw Material Inspection**												
1.1	Body & Baffle plate, Structural supports	Chemical Composition	Major	Chemical	1 Sample/heat		Approved DRG/Specification	MTC/Lab TC	√	P	V	V	
		Mechanical Test	Major	Mechanical	1 Sample/heat		Approved DRG/Specification	MTC/Lab TC	√	P	V	V	
		Surface Defect	Major	Visual & DP T	100%		Approved DRG/Specification	IR	√	P	V	V	
2.0	**In Process Inspection**												
2.1	Body & Structural, Dish end												
	a) Marking, cutting edge preparation, Cleaning, tacking, straightening etc.	a) Fit up check (ovality / misalignment)	Major	Dimensional/ Visual	100%		Approved DRG/Specification	IR	√	P	V	V	
	b) Welder Qualification and welding procedure	Welding Documents	Major	Review	100%		ASME SEC IX	IR	√	P	V	V	
	c) NDT	Surface Defect	Major	Visual of DP Test	100%		Approved DRG/Specification	IR	√	p	V	V	
		Weld Quality	Major	DP Test	100% Butt 10% Fillet		ASME SEC V	IR	√	P	V	V	
3.0	**Final Inspection**												

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
3.1	Check for critical dimensions, straightness, Distortion, alignments etc.	Completeness and visual/ limensional xamination	Major	Measurement/Visual	Overall Dimensions 100%		Approved DRG/Specification	IR	√	P	W	W	Witness 100% of offered lot
3.2	Hydrostatic Pr. Testing of shell	Hydraulic pressure for 5 min.	Major	Pressure Test	100%		Test Pressure as per Approved Drg/DS/Relevant code & standard / No leakage/Pressure Drop	IR	√	P	W	W	
3.3	Painting	Paint shade, DFT	Major	Visual & Measurement	100%		Approved painting Schedule	IR	√	P	V	V	
3.4	QA Documentation	Visual	Major	Review	100%		Approved QAP-	Report	√	P	V	V	
3.10.5	**Cast Iron Pipe**												
1.0	**Raw Material Inspection**												
1.1	Raw Material Pig Iron & Scrap	Material Compliance	Major	Chemical Check	One Sample / Lot		AS per Mfg. Std	MTC	√	P	V	V	
2.0	**In Process Inspection**												
2.1	Pipe Spinning	Surface Condition	Major	Verification of Lot Sheet	100%		IS:1536/BS:1211	IR	√	P	V	V	
		Thickness	Major	Visual	100%		IS:1536/BS:1211	IR	√	P	V	V	
2.2	Heat Treatment	Verification of Heat Treatment	Critical	Review	100%		AS per Mfg. Std	IR	√	P	V	V	
2.3	Pipe after heat Treatment	Major Dimensions	Major	By Vernier Calliper	Every Hour		IS:1536/BS:1211	IR	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
3.0	**Final Inspection**												
3.1	Physical Testing	Mechanical Test	Critical	Mech.	One sample / Batch		IS:1536/BS:1211	IR	√	P	W	W	
		Brinell Hardness	Critical	Hardness Test	One sample / Batch		IS:1536/BS:1211	IR	√	P	W	W	
3.2	Dimension	OD, Thickness, Ovality & Length	Major	By Vernier Caliper, Measuring Test	100%		IS:1536/BS:1211	IR	√	P	W	W	10% from the offer lot (Rev 01)
3.3	Hydrostatic Test	Leak Test	Major	Hydrostatic Test	100%		IS:1536/BS:1211	IR	√	P	W	W	10% from the offer lot
3.4	Bitumeneous Black Paint / Tar	Coating Adherence	Major	Adherence Test	100%		IS:1536/BS:1211	IR	√	P	V	V	
3.5	Marking	Compliance	Major	Verification	100%		IS:1536/BS:1211	IR	√	P	V	V	
3.10.6	**Expansion Bellow, Bellow APH, Duct & SCR Hopper**												
1.0	**Raw Material Inspection**												
1.1	Sheet for Bellows	Mechanical & Chemical Properties	Major	Mechanical & Chemical	Sample Test Report or Mill TC		Approved Drawing/ Specification	TC	√	P	V	V	
1.2	CS Flange and plate for socket/centre pipe	Mechanical & Chemical Properties	Major	Mechanical & Chemical	Sample Test Report or Mill TC		Approved Drawing/ Specification	TC	√	P	V	V	
2.0	**In Process Inspection**												
2.1	Marking, Cutting & machining	Measurement	Major	Dimension	100% by SIPL		Approved Drawing	IR	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
2.2	Fabrication before welding	Edge preparation & Fit up checking	Major	Visual & Dimension	100% by SIPL		Approved Drawing	IR	√	P	V	V	
2.3	After welding of bellows Long scam (plies)	Soundness of weld joints	Major	Visual & DP Test	100% by SIPL		ASTM E 165 / As per std. Practice	IR	√	P	V	V	
3.0	**Final Inspection**												
3.1	After welding of bellows with socket & Flange with socket full assembly	Surface defect, Dimension	Major	Visual, Measurement	100% by SIPL		Approved Drawing	IR	√	P	W	W	
3.2	Deflection Test (Routine Test)	Deflection Test	Critical	Axial & Lateral Movement Measurement	100% by SIPL		Approved Drawing	IR	√	P	W	W	
3.3	Pneumatic Test (Routine Test)	Leakage Test at Specified Test Pressure with air and soap solution	Major	Pneumatic Leakage Test	100% by SIPL		Approved Drawing/ Specification	IR	√	P	W	W	
3.4	Painting on all MS Paints	Surface cleaning and painting	Minor	Visual Checking	100% by SIPL		As per approved paint specification	IR	√	P	V	W	
3.5	QA Documentation	Visual	Major	Review	100%		Approved Drawing & QAP	IR	√	-P	V	V	
3.10.7	**Fluidising Blower**												
1.0	**Raw Material Inspection**												
1.1	Casing, Rotary Lobi (Rotor), end cover/end plate/side plate	Physical & Chemical	Major	Physical & Chemical	1/Heat		IS:210/ Approved Drg/ DS	MTC	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.2	Shaft	Physical & Chemical	Major	Physical & Chemical	1/Heat		approved Drg/Data sheet	MTC	√	P	V	V	
		NDT	Major	UT	100%		ASTM – A 388	IR					For Dia > 50 mm 40MM, NOTE-1
1.3	Gears	Chemical	Major	Chemical	1/Heat		approved Drg/Data sheet	MTC	√	P	V	V	
		Internal Defects	Major	UT	100%		ASTM – A 388	IR	√	P	V	V	For Dia > 50 mm 40MM, , NOTE-1
		Hardness 54 to 60 HRC	Major	Mechanical	100%		Approved Drg/DS	Test Report	√	P	V	V	
2.0	**In Process Inspection**												
2.1	Impeller (Lobe with shaft assembly) after machining	Surface Defects in machining area	Major	DPT	100%		ASTM – 165 / No Linear Indication	IR	√	P	V	V	
		Dynamic Balancing	Major	Balancing	100%		ISO:1940 GR 6.3	IR	√	P	V	V	
2.2	Casing and end cover assembly	Pressure Test	Major	Hydro Test	100%		1.5 Times of Design pressure or 2 times of working pressure whichever is higher for 30 minutes / No leakage	IR	√	P	V	V	
3.0	**Final Inspection**												
3.1	Complete Blower Assembly	Overall Dimensions, completeness	Major	Visual & Measure	100%		Approved DRG	IR	√	P	W	W	
3.2		Performance Test with Shop Motor	Critical	Capacity, Head, speed Power, efficiency	100%		BS-1571 Part II/Approved Drg/Data Sheet	IR	√	P	W	W	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record		Agency			Remarks
					M	C/U			D	M	C	U	
3.3		Noise & Vibration	Critical	Measurement	100%		Approved Drg/Data Sheet	IR	√	P	V	W	
3.4		Painting	Minor	Visual & Measurement	100%		As per Approved Painting Specification	IR	√	P	V	V	
3.2	QA Documentation	Visual	Major	Review	100%		Approved QAP	Report	√	P	V	V	
NOTE-1: UT shall be carried out by using suitable frequency PROBE. Using this probe, the Back Wall Echo shall be set at 100% of Full Scale Height (FSH) in sound area. At this sensitivity level, any defect echo exceeding 20% of FSH is not acceptable. Also loss of back wall echo more than 20% at any location is not acceptable													
3.10.8 Fly Ash Feed Valve													
1.0	**Raw Material Inspection**												
1.1	Body Intake, Tee Intake	Mechanical Properties	Major	Hardness	1/Heat		Approved Drg./TDS	MTC	√	P	V	V	
		Chemical		Chem. Compo.	1/Heat			MTC	√	P	V	V	
		Dimensions		Measurement	100%			IR	√	P	V	V	
		Surface Defects		Visual	100%			IR	√	P	V	V	
1.2	Disc & Seat	Mechanical Properties	Major	Hardness	1/Heat		Approved Drg./TDS	MTC	√	P	V	V	
		Chemical		Chem. Compo.	1/Heat			MTC	√	P	V	V	
		Dimensions		Measurement	100%			IR	√	P	V	V	
		Surface Defects		Visual	100%			IR	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.3	Shafts	Chemical & Mech. Properties	Major	Chem. Analysis & Mech. Prop	1/Batch/Lot		Approved Drg./T DS	MTC	√	P	V	V	
									√	P	V	V	
									√	P	V	V	
									√	P	V	V	
1.4	Hopper Inlet	Physical Properties	Major	UTs & Hardness	1/Heat		Approved Drg./TDS	MTC	√	P	V	V	
		Surface Defects		Visual	100%			IR	√	P	V	V	
		Dimensions		Measurement	100%			IR	√	P	V	V	
1.5	Spring (Spring Steel)	Chemical Properties	Major	Chem. Analysis stiffness measurement	1/Batch		Approved Drg./TDS	MTC	√	P	V	V	
		Physical Properties			25%			IR	√	P	V	V	
		Dimensions			100%			IR	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.6	Diffuser Mounting plenum	Review Document & Operation	Major	Verification	100%		Approved Drg./TDS	IR & TC	√	P	V	V	
									√	P	V	V	
									√	P	V	V	
									√	P	V	V	
1.7	Porus Tile	Review Document & Operation	Major	Verification	100%		Approved Drg./TDS	IR & TC	√	P	V	V	
1.8	Pneumatic Cylinder	Review Document & operation	Major	Verification	100%		Approved Drg./TDS	IR & TC	√	P	V	V	
2.0	**In Process Inspection**												
2.1	Machining of components	Dimensions Surface Defects	Major	Measurement Visual	100%		Approved/Mfg. Drg	IR IR	√	P	V	V	
									√	P	V	V	
2.2	Machining of valve seat & Disc.	Machining Grinding Lapping	Minor	Measurement Blue Matching of Disc & Seat	100%		Mfr. Drg / Full circle matching (at least 80%of area)	IR IR IR	√	P	V	V	
									√	P	V	V	
									√	P	V	V	
2.3	Pressure testing of Hopper Inlet & Tee Intake	Leak Tightness	Major	Hydro Test	100%		Approved Drg./TDS	IR	√	P	V	V	
3.0	**Final Inspection**												

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
3.1	Complete Fly ash Feed Valve Assembly along with Air Cylinder	Dimensions & Completeness Operational Test(No Load) 10 cycles Seat vacuum Test	Major Major Major	Measurement Visual By Comp. Air -Do-	100% 100% 100%		Approved Drg./TDS Smooth operation	IR IR IR	√	P	W	W	
									√	P	W	W	
									√	P	W	W	
3.2	Painting	Appearance & Cleanliness	Major	Visual	100%		Approved painting schedule	IR	√	P	V	V	
3.3	QA Documentation	Visual	Major	Review	100%		Approved QAP	Report	√	P	V	V	
3.10.9 Air Washer													
1.0	**Raw Material Inspection**												
1.1	Body Steel plates, structural steel members	Chemical Composition	Major	Chemical	100%		Approved DRG/DATA SHEET	MTC/IR	√	P	V	V	UT of plate thickness more than 25mm
		Mechanical Test	Major	Mechanical	100%		Approved DRG/ DATA SHEET	IR	√	P	V	V	
2	**In Process Inspection**												
2.1	Body a) Marking, Cutting, edge preparation, Cleaning, tacking, straightness	Dimensional conformity	Major	Measurement/Visual	100%		AS per shop Drg	IR	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
	Weld joint & Welding	Welder Qualification and procedure welding	Major	Mechanical	100%		ASME Sec IX	PQR/WPS Certificate	√	P	V	V	
		Weld Quality	Major	DPT	100%		ASTME-165	IR	√	P	V	V	
2.2	Pipe connection and fittings	Dimensional conformity Alignment	Major	Measurement/Visual	100%		AS per shop Drg	IR	√	P	V	V	
2.3	Structural Welding	Weld Quality	Major	DPT on root run	100%		ASTME-165	IR	√	P	V	V	
				DPT on final & fillet weld	100%		ASTME-165	IR	√	P	V	V	
3	**Final Inspection**												
3.1	Check for critical dimensions, completeness	Dimensional conformity	Major	Measurement/Visual	100%		As per Approved DRG	IR	√	P	W	W	
3.2	Leak Test	Water Fill Test for 1 hour duration	Major	Fill Test	100%		As per Approved DRG	IR	√	P	W	W	
3.3	Painting	Paint shade, DFT	Major	Visual & Measurement	100%		Approved painting Schedule	IR	√	P	V	V	
3.4	QA Documentation	Visual	Major	Review	100%		Approved QAP-	Report	√	P	V	V	
3.10.10 Ash Slurry Pumps													
1.0	**Raw Material Inspection**												

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.1	Casing, impeller, Wear Ring/Wear Plate	Visual, Physical & Chemical	Major	Visual Measurement	1/Pouring		App. Drg/ Data sheet	MTC	√	P	V	V	
1.2	Shaft	Physical, Chemical	Major	Visual Measurement	1/Lot		App. Drg/ Data sheet	MTC	√	P	V	V	
2	**In Process Inspection**												
2.1	Machining of shaft, Bearing Housing Sleeve, Impeller Casing etc.,	Compliance Report	Major	Visual Measurement	100%		Mfr. Drawing	Inspection Report	√	P	V	V	
2.2	Casing Hydrostatic Test	Hydrostatic	Critical	Hydrostatic	As per Std		App. Drg/ Data sheet/ / As per IS 5120	Inspection Report	√	P	V	V	Hydrostatic Pressure 38.113b kg/cm² Duration = 30 mins
2.3	Impeller Dynamic Balancing	Dynamic Balancing	Critical	Measurement	AS per Std		As per Std / ISO 1940-1973 Gr.6.3	Inspection Report	√	P	V	V	
3	**Final Inspection**												
3.1	Dimensional	Overall Dimensional Conformity	Major	Visual Measurement	One/Type/Size		Approved Drawing/Data Sheet	Inspection Report	√	P	W	W	
3.2	Performance Test with Calibrated test lab motor	Q Vs H, P & Noise, Vibration	Critical	Performance	One/Type/Size		Approved Drawing/Data Sheet/IS 5120/BIS	Inspection Report	√	P	W	W	
3.3	Painting	Visual & DFT	Major	Visual & measure	Random		Approved Painting Schedule	Inspection Report	√	P	V	V	
3.10.11 Wetting Head													

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.0	**Raw Material Inspection**												
1.1	Casting (ejector head)	Chemical Composition	Major	Chemical	1 Sample /heat		Approved DRG/ Specification/DS	MTC/Lab TC	√	P	V	V	
		Mechanical Properties	Major	Mechanical	1 Sample /heat		Approved DRG/ Specification/DS	MTC/Lab TC	√	P	V	V	
		Casting Defects	Major	Visual Checking	100%		Approved DRG/ Specification/DS	IR	√	P	V	V	
		Hydro Test (Water jacket only) for 5 Min.	Major	Hydro Test	100%		Approved DRG/ Specification/DS / No Leakage/Sewage & Drop	IR	√	P	V	V	Hydro Test to be done before drilling of Nozzle hole.
		Hardness	Major	Measurement	100%		Approved DRG/ Specification/DS	IR	√	P	V	V	
1.2	Nozzle Tip	Chemical Composition	Major	Chemical	1 Sample /heat		Approved DRG/ Specification/DS	MTC/Lab TC	√	P	V	V	
		Mechanical Properties	Minor	Mechanical	1 Sample /heat		Approved DRG/ Specification/DS	MTC/Lab TC	√	P	V	V	
		Dimensional conformity	Major	Measurement	100%		Plant Drg.	IR	√	P	V	V	
		Hardness	Major	Measurement	100%		Approved DRG/ Specification/DS	IR	√	P	V	V	
2.0	**In Process Inspection**												
2.1	Drilling Machining, Visual & Dimensions	Accuracy/ Appearance & conformity to the drawing shape, size, orientation.	Major	Visual & Measurement	100%		Approval/Details Drg.	IR	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		All machined area DPT to be done before & after machining	Major	DP Test	100%		ASME SEC V / ASME SEC VIII Appendix & (cl 8-4)	IR	√	P	V	V	
3.0	**Final Inspection**												
3.1	Assembly	Dimension	Major	Measurement	100%		Approved DRG/ Specification/DS	IR	√	P	W	W	
		Completeness	Major	Visual Checking	100%		Approved DRG/ Specification/DS	IR	√	P	W	W	
3.2	Leakage Test	Water fill Test (2hr)	Major	Water fill Test	100%		Approved DRG/ Specification/DS / No Leakage/ Sewage & Drop	IR	√	P	W	W	
3.3	Painting	Paint shade, DFT	Minor	Measurement/Visual	100%		Approved painting Schedule	IR	√	P	V	V	
3.4	QA Documentation	Visual	Major	Review	100%		Approved QAP	Report	√	P	V	V	
3.11 COAL HANDLING PLANT													
3.11.1 Feed Ejector													
1.0	**Raw Material Inspection**												
1.1	Inlet liner, discharge throat, Tall pipe, Elbow, Plate, Flange	Chemical	Major	Chemical	1 Sample /heat		Approved /Mfg. DRG/ Specification	MTC/Lab TC	√	P	V	V	
		Mechanical Test	Major	Hardness Measurement	1 Sample /heat		Approved /Mfg. Drg/ Specification	MTC/Lab TC	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
1.2	Ejector head, Nozzle, Nozzle Tip	Chemical	Major	Chemical	1 Sample /heat		Approved /Mfg. DRG	MTC/Lab TC	√	P	V	V	
		Mechanical Test	Major	Mechanical	1 Sample /heat		Approved /Mfg. DRG	MTC/Lab TC	√	P	V	V	
1.3	NDT for Forged Flanges	NDT	Major	UT	1 Sample/heat		Approved /Mfg. DRG/REL STD	MTC/Lab TC	√	P	V	V	
2.0	**In Process Inspection**												
2.1	Inlet liner, Discharge throat, Tall pipe	Visual & Dimensional conformity	Major	Measurement/Visual	100%		Mfg. Drg/ Specification	IR	-	P	W	V	
2.2	Ejector Head	Visual & Dimensional conformity	Major	Measurement/Visual	100%		Mfg. Drg/ Specification	IR	√	P	W	V	
		Hydro Test (30 min)	Major	Hydro Test	100%		Approved Drg./ Specification/ No Leakage/ Seepage	IR	√	P	V	V	
2.3	Nozzle	Hardness	Major	Measurement	100%		Mfg. Drg/ Specification	IR	-	P	V	V	
3.0	**Final Inspection**												
3.1	Completeness and final dimensional examination for overall assembly	Fitment Dimension	Major	Measurement/Visual	100%		Approved Drg./ Specification	IR	√	P	W	W	
3.2	Leak Test	Water fill Test (1hr)	Major	Water fill Test	100%		Approved Drg./ Specification No Leakage/ Seepage /	IR	√	P	W	W	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
3.3	Painting	Paint shade, DFT	Minor	Measurement/Visual	100%		Approved painting Schedule	IR	√	P	V	V	
3.4	QA Documentation	Visual	Major	Review	100%		Approved QAP	Report	√	P	V	V	
3.11.2 Belt Weigher													
1.0	**Raw Material Inspection**												
1.1	Steel	i) Dimension ii) Chemical analysis iii) Mechanical Properties	Major	Visual Chemical Mechanical	100%	100%	As per ISO/BIS	As per ISO/BIS/ MTC	√	P	V	V	
1.2	Loadcell Blank	i) Visual dimension ii) Chemical test iii) Ultrasonic test iv) Hardness Test v) Planting DFT	Major	Visual, Chemical, Measurement	100%		Manufacturer Standard	Manufacturer Standard/ Test report/Lab report	√	P P	V W	V V	Witness of final plating DFT during final inspection
1.3	Speed Sensor	Visual & Functional	Major	Visual, Functional	100%		Relevant Standard/ Specification	Relevant Standard/ Specification/ Internal/ External Test Report	√	P	V	V	
1.4	Cable	i) Visual, Dimensional ii) Insulation, high voltage test	Major	Visual, Measurement	100%		Relevant Standard/ Specification	Relevant Standard/ Specification/ Internal/	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
								External Test Report					
1.5	Junction Box	i) Visual, Dimensional ii) ingress test	Major	Visual	100%		Relevant Standard/ Specification	Relevant Standard/ Specification/ Internal/ External Test Report	√	P	V	V	
1.6	Enclosure	i) Visual, Dimensional ii) Paints & Shade	Major	Visual Dimensional DFT	100%		Relevant Standard/ Specification	Relevant Standard/ Specification/ Internal/ External Test Report	√	P	V	V	
2.0	**In Process Inspection**												
2.1	Indicated/ Controller assembly and testing	i) Calibration ii) Functional check iii) Surface finish iv) NDT	Major	Visual, Dimensional	100%		Approved Specification	Approved Specification/ Internal/ External Test Report	√	P	V	V	
2.2	Fabricated & machined item	i) Visual, Dimension	Major	Visual, Dimensional, DP	100%		IPA Procedure	IPA Procedure Internal/	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
								External Test Report /					
3.0	**Final Inspection**												
3.1	Load Cell	i) Visual, Dimensional ii) Linearly, Accuracy iii) Ingress & temp test iv) capacity, make & model	Major	Visual, Dimensional, Functional	100%		Design Documents, test procedure, standard operating procedure(SOP)	IPA Procedure Internal/ External Test Report	√	P P P P	W V V V	W W W -	
3.2	Electronic testing under simulated conditions	i) Visual, Dimensional ii) Linearly, Repeatability, Calibration, functional, accuracy iii) Vibration, Ingress protection, temperature, sock test.	Major	Visual, Dimensional, Functional	100% Sampling 100%		Design Documents, test procedure, standard operating procedure(SOP)	IPA Procedure Internal/ External Test Report	√	P P P	W W V	W W W	
3.3	Mechanicals	i) Visual, Dimensional ii) Paint & Shade	Major	Visual, Dimensional, DFT	SAMPLING		Design Documents, standard operating procedure(SOP)	IPA Procedure Internal/ External Test Report	√	P	W	W	Witness of final paint, DFT during final inspection.

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
3.11.3 FR Grade Conveyor Belt													
1.0	**Raw Material Inspection**												
1.1	Raw Rubber	A) Volatile Matter B) Ash Content C)Mooney Viscosity D)Dirt Content E) Plasticity F) Retention Index	Major	Physical Chemical Physical Physical Physical Chemical	Random One Sample Per Lot	-	IS:4588 & Is:3660/ Mfr. Std.	Raw Material Analysis Sheet		V	-	-	
1.2	Zinc Oxide	A) Moisture Content B) Ignition Test C) Purity D)Particle Size E)Bulk Density F) Acid Insolubility	Major	Physical Chemical	Random One Sample Per Lot	-	IS:3399/ Mfr. Std.	Raw Material Analysis Sheet		V	-	-	
1.3	Stearic Acid	A) Ash Content B) Melting Point C) Acid Value	Major	Chemical Physical	Random One Sample Per Lot	-	IS:1675 / Mfr. Std.	Raw Material Analysis Sheet		V	-	-	
1.4	Carbon Black	A) Moisture Content B) Ash Content C)Iodine Absorption No. D)BDP Absorption	Major	Physical Chemical	Random One Sample Per Lot	-	IS:7497 & Is:7498/ Mfr. Std.	Raw Material Analysis Sheet	-	V	-	-	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		No. E) pH											
1.5	White Filter	A)Moisture Content B)Ignition Test C)Insolubility in HCl D) Particle Size	Major	Physical Chemical Chemical Physical	Random One Sample Per Lot	-	IS:1685/ Mfr. Std.	Raw Material Analysis Sheet	-	V	-	-	
1.6	Protective Agent	A)Moisture Content B)Ash Content C)Softening Point/Melting Point	Major	Physical Chemical Physical	Random One Sample Per Lot	-	Mfr. Standard	Raw Material Analysis Sheet	-	V	-	-	
1.7	Rubber/Chemicals/ Accelerators	A)Moisture Content B)Ash Content C)Meeting Point D)Solubility	Major	Physical Chemical Physical Physical	Random One Sample Per Lot	-	Mfr. Standard	Raw Material Analysis Sheet	-	V	-	-	
1.8	Sulphur	A)Moisture Content B)Ash Content C)Purity	Major	Physical Chemical Chemical	Random One Sample Per Lot	-	IS:8851/Mfr. Std.	Raw Material Analysis Sheet	-	V	-	-	
1.9	Plasticizer	A)Relative Density B)Aniline Point C)Viscosity	Major	Physical	Random One Sample Per Lot	-	Mfr. Standard	Raw Material Analysis Sheet	-	V	-	-	
1.10	Textile Fabric	A)Thickness B)Width C)Weight (GSM)	Major	Physical	Random One	Random One	Mfr. Standard	Textile Laboratory	√	V	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
					Sample Per Roll	Sample Per Roll		Testing Report					
1.11	Dipped Textile Fabric	A) Breaking Strength (Warp & Weft) B) Elongation At Break (Warp & Weft) C)Elongation T Ref. Load (Warp & Weft) D) Rubber Adhesio Cover To Ply And Ply To Ply E) Shrinkage (Warp & Weft) F) % Cramp (Warp & Weft)	Major	Physical	Random One Sample Per Batch	Random One Sample Per Batch	Mfr. Standard	Textile Laboratory Testing Report	√	V	V	V	
1.12	Rubber Compound	A) Rheometric Analysis B) Specific Gravity C)Hardness D)Tensile Strength E) Elongation At Break F) Adhesion	Major	Physical	Random One Sample Per Batch	Random One Sample Per Batch	Mfr. Standard	√Lab Report	√	P	V	V	
2.0	**In Process Inspection**												
2.1	Rubber Coating Of Fabrics	A)Ply Thickness B)Ply Width	Major	Physical	Each Ply	Each Ply	Mfr. Standard	Production Log	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		C)Ply Length D)Fabric Roll No. And Type E)Compound Code And Batch No.						Sheet/Internal Record					
2.2	Rubber Cover Sheeting/Calendering	A)Thickness B)Width C)Length D)Compound Code And Batch No.	Major	Physical	Each Sheet	Each Sheet	Mfr. Standard	Production Log Sheet/Internal Record	√	P	V	V	
2.3	Belt Building	A)Thickness B)Width C)Length D)Cover And Ply Position	Major	Physical	Each Belt	Each Belt	Mfr. Standard	Production Log Sheet/Internal Record√	√	P	V	V	
2.4	Moulding (Curing)	A)Curing Temperature B)Curing Time C) Hydraulic Pressure C) Cured Belt Width, Length And Thickness	Major	Physical	Each Belt	Each Belt	Mfr. Standard	Production Log Sheet/ Internal Record	√	P	V	V	
2.5	Dressing & Sizing	A)Finish B)Edge (Mould Cut)	Major	Visual	100%	100%	Approved Drg/Ds/ Tech. Specs	Production Log sheet/ Internal Record		P	V	-	
2.6	Cured Belt Inspection	Mapping Of Surface Defects Their Type And Repairs	Major	Visual	Each Belt	Each Belt	IS:1891/ Specification	Production Log sheet/ Internal Record	√	P	V	V	Refer Not-01

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
3.0	**Final Inspection**												
3.1	Dimensional and Visual	A) Visual Exam For Surface Finish B) Mapping Of Surface Defects Their Type And Repairs C)Length D)Edge (Mould/Cut) E) Width F) Shore Hardness G) Thickness Of Full Belt H) No. Of Plies I)Top & Bottom Cover Thickness	Critical	Physical	100% 100% 100% 100% Random Location In Each Roll Random Spots In Each Roll Each Roll Each Roll	Sample As Per Is:1891-1	Approved Drg/DS/ Tech. Specs.	IR	√	P	W	W	Refer Note-01 & 02 & 05
3.2	Tensile Strength Of Full Belt Thickness	A) Breaking Strength (Warp & Weft) B) Elongation At Ref. Load (Warp) C)Elongation At Break (Warp)	Critical	Physical	Each Roll	Sample As Per Is:1891-I	IS:1891 Part-I / Specification/ Approved Data Sheet	Laboratory Test Report	√	P	W	W	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
3.3	Adhesion	A) Top Cover To Ply B)Ply To Ply C)Ply To Bottom Cover	Critical	Physical	Each Roll	Sample As Per Is:1891-I	IS:1891 Part-I / Specification / Approved Data Sheet	Laboratory Test Report	√	P	W	W	
3.4	Troughability	Troughability	Critical	Physical	Each Roll	Sample As Per Is:1891-I	IS:1891 Part-I	Laboratory Test Report	√	P	W	W	Refer Note -02
3.5	Cover Rubber Properties	A) Cover Tensile Strength (Before & After Ageing) B) Elongationa At Break (Before & After Ageing)	Critical	Physical	Each Roll	Sample As Per Is:1891-I	IS:1891 (Part-I & V) / Specification / Approved Data Sheet	Laboratory Test Report	√	P	W	W	
		C)Angular Tear Strength	Critical	Physical	Each Roll	Sample As Per Is:1891-I	ASTM D 624 Type-C / Specification/ Approved Data Sheet		√	P	W	W	
		D)Abrasion Loss	Critical	Physical	Each Roll	Sample As Per Is:1891-I	Din:53516 / Specification/ Approved Data Sheet	Laboratory Test Report	√	P	W	W	
3.6	Fire Resistivity Test	A) Drum Friction Test	Critical	Physical	Each Roll	Sample As Per Is:1891-I	CAN/CSA/M422-M87 Type C	Laboratory Test Report	√	P	W	W	
		B) Flame Test	Critical	Physical	Each Roll	Sample As Per Is:1891-I	ISO 340	Laboratory Test Report	√	P	W	W	
		C)Electrical Surface Resistance Test	Critical	Physical	Each Roll	Sample As Per Is:1891-I	CAN/CSA /M422-M87 Type C	Laboratory Test Report	√	P	W	W	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
4.0	Identification & Marking	Belt number, manufacture's name, logo, belt ratting, grade, fabric type, and year of manufacture etc. shall be embossed by the manufacture on every valcanized length of belt or as per PO condition. Belts nos. Offered for inspection & belt nos. From which samples are drawn for testing shall be indicated in the CHP. Accepted belt nos. Shall be identified with signature and date using permanent marker as well as hard punch in white paint. The identification marks shall be preserved by the manufacturer.											
5.0	Dispatch	Packing And Marking	Major	Visual	Each Roll	Each Roll	Mfr. Standard Specs.	Finished Product Department Record		P	V	-	

NOTE-01: Defectogram shall be prepared by the belt manufacturer and shall be submitted for verification by NTPC representative/Inspection Engineer during Final Inspection. Following repair norms shall be applicable –

i) Patch repair: Localized rectification of surface blemishes/defect in cured belt by using rubber compound similar to the mother compound up to top carcass may be done followed by local vulcanization.

ii) Buffing/dough: Entrapment of foreign matters may be buffed. Depth of buffing should not exceed the difference in thickness of the rubber (as measured in test sample for the purpose of acceptance of cover rubber thickness) and the specified minimum cover thickness. Where the indentation depth is more, the same may be filled with rubber compound followed by vulcanization locally. The repairs of size up to and including (25X25 mm) (625 sq mm) shall not be considered as patch repair.

iii) a) Maximum number of repairs as per (i) as indicated above shall be limited to 5 per 100 sq . meters of belt area (rounded up to higher unit).

b) Total number of repairs as per (i) and (ii) indicated above shall not exceed more than 10 per 100 sq. meter of belt.

c) In case of patch repair as indicated in i above, the maximum size/area of each repair shall be limited to 1/5 W x1/5 W, with one-dimension Max, 1/5W, where 'W' is width of the belt.

Note-02: Sample shall be taken randomly from anywhere of belt roll/length offered for inspection. Belt to be supplied in 02 pieces and the lengths shall be indicated on packing drum.

Note-03: Latest edition of all the standards mentioned in the quality plan is to be used.

Note- 04 : Two Copies of MTC (material test certificate) and IR (Inspection report) to be submitted in hard form or soft form.

Note-05: Visual Inspection (including random check of belt width, hardness and total belt thickness) on both sides shall be done on the complete belts from which sample shall be taken as per IS-1891 part-I.

I	**3.11.4 FABRICATED GEAR CASE:**												
1.0	**Raw Material inspection**												
A1		Chemical Composition	Critical	Check Test	1 per heat	1 Per Heat	Relevant Material Specification as per Approved Drawing / DS.	TC	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
A2		Mechanical Properties	Critical	Tensile Test	1 per heat	1 Per Heat	Relevant Material Specification as per Approved Drawing / DS.	TC	√	P	V	V	
A3		Internal Defect	Major	UT	100%	100%	ASTM-A-435	TC	√	P	V	V	For Thickness >= 20 MM
II	**Pinions, Wheels & Shafts**												
(A)	**Raw Material (as per drawing)**												
A1	(Forgings & Round Bars of Carbon Steel / Alloy Steel)	Surface Condition	Major	Visual	100%	100%	Drawing/Relevant Standard	I.R./TC	√	P	V	V	
A2		Internal Defect	Critical	Ultrasonic	100%	100%	Relevant Standard	I.R./TC	√	P	V	V	
A3		Chemical Composition	Critical	Check testing	1/heat	1/heat	Relevant Material Specification as per Approved Drawing / DS.	TC	√	P	V	V	
A4		Mechanical Properties	Critical	Tensile test	1/heat	1/heat	Relevant Material Specification as per Approved Drawing / DS.	TC	√	P	V	V	
A5		Microstructure	Critical	Visual under microscope	1/heat	1/heat	Relevant Material Specification as per Approved Drawing / DS.	TC	√	P	V	V	
	In Process Inspection												

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
III.A													
1)	Gear Casing (Fabricated)	WPS/PQR/WPQ	Major	Verification	100%	100%	ASME Sec-IX	WPS/PQR/ WPQ	√	P	V	V	Refer Not-05
2)		Stress Relieving	Major	Visual	100%	100%	Mfr. S.R. Procedure	H.T. Chart	√	P	V	V	
3)		Surface Defect (Welding)	Major	DP Test on Weld	100%	100%	ASTM E 165 / No Linear Indication	IR	√	P	V	V	
III.B													
1)	Pinion and Gear (After Machining & Case Hardening)	Case Depth	Major	Measurement	1/HT Batch	1/HT Batch	Mfr. Standard	IR	√	P	V	V	
2)		Hardness	Major	Measurement	1/HT Batch	1/HT Batch	NTPC Approved Drawing / DS	IR	√	P	V	V	
3)		Surface Defect	Major	DP Test	100%	100%	ASTM E 165 / No linear Indication	IR	√	P	V	V	
4)		Dimension	Major	Measurement	100%	-	Mfr. Drawing	IR		P	-	-	
III.C													
1)	Input and Out Put Shaft after Machining	Dimension	Major	Measurement	100%	-	Mfr. Standard	IR	√	P	--	-	
2)		Surface Defect	Major	DP Test	100%	100%	ASTM E 165 / No linear Indication	IR	√	P	V	V	
3)		Hardness	Major	Measurement	1/HT Batch	1/HT Batch	NTPC Approved Drawing / DS	IR	√	P	V	V	
IV	**Final inspection of assembled gear box**												
1)		Arrangement Verification	Major	Visual	100%	10%	Approved Drawing.	IR	√	P	W	W	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
2)		Overall Dimensions & Completeness	Major	Measurement	100%	10%	Approved Drawing.	IR	√	P	W	W	
3)		Backlash	Critical	Measurement	100%	10%	Mfr. Standard / Approved Drawing	IR/TC	√	P	W	W	
4)		Contact Pattern	Critical	Blue matching	100%	10%	Mfr. Standard / Approved Drawing	IR/TC	√	P	W	W	
II	**No-Load Running Trial Test**												
1)		Reduction Ratio	Critical	Visual/ Measurement	100%	10%	Approved Drawing / Datasheet	IR	√	P	W V	W	
2)		Oil Leakage	Critical	Visual	100%	10%	Relevant Standard / No Leakage	IR	√	P	W V	W	
3)		Temp rise of Oil	Critical	Measurement	100%	10%	Relevant / Standard	IR	√	P	W V	W	
4)		Noise Level	Critical	Measurement	100%	10%	Max 85 DBA at 1 Mtr in horizontal direction and 1.5 M in elevation.	IR	√	P	W	W	
5)		Vibration	Critical	Measurement	100%	10%	ISO 10816 / 5mm/sec RMS MAX (Group B based on the class)	IR	√	P	W	W	
II)	**Painting, packing & identification**												

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check			Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U					M	C	U	
1)		Uniformity of Coating & Finishing, DFT Measurement	Major	Visual	100%	100%		As per Approved Data Sheet.	IR	√	P	V	V	
3.11.5 In Line Magnetic separator														
1.0	**Raw Material inspection**													
1.1	Top & Side plates	Visual/ dimensional/ Chemical	Minor	Visual/ physical measurement	100%	100%	100%	G.A. Drg/ Approved Drawing	MTC	√	P	V	V	
1.2	Nonmagnetic Sheet (S.S)	Visual/ Dimensional /Chemical	Minor	Visual/ physical/ chemical	100%	100%	100%	G.A. Drg/ Approved Drawing	MTC	√	P	V	V	
1.3	Coil material – Anodized Annealed Aluminum strips	MTC	Critical	MTC	100%	100%	100%	Relevant Standard/ Specification. Approved Drawing	MTC	√	P	V	V	
1.4	Switch gear/Geared Motor, Belting Pulley, Rectifier Transformer	Visual/Electrical/Type/Rating Verify/ Continuity Check	Major	Visual	100%	100%	100%	G.A. Drg/ App. B.O.M	IR	√	P	V	V	
1.5	In Process Fabrication Marking, Cutting, Drill	Workmanship, Dimensions & DP Test of Welding leakage test on tank	Major	Visual/ physical measurement	100%	100%	100%	G.A. Drg/ Approved Drawing	IR	√	P	V	V	
1.6	Silicon Oil	Electrical & Chemical	Major	Visual, Measure	1/Lot	1/Lot	1/Lot	G.A. Drg/Relevant Std./ Approved Drawing	IR	√	P	V	V	
2.0	**In process inspection**													

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check			Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U					M	C	U	
2.1	Magnet housing fabricator	Visual/ dimensional	Major	Visual/ physical measurement	100%	100%	100%	App.G.A. Drg	ITC	√	P	V	V	Degree of protection (DOP) certificate to verification shall be produced.
2.2	Control Panel manufacturing	BOM/make ferruling/wire size/terminal/ marking interlock/ functional Check/H.V. Test /Insulation Resistance Test/Painting shade thickness	Major	Visual/ dimensional / electrical/ Megger test/HV test	100%	100%	100%	App.G.A. Drg	ITC	√	P	W	W	
3.0	**Final inspection**													
3.1	In Line Magnetic Separator (Electric Magnetic Type)	Visual/ Dimensional/ operational check with control panel	Critical	Visual physical measurement/HV test & Insulation Resistance test current & voltage measurement/Temp rise test, load test in hot & cold condition, force index, calculation at hot steady state, Noise level.	100%	100%	100%	App.G.A. Drg	ITC	√	P	W	W	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check			Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U					M	C	U	
3.2	Random lifting of tramp iron pieces as per App. Drg & Lifting force	performance	Major	Functional	100%	100%	100%	App.G.A. Drg	ITC	√	P	W	W	
3.3	Gauss Valve	Electrical	Major	Gauss valve	100%	100%	100%	App.G.A. Drg	ITC	√	P	W	W	
3.4	Painting	Painting shade/DFT	Major	Visual/ Thickness of paint	100%	100%	100%	As per Approved Painting Specs.	ITC	√	P	V	V	

Note**:**
1. Statutory requirement will be complied.
2. Instruments used for test shall have valid calibration certificate with tractability to national level.
3. Bought out items shall be from approved vendor by Customer.
4. All inspection/verification/NDT report along with material certificate shall be reviewed at the time of witness point.
5. W at customer column shall be considered as hold point/Witness.

3.11.10 Toothed Ring Hammers

1.0	**Raw Material Inspection**												
1.1	Casting Hammers and Test bar Elements of C, Si, Mn, P, S, Cr	Chemical Properties	Major	Chemical analysis	One Sample/Heat	As per Approved Drawing & IS 276 Grade 3/ Clause 8, Table-1	MTC	√	P	V	V	
2.0	**In Process Inspection**												
2.1	Heat treatment	Mechanical	Major	Heat Treatment	100%	As Per IS 276 Grade 3	HT Chart	√	P	V	V	
2.2	Brinells Hardness Test	Mechanical	Major	Harness check Physical	Min 10% Heat & HT Batch	As Per IS 276 Grade 3	TC	√	P	V	V	Max Hardness HB 229 BHN Class II

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
2.3	Bend Test	Mechanical	Major	Mechanical Test Physical	IS 6907		As Per IS 276 Grade 3/ Clause 14.3	TC	√	P	V	V	
2.4	Liquid penetrant Test	Mechanical	Major	NDE	Min 10% of offer Qty		IS 3658/ IS 11732	TC	√	P	-	V	
2.5	Radiographic test	Mechanical	Major	Physical	IS 6907		IS 2595/ IS 12938	TC	√	P	-	V	
3.0	**Final Inspection**												
3.1	Finished Hammer for Coal Crushers	Surface Defects, Marking and Dimensional (OD, ID, Height, Width, Thickness, Edge Preparation)	Major	Measurement	100% / Random 5%		As per Approved Drawing	IR	√	P	W	W	See Note 1&2
3.2		Chemical Composition	Major	Chemical Analysis	One Sample/Heat		Approved Drawing/DS / IS 276 Grade 3, Clause 8, Table-1	IR	√	P	W	W	Testing with PMI
3.3		Bend Test on Test bar	Critical	Bend Test	One Sample/Heat		Approved Drawing/DS/ IS 276, Clause 14.3	IR	√	P	W	W	Max Hardness HB229BHR: and see Note 2 & 3
3.4		Hardness	Major	Mechanical	Random 10% of offer Qty 1 per Heat per Batch		IS 276 Gr. III / IS 276, Clause 14.2	IR	√	P	W	W	Approximate weighment of each hammer 39.5 kg Tolerance +/-0.50kg
3.5		Weight	Critical	Measurement	100% offer Qty / Random 5% offer Qty		As per Approved Drawing/Data Sheet	IR	√	P	W	W	
3.6		Drop Test	Major	Mechanical	Random 1% offer Qty		See Note 4	IR		P	W	W	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
3.7	Finished Hammer for Coal Crushers	Painting	Major	Visual	100%		IS 276 Clause 18	IR	√	P	W	W	Painting with Red oxide and weighment marking on each hammer with yellow paint
	Note:- 1. Casting should be properly fitted and dressed before inspection. Risers/Runners shall not be removed by gas cutting. Surface cracks and pitting visible to naked eyes, are not acceptable. 2. Dimensions and weights shall be as per approved drawing/data sheet/technical specifications with a max. Variation of +/-1mm in dimensions and +/-0.5 Kgs in Weights. 3. Weight of hammer casting should be punched on each casting and embossing of plant name, Heat batch number and firm name. 4. Drop test: The hammer casting shall be keep with its axis in horizontal position, over a steel plate. A dead weight of not less than 100Kgs shall be dropped on the casting, from not less than 03 Mtrs height. Any crack or chip off is not acceptable. Further any significant variation in dimensions after drop test is not acceptable. In case of failure of the first sample, two more samples, for each failed sample, from the same lot, shall be subjected to the drop test. In case of failure in retest, the entire lot shall be rejected and hammer castings used in drop test are not to be supplied and are to be destroyed in presence of TSGENCO. 5. Hardness shall be measured by digital hardness tester. 6. Weld repair on the hammer castings is not acceptable. 7. Manufacturer shall ensure proper surface protection on the castings, prior to dispatch.												
3.11.11	**Vibrating Feeders**												
1.0	**Raw Material Inspection**												
1.1	Plates for Feeder/Screen body	Chemical & Mechanical Properties	Major	MTC	1/Heat	1/Heat	1/Heat	Approved Drawings/ Relevant STD	Mill TC	√	P	V	V	
		NDE (UT) for plate material soundness for 40mm thickness and above.	Major	Testing	100%	100%	100%	ASTM A 435	NDE Report	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check			Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U					M	C	U	
1.2	Stiffness Angles/Flat/Channel /Rectangular Section/Pipe Beams/Exciter Shaft	Chemical & Mechanical Properties	Major	MTC	1/Heat	1/Heat	1/Heat	Approved Drawings/Relevant STD	Mill TC	√	P	V	V	
1.3	Liner Plates	Chemical & Mechanical Properties	Major	MTC	100%	100%	100%	Approved Drawing/ Relevant Standard	MTC	√	P	V	V	
2.0	**Bought Out Items**													
2.1	Bearings	Visual, Identification & Review of warranty certificate	Major	Warranty Cert.	100%	100%	100%	Tech. Specification	Warranty Certificate	√	P	V	V	Bearings shall be procured from original manufacture (SKF/NTN)
2.2.	Coil spring	Visual, Dimensions & Review of MTC	Major	MTC	100%	100%	100%	Approved Drawings/ Tech. Specification	MTC	√	P	V	V	
2.3	Fasteners of vibrating Parts	Chemical & Mechanical Properties, Visual and Grade	Major	Visual, Measurement & Verification	Random	Random	Random	Tech. Specification/ Mfg Drgs	MTC	√	P	V	V	
3.0	WELDING CONTROL													
3.1	Procedure & performance Qualification	Review of established WPS, PQR & WPQ	Major	Verification	100%	100%	100%	ASME Sec-IX	WPS, PQR & WPQ	√	P	V	V	
3.2	Welding electrodes	Baking & Holding of electrodes for low hydrogen	Major	Visual & Measurement	100%	100%	100%	Mfg .Recommendation /Standard Procedure	Register		P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check			Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U					M	C	U	
		electrodes (if applicable)												
4.0	In Process Inspection													
4.1	Material Preparation	Edge preparation (Bevel angle and Root face)	Major	Visual & Measurement	100%	100%	100%	As per /Drawings	I/R	√	P	V	V	Verification at Final Inspection
	Weld Joints	Fitment and alignment (Root gap & bevel angle)	Major	Visual & Measurement	100%	100%	100%	As per /Drawings	I/R	√	P	V	V	Verification at Final Inspection
4.2	Weld soundness	NDE for filler welds	Major	DPT	10%	10%	10%	ASME Sec-VIII Div-1 app.8/ASTM SE 165	NDE Report	√	P	V	V	
5.0	**Final Inspection**													
5.1	Sub assembly of Feeder/Screen other accessories	Completeness & Dimensions	Major	Visual & Measurement	100%	100%	100%	Approved Drawings/ Tech. Specifications	IR	√	P	W	W	
5.2	UB Motor Exciter Assembly	Completeness & Dimensions of final assembly, Motor Data (Resistance Value, HV Test & Reduce voltage)	Major	RTC	100%	100%	100%	Manufacturing Drawing/ Tech. Specification	RTC	√	P	W	W	
5.3	Final Assembly	Completeness & Dimensions of final assembly, no load running test speed (RPM), amplitude (stroke), Temperature rise & Noise Level	Major	Visual & Measurement	100%	100%	100%	Mfg. Drawing & Standard Procedures	IR	√	P	W	W	No Load running test shall be conducted fo 4-hours at available test bed in works. Amplitude of vibration, Bearing temperature rise and

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
													Noise Level is measured. Vibration will be recorded in vibograph , Noise Level shall be 85 dBA at 1.0m in horizontal and 1.5m in vertical.
5.4	Surface preparation & Painting	Roughness	Major	Visual & Measurement	100%	Random	Random	Approved Drawing/ Painting Specification	IR	√	P	V	V	
		Visual, Shade, DFT	Major	Visual & Measurement	100%	Random	Random	Approved Drawing/ Painting Specification		√	P	W	W	
5.5	Final Documentation	Complete Inspection documents	Major	Verification	100%	100%	100%	AS per approved MQP	IR	√	P	V	V	
Note: No load test procedure shall be tied up during QAP Approval.														
3.11.12 Vibration Isolation System														
1.0	**Raw Material Inspection**													
1.1	For Boxes	Chemical / Mechanical	Minor	Verify	One / Heat		IS 2062/Approved Diagram/ Approved Specification	MTC	√	V	V	V		
1.2	For Springs	) Chemical	Major	Verify	One / Lot		IS 2062/Approved Diagram/ Approved Specification	MTC	√	V	V	V		
		) Grain Size	Major	Verify	One / Lot		ASTM E 112/Approved Specification	MTC	√	V	V	V		

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
		) Micro Structure	Major	Verify	One / Lot		Tempered Martensite / Approved Specification	MTC	√	V	V	V	
1.3	Springs at Manufacturer's end	Hardness	Major	Test	One / Lot		IS 1500 / 415-460 BHN	MTC	√	V	V	V	
1.4	Springs at Manufacturer's end	Decarburization	Major	Test	One / Lot		IS 6396 / Max. depth 0.5% bar dia – partial	MTC	√	V	V	V	
1.5	Springs at Manufacturer's end	NDE after ompression	Major	MPI	100%		IS 3703 / No cracks	MTC	√	V	V	V	
1.6	Adhesive pads (jute) 4mm thick, Steel shims	Dimensions (mm)	Minor	Measurement/ Visual	5%		Approved Drawing	Internal Record	√	P	V	V	
1.7	Studs & Nuts	Chemical/ Mechanical	Minor	Verify	One / Lot		Approved Specification	Lab Test Report	√	V	V	V	
		Dimensions	Minor	Measurement	5%		Approved Specification	Internal Record	√	P	V	V	
2.0	In Process Inspection												
2.1	Welding	Visual/Surface exam (mm)	Major	Visual/ Measurement	10% on welds		Approved Drawing/Data Sheet	Certificate	√	P	V	V	
		NDE	Major	DPT	10% Random		ASTM/E 165	Certificate	√	P	V	V	
2.2	Boxes	Dimensions (mm)	Major	Measurement	10%		Drawing/Data sheet	Internal Record	√	P	V	V	
3.0	Final Inspection												
3.1	Shot Blasting	Picture	Major	Compare	10%		Approved Drawing/Data Sheet	IR	√	P	V	V	
3.2	Painting	Thickness (180 microns)	Major	Measurement/ Visual	10%		Approved Drawing/Data Sheet	IR	√	P	V	W	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check			Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U					M	C	U	
3.3	Spring Unit	Dimensions (Except HF&HV)	Minor	Measurement	10%			Approved Drawing/Data Sheet	Internal Record	√	P	W	W	
3.4	Constant of Spring Units (Vertical Kv)	Load Vs Displacement (kN/mm)	Critical	Test	10%			Approved Drawing/Data Sheet	Certificate	√	P	W	W	
3.5	Document Control	Verification of above documents (TC/IR)	Major	Compare	All			Approved MQP	Certificate	√	P	V	W	
3.6	Packing / Marking	visual	Major	Visual/ Compare	100%			Approved Specification	IR	√	P		V	
3.11.13 Pulley														
1.0	**Raw Material & Bought out Inspection**													
1.1	Shell Plate(MS)	Chemical, Mechanical, Physical	Major	Chemical Mechanical	1/ Heat	1/ Heat	1/ Heat	Approved drawing	Mill TC/Lab TC	√	P	V	V	UT fore plate above 25mm thickness
		Ultrasonic test*		NDT	100%	100%	100%	ASTM A435	UT Report	√	P	V	V	
1.2	SS Plate for Non-magnetic pulley	Chemical, Mechanical	Major	Chemical Mechanical	1/ Heat	1/ Heat	1/ Heat	Approved drawing	Mill TC/Lab TC	√	P	V	V	
1.3	Shaft(forged)	Chemical, Mechanical, Physical, Heat Treatment, Microstructure & Hardness	Major	Chemical Mechanical HT	1/ Heat	1/ Heat	1/ Heat	Approved drawing	Mill TC/Lab TC	√	P	V	V	UT Applicable on above 50mm Dia shaft
		Ultrasonic test*		NDT	100%	100%	100%	ASTM A 388	UT Report	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check			Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U					M	C	U	
1.4	Hub	Chemical, Mechanical	Major	Chemical Mechanical	1/Heat	1/Heat	1/Heat	Approved drawing	Mill TC/Lab TC	√	P	V	V	UT Applicable on above 50mm Dia hub
		Ultrasonic test*		NDT	100%	100%	100%	ASTM A 388	UT Report	√	P	V	V	
1.5	SS Plate for Non-magnetic Pulley	Chemical, Mechanical	Major	Chemical Mechanical	1/Heat	1/Heat	1/Heat	Approved drawing	Mill TC/Lab TC	√	P	V	V	
1.6	Diaphragm	Chemical, Mechanical, Physical	Major	Chemical Mechanical	1/Heat	1/Heat	1/Heat	Approved drawing	Mill TC/Lab TC	√	P	V	V	UT fore plate above 25mm thickness
		Ultrasonic test*		NDT	100%	100%	100%	ASTM A435	UT Report	√	P	V	V	
1.7	Rib Plate	Chemical, Mechanical	Major	Chemical Mechanical	1/Heat	1/Heat	1/Heat	Approved drawing	TC/GC	√	P	V	V	
1.8	Plummer Block & Bearing	Verification of make & Number	Major	Visual	Random	Random		Approved drawing	TC	√	P	V	V	
2.0	**In process Inspection**													
2.1	Fitup & Welding of shell plate & Diaphragm Plate	Mismatch/ Dimension /Weld Defects	Major	Visual & Measurement	100%	100%	100%	Approved drawing	IR	√	P	V	V	
2.2	NDT	(*)Pulley Shell L-seam	Major	RT/UT&MPI	100%	10% from each offered lot		ASME SEC – V / ASME Sec VIII DIV.1	NDT Report	√	P	W	V	10% Witness & 90% verification
		Full penetration weld (End Disc to shell)		UT&DPT	100%	10% from each offered lot		ASME SEC – V / ASME Sec VIII DIV.1	NDT Report	√	P	W	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check			Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U					M	C	U	
		Filler weld (End Disc to Hub)		DPT/MPI	100%	10% from each offered lot		ASME SEC – V / ASME Sec VIII DIV.1	NDT Report	√	P	W	V	
2.3	Machining of Pulley Shaft	Measurement	Major	Dimension & run out	100%	100%	100%	Approved drawing	IR	√	P	W	V	
		DPT on machined Shaft	Major	NDT	100%	100%	100%	ASME SEC – V / ASME Sec VIII DIV.1	DPT Report	√	P	V	V	
3.0	**Final Inspection**													
3.1	Visual, Dimensional, Out of roundness, Eccentricity & Static balancing before rubber lagging.	Accuracy/appearance & conformity to the approved Drg.	Major	Visual, Measurement	100%	10% from each offered lot		Approved Drg, Spec & IS: 8531	IR	√	P	W	V	
3.2	Rubber Lagging	Visual, Thickness, Shore hardness, Spark Test, Strength, EI & Abrasion loss, adhesion strength, specific gravity	Major	Visual, Measurement	100%	10% from each offered lot		Approved drawing	IR	√	P	W	V	
		Ash content	Major	Test	100%	10%	10%	Approved drawing / 12% Max	IR	√	P	W	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U				M	C	U	
3.3	Static balancing after lagging	Accuracy/appearance & conformity to the approved Drg.	Major	Measurement	100%	10% from each offered lot	Approved Drg, Spec & IS: 8531	IR	√	P	W	V	
3.4	Painting	Surface preparation, Painting thickness & Shade	Major	Measurement	100%	Random	AS per painting specification	IR	√	P	V	V	
3.5	QA documentation Marking, Packing	Checking of all QA point	Major	Visual	100%	- -	Approved Diagram	IR	√	P	V	V	
3.6	Visual, Dimensional, Out of roundness, Eccentricity & Static balancing before rubber lagging.	Accuracy/appearance & conformity to the approved Drg.	Major	Visual, Measurement	100%	10% from each offered lot	Approved Drg, Spec & IS: 8531	IR	√	P	V	V	
3.7	Rubber Lagging	Visual, Thickness, Shore hardness, Spark Test, Strength, EI & Abrasion loss, adhesion strength, specific gravity	Major	Visual, Measurement	100%	10% from each offered lot	Approved drawing	IR	√	P	V	V	
		Ash content	Major	Test	100%	10% 10%	Approved drawing / 12% Max	IR	√	P	V	V	
3.8	Static balancing after lagging	Accuracy/appearance & conformity to the approved Drg.	Major	Measurement	100%	10% from each offered lot	Approved Drg, Spec & IS: 8531	IR	√	P	V	V	
3.9	Painting	Surface preparation,	Major	Measurement	100%	Random	AS per painting specification	IR	√	P	V	V	

Sl, No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check			Reference Document / Acceptance Norms	Format of Record	D	Agency			Remarks
					M	C/U					M	C	U	
		Painting thickness & Shade												
3.10	QA documentation Marking, Packing	Checking of all QA point	Major	Visual	100%	-	-	Approved Diagram	IR	√	P	V	V	

1.6 ELECTRICAL SYSTEMS

1.6.1 Generator and auxiliary systems

1.6.1.1 Process check for static parts of generator/ exciter

Items/ Components/ Process	Tests/ Checks												
	Visual, dimension	Chemical property (raw material)	Heat treatment	Mechanical property (raw material)	Impact (raw material)	Hydraulic test	Pneumatic test	RT or UT (10% for butt weld)	MP or DPT (All welds)	Relative permeability	Ferrite content	DIN 43760, IS:2848,7358	DIN 48124
Sheet and Fabrication :													
- END shield	Y	Y	Y	Y	Y	Y	Y	Y	Y				
- Stator casing	Y	Y	Y	Y	Y	Y	Y	Y	Y				
- Bushing boxes	Y	Y	Y	Y	Y	Y	Y	Y	Y				
- Terminal plates	Y	Y	Y	Y	Y	Y	Y		Y				
- Manhole andcovers	Y	Y	Y	Y	Y	Y	Y		Y				
- Trunniuns	Y	Y	Y	Y	Y			Y	Y				
- Core bar	Y	Y		Y									
- Press ring	Y	Y		Y					Y				
- Core bolt (insulated)	Y	Y		Y				Y	Y				
- Gaskets	Y			Y									
- Bearing sealsand hydrogen seals	Y	Y		Y				Y1					
- Terminalbushing													Y
- RTD/ Thermocouple												Y	
Additional check for nonmagnetic components										Y			
Non magnetic componentswelding											Y		

Y=Test applicable, Y1=UT on babbit for bearing

1.6.1.2 Process check for core of generator/ exciter (Table 1/2)

Items/ Components/ Process	Tests/ Checks							
	Specific loss before and after ageing	Magnetisation	Anotrophy of losses	Stacking factor	Burr level	Check for varnish, insulation (chemical, electrical, viscosity, cure time, solid content, dielectric properties)	Dimension and surface (uniformity of varnish coat	Spot weld check
Core lamination	Y	Y	Y	Y		Y	Y	
After punching insulated core laminations				Y	Y	Y	Y	
Ventilation stamping								Y
Core assembly	Y	Y					Y1	

Y = Test applicable, Y1 = Visual checks

1.6.1.2 Process check for core of generator/ exciter (Table 2/2)

Items/ Components/ Process	Tests/ Checks					
	Process check including heating and	Insulation test of core tension bolt and core bar	Functional check of ventilation ducts	Hot spot by infra red camera, ELCID pressure application	Location of temperature detectors	Iron loss at rated flux density
Core assembly (additional checks for generator)	Y	Y	Y	Y	Y	Y

Y = Test applicable, Y1 = Visual check

1.6.1.3 Process check for stator conductor and winding of generator/ exciter (Table 1/3)

	Tests/ Checks											
	Mechanical Properties (sample)	Chemical Properties (sample)	Resistivity/ Resistance	Metallography properties	Eddy current and pressure test	Insulation adhesion	Flexibility of bending	Dielectric test	Dimension/ visual	Electric test	Physical properties	Brazing procedure
Winding copper and connecting busbars	Y	Y	Y	Y	Y1				Y			
Insulated conductor						Y	Y	Y	Y	Y		
Insulation material	Y	Y							Y	Y	Y	
Manufacturing winding bar and phase bar								Y	Y	Y		Y
Winding laying								Y	Y	Y		
Water supply hoses	Y	Y						Y	Y			
Winding supportring		Y							Y		Y	
Connection between bars												Y
Wound stator												
Y = Test applicable, Y1 = Visual checks												

1.6.1.3 Process check for stator conductor and winding of generator/ exciter

(Table 2/3)

Items/ Components / Process	Tests/ Checks				
	X-Ray	Process check	Flow test	Helium leak test and pressure test	Check on RTD and location
Winding copper and connecting busbars					
Insulated conductor					
Insulation material					
Manufacturing winding bar and phase bar	Y1	Y	Y1	Y	
Winding laying		Y			Y
Water supply hoses				Y	
Winding support ring					
Connection between bars					
Wound stator				Y1	
Y = Test applicable, Y1 = Visual checks					

1.6.1.3 Process check for stator conductor and winding of generator/ exciter (Table 3/3)

Items/ Components/ Process	Tests/ Checks										
	Tan delta and delta (tan delta upto 1.2 Un)	Corona protection resistance	Reactance of stator winding	Magnetic permeability of metallic parts	Magnetic test and Vibration fatigue	Dielectric test at elevated, room temperature	Inter strand Insulation test	Thermal shock and boroscopic examination of brazed water box	Slot wedge tightness and radial movement	Type test on two bars for heating cycle test, Thermal stability test, Voltage endurance test	Support arrangement
Winding copper and connecting bus bars											
Insulated conductor						Y					
Insulation material											
Manufacturing winding bar and phase bar	Y	Y					Y	Y1		Y	
Winding laying	Y										Y
Water supply hoses				Y	Y						Y
Winding support ring											
Connection betweenbars							Y				
Wound stator	Y		Y						Y		
Y = Test applicable, Y1= Applicable for hollow conductor											

1.6.1.4 Process check for rotor and assembly of generator / exciter (Table 1/4)

Items/ Components/ Process	Tests/ Checks											
	Sample tensile stress	Sample 0.2 limit	Sample elongation	Hardness on sample	Impact and stress rupture propertiescheck on sample	Sample chemical properties	NDTT, FATT	Process check including heat treatment (as applicable)	Ultrasonic test/ RT (at suppliers works and after preliminary machining)	Sulphur prints check flux carrying capacity/ magnetic	Flux carrying capacity/ magneticproperties	Boroscopic examination
Rotor forging and slip ring shaft	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Rotor end retaining ring and cover, locking ring and slip ring forgings, diode wheel	Y	Y	Y		Y	Y		Y	Y			
Rotor winding copper rotor wedges, damper wedges, CC-bolts and D-leads	Y		Y			Y		Y	Y			
Rotor slot boxes/ insulating material						Y						
Coil manufacture												
Rotor winding								Y				
Winding connection studsand assembly												
Complete rotor								Y				
Test on completed rotor at various speed upto rated speed												
Test on completed rotor before and after overspeed												
Fan hubs/ blades						Y		Y	Y			
Generator assembly												
Rectifier wheel	Y		Y					Y	Y			
Permanent magnet					Y						Y	
Exciter assembly												
Y = Test applicable												

1.6.1.4 Process check for rotor and assembly of generator / exciter (Table 2/4)

Items/ Components/ Process	Tests/ Checks											
	MPI or DP, NDT	Visual, dimension, cleanliness	Adhesion, thickness of coat onsilver plating	Electrical conductivity andoxygen content	Mechanical test on sample	Electrical test	Resistance measurement	Purge test on vents	Helium leak test for H_2 cooled machine	Inter-turn test	Dielectric test	Gas tightness
Rotor forging and slip ring shaft	Y	Y										
Rotor end retaining ringand cover, locking ring and slip ring forgings, diode wheel	Y		Y									
Rotor winding copper rotor wedges, damper wedges, CC-bolts andD-leads	Y		Y	Y	Y	Y						
Rotor slot boxes/ insulating material					Y	Y						
Coil manufacture		Y										
Rotor winding	Y	Y				Y	Y	Y	Y	Y	Y	
Winding connection studs and assembly	Y				Y						Y	Y
Complete rotor							Y				Y	
Test on completed rotor at various speed upto rated speed							Y			Y	Y1	
Test on completed rotor before and after over- speed		Y								Y	Y	
Fan hubs/ blades	Y	Y										
Generator assembly		Y										
Rectifier wheel		Y				Y						
Permanent magnet		Y			Y							
Exciter assembly		Y				Y						
Y=Test applicable, Y1= at rated speed only												

1.6.1.4 Process check for rotor and assembly of generator / exciter (Table 3/4)

Items/ Components/ Process	Tests/ Checks											
	Insulation Resistance	PI at 5 kV	Radial run out/ alignment	Impedence measurement/ Repetitive Surge Oscillograph	Dynamic balancing ISO 5393, 5406, 2372, 1940 including Air run test	Over speed test (120%) for 2 minute	Functional test	Axial run out, seal ring holder	Metallography examination	Torque on joint bolts	Fitting and locking of balancing weights	Brazer and brazing procedure
Rotor forging and slip ring shaft									Y			
Rotor end retaining ring and cover, locking ring and slip ring forgings, diode wheel												
Rotor winding copper rotor wedges, damper wedges, CC-bolts and D-leads										Y		
Rotor slot boxes/ insulating material												
Coil manufacture												Y
Rotor winding												Y
Winding connection studs and assembly	Y											
Complete rotor	Y	Y	Y	Y	Y	Y				Y		
Test on completed rotor at various speed upto rated speed				Y								
Test on completed rotor before and after over-speed	Y		Y	Y								
Fan hubs/ blades											Y	
Generator assembly	Y	Y	Y				Y		Y	Y	Y	Y
Rectifier wheel			Y					Y		Y	Y	
Permanent magnet												
Exciter assembly			Y				Y			Y	Y	
Y=Test applicable												

1.6.1.4 Process check for rotor and assembly of generator/ exciter (Table 4/4) (additional checks for exciter)

Item/ Components/ Process	Tests/ Checks								
	As per IEC-146	As per IEC-76	Pole parallelism and polarity	Mechanical chemical andMagnetic properties	Functional check	Insulation resistance	IEEE/ ANSI-C37.18	As per specification	Dimensional and visual
Fuse diode and filter Circuit	Y								Y
PMG and exciter stator			Y	Y		Y			
Banding wire				Y					
Exciter field Breaker, field discharge resistor					Y				
Bearing, exciter armature field, axis coil RTD						Y			
Voltage Regulator								Y	
Y = Test applicable									

1.6.1.5 Final acceptance tests for generator/ exciter (Table 1/3)

Item/ Components/ Process	Tests/ Checks										
	Gas tightness for H_2 cooled	Resistance measurement	Rotor impedance at various speeds	Heat run test	Function check	Voltage regulation	OCC	SCC	Record auxiliary parameters	Steady state reactance	Efficiency by separation of losses
Works tests on running generator	Y	Y	Y	Y			Y	Y	Y	Y	Y
Without Excitation, OC and SC with rated voltage and current for generator				Y							
On total winding/ phases at interval 0.2Un for generator											
Condition after dismantling											
Works tests on brushless exciter		Y		Y			Y				
PMG works tests		Y		Y		Y					
Full load for PMG and converter assembly				Y							
Converter assembly				Y							
Y = Test applicable											

1.6.1.5 Final acceptance tests for generator / exciter (Table 2/3)

Item/ Components/ Process	Tests/ Checks									
	Insulation resistance at 5 kV	Polarization index at 5 kV	Phase sequence voltage balance	Shaft voltage and current	HV test (except electronic circuit)	RTD, BTD Check	Capacitance measurement	Tan delta, delta tan-delta	Rotor journal	Bearing oil catcher
Works tests on running generator	Y	Y	Y	Y	Y	Y	Y	Y		
Without Excitation, OC and SC with rated voltage and current for generator										
On total winding/ phases at interval 0.2Un for generator							Y	Y		
Condition after dismantling									Y	Y
Works tests on brushless exciter	Y				Y					
PMG works tests	Y		Y		Y					
Full load for PMG and converter assembly										
Converter assembly	Y				Y					
Y = Test applicable										

1.6.1.5 Final acceptance tests for generator/ exciter (Table 3/3)

Item/ Components/ Process	Tests/ Checks									
	Seal rings, liners	Winding overhang	Vibration measurement	Reduced voltage running and No load	Load characteristics	Characteristics of search coil, quadrature	Ripple content	Visual and dimension	Partial discharge, DLA	Routine tests as per IS/ IEC
Works tests on running generator			Y					Y	Y	Y
Without Excitation, OC and SC with rated voltage and current for generator										
On total winding/ phases at interval 0.2Un for generator										
Condition after dismantling	Y	Y								
Works tests on brushless exciter			Y	Y	Y	Y		Y		
PMG works tests				Y	Y					
Full load for PMG and converter assembly										
Converter assembly										
Y =Test applicable										

Note:

1. All generators shall be assembled at works and shall be tested to verify/ ensure design and workmanship in accordance with IEC-34, VDE-0530, IEEE-115, IEEE 43. The manufacturer shall submit detailed test procedure which clearly specify test set up, instruments to be used, acceptance norms (wherever applicable), recording of different parameter, interval of recording, precautions, etc.
2. MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.1.6 Type tests

1.6.1.6.1 Type tests (Category-I)

i) Generator

One number assembled generator shall be tested at works as per IEC-34. The tests shall be carried out keeping all conditions/ parameters as close as possible to site conditions with all the built-in instrumentation (like RTD etc.) suitably wired and the readings recorded. During various tests, bearing and shaft overhang vibrations shall also be measured with and without excitation. Recording ofvarious parameters of bearing, seal oil system, gas system, stator water cooling system and environmental conditions (like temperature etc.) shall also be done. The following tests shall be conducted:

a) Instantaneous short circuit test to determine transient and sub-transient reactance parameters and to ensure stability of winding during sudden short circuit condition

b) Negative sequence and zero sequence impedance

c) Voltage waveform factor and Total Harmonic Factor

d) Short circuit heat run test at rated pressure and cooling parameters with one cooler out of circuit at two third of rated stator current. In case of unsymmetrical cooler configuration, test with all possible variants of one cooler out of circuit shall be carried out.

e) Vibration measurement on all planes on stator overhang winding at suitable locations on each end and at other critical locations to be decided by purchaser for the following conditions:

- Open circuit operation
- Short circuit operation
- Sudden short circuit conditions
- Stand still condition - with Hammer test

ii) Brushless excitation system

a) Exciter - Temperature rise test at peak rating of excitation system. Ceiling duty condition shall also be demonstrated

b) Permanent magnet generator - Temperature rise test at peak rating ofexcitation system and ceiling duty condition shall also be demonstrated

c) Converter assembly (of the exciter field) - Temperature rise test at peak rating of excitation system. Ceiling duty condition shall also be demonstrated

1.6.1.6.2 Type test (Category-II)

Brushless excitation system

a) Converter assembly of the exciter field
   - Input and output surge withstand capability test
   - Soak test for Electronic module

b) Degree of protection test for Excitation system panels

1.6.1.7 Site tests

The tests to be conducted on each generator at site shall include but not be limited to those listed below. Any other test considered necessary by the contractor shall also becarried out :

a) Electrical

i) Measurement of the insulation resistance of the stator and rotor windingsto the frame and between phases, after drying out the machine and measurement of the polarisation index
ii) Measurement of the DC resistance of all windings and embedded temperature detectors
iii) Measurement of the insulation resistance of bearings
iv) Capacitance measurement and dissipation factor between the winding and body at rated voltage
v) Stator -Partial Discharger test @ 1.3 Phase to Neutral voltage for PRPD & Extinction & inception voltages.
vi) Stator- NFT test
vii) Open circuit and short circuit tests
viii) Measurement of temperature rise at the rated load
ix) Performance capability of the machine
x) Line charging capacity
xi) Short circuit tests on the generator HV end and the generator transformer HV end to check the stability and operation of the generator and the overall (i.e. generator and generator transformer) differential protections and negative phase sequence protection.
xii) Rotor-IR, Winding resistance, Impedance & RSO test
xiii) Shaft voltage

b) Mechanical

i) Hydrogen leakage test
ii) Vibration test
iii) Over-speed test
iv) Hydraulic tests on coolers
v) Bearing and shaft current test

c) Load throw-off tests.

1.6.2 Generator Isolated Phase Bus ducts and Neutral Grounding equipment

1.6.2.1 Generator Isolated Phase Bus duct (Table 1/2)

Items/ Components/ Sub-systems	Tests/ Checks									
	Visual and Dimensional Checks	Electrical/ Mechanical/ Chemical Properties	WPS and PQR	NDT, DP or MPI, RT	Painting shade and adhesion test	Galvanizing test as per IS: 2629/ 2633/ 6745	Electrical clearance and Creepage	Functional/ Operational check	Make, Type, Rating, Model, TC, General physical inspection	Routine test as per relevant standard
Enclosure/ cubicle	Y	Y		Y	Y		Y			
Busbar flexible connector and dis-connector link	Y	Y								
Galvanized steel structure and plate	Y					Y				
Seal of bushing and post insulator IS:5621, 2544	Y	Y					Y		Y	Y
Welding of enclosure and conductor	Y		Y	Y						
Gasket, silicagel breather, CT, VT, surge capacitor and arrestor, NGT, NGR, elastomer spring head								Y	Y	Y
Busbar pressurisation system	Y							Y		
Complete busduct IS:8084	Y				Y					Y
Y =Test applicable										

1.6.2 Generator Isolated Phase Bus ducts and Neutral Grounding equipment

1.6.2.1 Generator Isolated Phase Bus duct (Table 2/2)

Items/ Components/ Sub-systems	Tests/ Checks				
	Trial assembly at works : Heat run test and Milli volt drop measurement acrossbolted flexible joints	Trial assembly at works : Short circuit withstand test	Trial assembly at works: Impulse withstand test	Trial assembly at works: one minute high voltage power frequency	Trial assembly at works: Air leakage rateand water tightness test
Enclosure/ cubicle					
Busbar flexible connector and disconnector link					
Galvanized steel structure and plate					
Seal of bushing and post insulator IS:5621, 2544					
Welding of enclosure and conductor					
Gasket, silicagel breather, CT, VT, surge capacitor and arrestor, NGT, NGR, elastomer spring head					
Busbar pressurisation system					
Complete busduct IS:8084	Y	Y	Y	Y	Y

Y =Test applicable

Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.2 Generator Isolated Phase Bus ducts and Neutral Grounding equipment

1.6.2.2 Neutral Grounding Resistor

Items/ Components/ Sub-systems	Tests/ Checks										
	Visual and Dimensional check	Mechanical properties	Electrical strength	Chemical Composition	Make, Type, Rating, Model, TC, Generalphysical inspection.	Insulation resistance measurement beforeand after HV Test	HV Test	Degree of protection test	Routine test as per relevant standard	Galvanizing test	Routine test
Resistor	Y	Y	Y	Y		Y					
Cubicle	Y		Y					Y			
Galvanized steel structures (IS:2633/ 2629/ 6745/ 2062)	Y	Y								Y	
Bushing/ Post and support Insulator (IS:2544/ 5621)	Y	Y	Y		Y	Y			Y		Y
Complete NGR (IEEE-32)	Y					Y	Y	Y	Y		Y

Y =Test applicable

Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.2.3 Type Tests

1.6.2.3.1 Type test (Category-I)

The following type tests shall be conducted on one bus-ducts of each rating:

a) Heat run test (the set up shall include 3 phase straight run, 90^0 bend, set of flexible connection of each type, metallic bellow on enclosure, CT's mounted in position, (as applicable), bolted link, and necessary inspection covers. Milli-volt drop across bolted flexible joint shall be measured

b) Short circuit withstand test (set up same as for heat run)

c) Impulse withstand test (set up shall include typical X-section with flexible

connections, 90^0 bend, CT's in position, seal off bushing, inspection cover and bellows)

d) One minute high voltage power frequency withstand test (set up as for short circuit test)

e) Air leakage rate and water tightness test (set up shall include inspection cover, flanged joint and bellow)

1.6.2.3.2 Type test (Category-II)

- Panels, cubicles and marshalling boxes shall be type tested for the degree of protection provided by the enclosure as given below :

  - For 5X-it shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.
  - For 4X-It shall not be possible to insert a one mm diameter steel wire into enclosure from any direction without force.
  - For 2X-It shall not be possible to insert a twelve (12) mm dia steel wire into the enclosure from any direction without any force.
  - Test for second digit shall be in line with IS:13947 part-1

- For the equipment and materials such a current transformers, voltage transformers, lightning arresters, grounding transformers, loading resistors, bushings and surge capacitors for which type test are not specified in this section,successful type tests certificate shall be submitted to the purchaser.

1.6.2.4 Site tests

i) 10% radiography and 100% DP test on all site welded joints of busbar and enclosure (for Root & Final welding).

ii) Milli-volt drop test

iii) Ratio and polarity tests on current and voltage transformers

iv) Insulation measurement of equipment and all wiring

v) Functional test on pressurization (Tightness test as per ANSI 37.20)

vi) One minute high potential power frequency withstand test at 75% of rated test voltage

vii) Enclosure Isolation test with support frame.

viii) Air pressurisation test.

1.6.3 Power Transformers
1.6.3.1 Generator Transformers/ Unit auxiliary transformers/ Station transformers) **Please refer QAP for transformer**

1.6.4 HT BUSDUCT

1.6.4.1 11kV, 6.6kV & 3.3kV Segregated Phase Bus ducts

Items/ Components/ Sub-systems	Tests/ Checks									
	Visual and Dimensional Checks	Electrical, Mechanical, Chemical properties	WPS and PQR	NDT, DP or MPI, RT	Paint shade and Adhesion test	Galvanizing Test as per IS: 2629/ 2633/ 6745	Electrical clearance and creepage	Functional/ Operational check	Make, Type, Rating, Model, TC, General physical inspection	Routine tests on complete busduct
Enclosure/ cubicle Arc test at rated short circuit current	Y	Y		Y	Y					
Busbar flexible connector and disconnector link	Y	Y								
Steel structure and plate IS:2062		Y				Y				
Bushing, post and support insulator (IS:9431 and 2544)	Y						Y			Y
Welding of enclosure and conductor	Y		Y							
Gasket, silicagel breather								Y	Y	Y
Complete busduct IS:8084	Y				Y					Y

Y =Test applicable

Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.4.2 Type test (Category-II)

(a) All bus-ducts supplied shall be of type tested quality.

(b) Type test reports for the following shall be submitted:

- One minute power frequency voltage withstand test
- Temperature rise test. Milli volt drop shall also be measured across boltedflexible joint
- Impulse voltage withstand test

- Short time current test
- Water tightness test (as per IS:8084)
- Arc test at rated short circuit for rated time
- Air leakage test

1.6.4.3 Site tests

The following minimum tests/ checks shall be conducted at site. Any other tests/ checksas per the manufacturer's recommendation shall also be carried out

- Power frequency voltage withstand test
- Air leakage test
- Water tightness test on outdoor portion of bus-duct
- Insulation resistant measurement of equipment and all wiring
- Milli-volt drop
- Tightness test for bus bar joints.

1.6.5 Auxiliary Service Transformers

1.6.5.1 Oil-filled Outdoor Transformers

	Tests/ Checks														
Items/ Components/ Sub-systems	Visual and Dimensional checks	Mechanical properties	Electrical strength	Thermal properties	Chemical Composition	Compatibility with oil	Core Loss (on first Job) Hot Spot	NDT, DP or MPI, UT	Ageing Test	Voltage Ratio, Vector Group andPolarity, Magnetic balance test	Make, Type, Rating, Model, TC, General physical Iispection.	WPS and PQR	Vacuum and Pressure Test	Routine Tests
Tank, HV and LV Cable Box/ Flange throat	Y	Y						Y				Y	Y	
Conservator/ Radiator/ Cooler/ Pipes	Y	Y						Y				Y		
Copper Conductor (IS:191)	Y	Y	Y		Y									
Insulating Material	Y	Y	Y	Y	Y	Y								
CRGO Lamination and Built Core	Y	Y	Y		Y	Y	Y							
Bushing / Insulator (IS:2544/ 5621)	Y	Y									Y			Y
Gasket	Y				Y	Y			Y					
Transformer oil (IS:335)														Y
Off-circuit tap changer	Y										Y			Y
Core coil assembly and pre-tanking	Y									Y				
Marshalling box	Y	Y						Y						Y
WTI, OTI, MOG, PRD, Breather, Terminal Connector, Bucholz Relay, Globe and Gate Valve,	Y										Y			
Welding (ASME Sect-IX)	Y											Y		
Complete Transformer (IS:2026)	Y									Y				Y

Y =Test applicable

Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.5.2 Dry Type Indoor Transformers

Items/ Components/ Sub-systems	Tests/ Checks											
	Visual and dimensional check	Mechanical properties	Electrical strength	Thermal properties	Chemical properties	Core loss (on first job), Hot	NDT, DP or MPI	Voltage ratio, vector group and polarity	Make, Type, Rating, Model, TC,General physical inspection	WPS and PQR	Measurement of capacitance andtan delta between winding	Routine tests
Enclosure door, HV and LV Cable box/ Flange throat	Y	Y							Y			
Copper conductor	Y	Y	Y		Y							
Insulating material	Y			Y	Y							
CRGO lamination and built core	Y					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											
WTI, Thermister, Terminal connector	Y								Y			
Welding										Y		
Complete transformer (IS:11171)	Y							Y			Y	Y

Y =Test applicable

Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.5.3 Type tests

1.6.5.3.1 Type tests (Category-I)

The transformer shall be subjected to the following type tests for rating above 2 MVA.

i) Short Circuit test – This test shall be carried out after conducting the routinetests. Rest of the type tests shall be conducted after successful short circuit testing.
ii) Noise level measurement
iii) Capacitance & tan Delta test
iv) Enclosure IP Degree test
v) Measurement of zero phase sequence impedance
vi) Measurement of the harmonics of no load current
vii) Temperature rise
viii) Lightning impulse voltage test on all the three limbs as per Cl. 13 of IS:2026Part-III,1981

1.6.5.3.2 Additional Type tests (Category-I)

I. Vacuum Test on Transformer Tank - One Transformer tank of each rating shall be subjected to the specified vacuum. The tank designed for full vacuum shall betested at an internal pressure of 0.35 kg/ cm^2 (absolute, 250 mm of Hg) for one hour. The permanent deflection of flat plates after the vacuum has been released shall not exceed the values specified below :

Horizontal Length of Flat Plate (mm)	Permanent deflection (mm)
Upto and including 750	5.0
751 to 1250	6.5
1251 to 1750	8.0
1751 to 2000	9.5
2001 to 2250	11.0
2251 to 2500	12.0
2501 to 3000	16.0
Above 3000	19.0

II. Pressure Test on Transformer Tank - One transformer tank of each rating shall be subjected to a pressure corresponding to twice the normal pressure of normal pressure plus 0.35 kg/ cm2 whichever is lower measured at the base of the tank and maintained for an hour. The permanent deflection of flat plates after the excess pressure has released shall not exceed the figure for vacuum test.

III. Oil Leakage Test - All tanks and oil filled compartments shall be tested for oil tightness by oil of a viscosity not greater than that of insulating oil to IS:335, at the specified ambient temperature and subjected to a pressure equal to the normalpressure plus 35 KN/ m^2 (51 lb/ $inch^2$) measured at the base of the tank. This pressure shall be maintained for a period of not less than 12 hours, during which time no leakage shall occur.

IV. Tests on associated equipment - Porcelain bushings, bushing current transformers, winding temperature indicating devices, dial thermometers, buchholz relays, ON/OFF load tap changer, auxiliary motors and motor starting contactors, coolers, control device, Insulating oil and other associated equipment shall be tested in accordance with relevant IS. The following checks shall also be made before dispatch:

ii) Check for proper packing and preservation of accessories like radiators, bushings, explosion vent, dehydrating breather, Buchholz relay, conservator etc.

iii) Check for proper provision of bracing to arrest the movement of core and winding assembly inside the tank.

iv) Test for Gas tightness and derivation of leakage rate to ensure adequate reserve gas capacity during transit and storage.

a. Type tests (Category-II)

All indoor transformers below and equal to 2 MVA rating to be supplied shall be of type tested quality. The test reports of the following type tests shall be submitted.

v) Short Circuit test – This test shall be carried out after conducting the routinetests. Rest of the type tests shall be conducted after successful short circuittesting.
vi) Noise level measurement
vii) Measurement of zero phase sequence impedance
viii) Measurement of the harmonics of no load current
ix) Temperature rise
x) Lightning impulse voltage test on all the three limbs as per Clause 13 of IS:2026 Part-III,1981

1. Site tests

i) The following minimum tests/ checks shall be conducted at site. Any other tests/ checks as per the manufacturer's recommendation shall also be carried out

a) Dry out test
b) Resistance measurement of windings
c) Ratio test
d) Vector group test
e) Tap changer test
f) Buchholz relay test
g) Low oil level alarm.
h) Temperature indicators
i) Marshalling kiosk
j) Protective relays
k) Magnetizing current
l) Door interlock tests

ii) The following additional checks shall be made to see the following:

a) All oil valves are in correct position closed or opened as required
b) All air pockets are cleared
c) Thermometer pockets are filled with oil
d) Oil is at correct level in the bushing, conservator, divertor switch, tank etc.
e) Earthing connections are made
f) Colour of silica gel is blue
g) Bushing arcing horn is set correctly
h) CT polarity is correct (when bushing mounted CTs are provided)

1.6.6 Motors

Item/ Components/ Sub-system	Tests/ Checks																	
	Visual	Dimensional	Make,Type,Rating,TC,General physical	Mechanical, Chemical properties	NDT, DP or 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:325/ IS:4722/ IS:9283	Vibration	Over speed	Tan delta, shaft voltage and 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									
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 coils	Y	Y	Y				Y	Y										Y
Castings, stator frame, terminal box and bearing housing etc.	Y	Y	Y	Y	Y			Y										
Fabrication and machining of stator, rotor, terminal box	Y	Y			Y				Y									
Wound stator	Y	Y					Y	Y										Y

Rotor complete	Y	Y					Y						Y	Y				
Stator, Rotor, Terminal Box assembly	Y	Y					Y											
Accessories, RTD, BTD,CT, Brushes, Diodes, space heater, antifriction bearing, cable glands, lugs, gaskets etc.	Y	Y	Y															
Complete motor (IS: 325/ IS:4722/ IS:9283)	Y	Y	Y				Y								Y	Y	Y	Y 1
Y =Test applicable, Y1 = for 11kV and 3.3kV motors only																		
Notes																		
1)	This is an indicative list of tests/ checks. The manufacture is to furnish the detailed Quality Plan indicating the practices and procedure followed along with relevant supporting documents during QP finalization. However QP approval is not envisaged for 415V motors upto 50 KW.																	
2)	Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.																	

1.6.6.1 Type tests

1.6.6.1.1 Type tests (Category-I)

<u>11kV, 6.6kV and 3.3kV motors</u>

The following type tests shall be conducted on each type and rating of 11kV, 6.6kV 3.3kVmotor:

- No load saturation and loss curves upto approximately 115% of rated voltage

- Measurement of noise at no load

- Momentary overload test (subject to test bed constraint)

- Full load test

- Temperature rise test at rated conditions (During heat run test, bearing temperature, winding temperature, core temperature, coolant flow and its temperature shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained.Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose).

- Impulse Voltage test (on the sample coil after placing it in stator core at (4U+5kV) and with at least five impulse of 1.2/50 micro-second wave, for MV motors only, where U is the line to line voltage in kV).

1.6.6.1.2 Type tests (Category-II)

i) 11kV, 6.6kV and 3.3kV motors

The following type test reports shall be submitted for each type and rating ofmotor.

- Degree of protection test for the enclosure followed by IR, HV and no load run test

- Terminal box-fault level withstand test for each type of terminal box

- Type test on Elastimold termination kit as per relevant standard

ii) 415V motors

415V motors shall be of type tested quality. The type test reports for type tests as per relevant standards shall be submitted for each type and rating of 415V motors.

1.6.6.2 Site Tests

The following minimum tests/ checks shall be conducted at site. Any other tests/ checksas per the manufacturer's recommendation shall also be carried out

i) Measurement of vibration.

ii) Measurement of insulation resistance and polarization index.

iii) Measurement of winding resistance of stator winding

iv) HV Power frequency test for 1 minute preceded and followed by measurement of IR values.

v) Capacitance & Tan Delta & Tip Up till rated voltage

vi) Measurement of full load current.

vii) Test running of the motors, checking the temperature rise and identifying the hot spotetc.

1.6.7 11kV, 6.6kV and 3.3kV Switchgear (Table 1/2)

Items/ Components/ Sub-systems	Tests/ Checks													
	Make, Type, Model, Rating and TC	Electrical Properties	Mechanical properties	Chemical properties	Dimensions and Finish	Functional and operational features	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint shade, thickness, adhesion and finish	Functional Checks	HV and IR Test	Degree of Protection - Routine test	CB Operation timing check	All Routine Tests as per relevant standards
Aluminum busbar material (IS: 5082)	Y	Y	Y	Y	Y		Y							
Copper busbar material (IS:613)	Y	Y	Y	Y	Y		Y							
Bus bar support insulation (IS:9431)	Y	Y	Y		Y		Y				Y			
HT Circuit Breaker (IEC:56)	Y				Y	Y	Y			Y			Y	Y
HT Contactors (IS:9046)	Y				Y	Y	Y			Y				Y
Protection and auxiliary relays (IS:3231/ 8686)	Y				Y	Y	Y			Y				Y
HT CT's and 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 and 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
LT fuses (IS:13703)	Y				Y	Y	Y							
Energy meters (IS:722)	Y				Y	Y	Y							Y
Transducers (IEC:60688)	Y				Y	Y	Y							Y

Y =Test applicable

Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.7 11kV, 6.6kV and 3.3kV Switchgear (Table 2/2)

Items/ Components,/ Sub-system	Tests/ Checks													
	Make, Type, Model, Rating and TC	Electrical properties	Mechanical properties	Chemical properties	Dimensions and Finish	Functional and Operational features	Item to conform to relevant standards	Pretreatment as per IS: 6005	Paint shade, thickness, adhesion and	Functional checks	HV and IR Test	Degree of Protection - Routine test	CB Operation timing check	All Routine Tests as per relevant standard
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 (IS:3427)	Y				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Y =Test applicable

Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.7.1 Type test (Category-II)

All 11kV, 6.6kV and 3.3kV Switchgears supplied shall be of type tested quality.

a) Type test reports for the following shall be submitted:

i) Circuit breaker/ circuit breaker panels, of each voltage class and current rating:

- Short circuit duty test on circuit breaker, mounted inside the panel offered alongwith CTs, bushing and separators

- Short time withstand test on circuit breaker, mounted inside paneloffered together with CTs, bushings and separators

- Power frequency withstand test on breaker mounted in side panel

- Lightning impulse withstand test on breaker mounted in side panel
- Temperature rise test on breaker and panel together. For this test, the test set up shall include three panels with breakers, the test breaker and panel being placed in the Center.

The adjacent panels shall also be loaded to their rated current capacity. Alternatively the test panel may be suitably insulated at the sides, which will be adjoining to other panels in actual site configuration

- Test to verify pressure relief devices operation of the panel. Thisshall be done on one panel of each voltage class

- measurement of resistance of main circuit

- Mechanical endurance test on breaker

- Mechanical operation test

ii) Contactor and contactor panels of each type and rating:

- Verification of rated making and breaking capacities of the contactor

- Short time withstand test of panel

- Power frequency test on the contactor mounted in side panel

- Lightning impulse voltage withstand test of the contactor mounted inside panel

- Measurement of resistance of main circuit

- Test to confirm coordination between fuse and contactor

iii) Surge arrestor/ lightning arrestor (as applicable) of each type:

- Standard lightning impulse voltage spark-over test

- Front of wave sparkover test (For surge arrestor used alongwithmotor feeder, this test shall be carried out with a voltage wavehaving a rate of rise of not less than 142kV/ micro-second for arrestor used in 11kV system, 85kV/ micro-second for 6.6kV system and 44kV/ micro-second for arrestor used in 3.3kV system).

- Power frequency sparkover and temporary overvoltage test

- Residual voltage test

- Operating duty test

- Current impulse withstand test (long duration and high current impulse)

- Pressure relief test

iv) Short circuit withstand test of earthing device (truck/ switch)

b) Shop testing of components and bought out items

For various bought out items like CT, VT, relays, meters, surge arrestors etc. for which identification can be physically verified and test certificate from manufacturer can be co-related, following shall be indicated in the QP.

- Review of manufacturer's Test Certificate (TC) as per relevant standard and compliance to requirements of this specification

- Physical check and functional/ operational check to ensure that item is fitfor assembly on the switch board cubicle.

For all other items where identification has not been envisaged by manufacturers,a certificate of conformance to be obtained from manufacturer, and component identification shall be tagged as per approved drawing/ schematic. Either of the following or both shall be adopted .

- Random sample to be tested either in-house or at an independent laboratory for all tests envisaged in relevant standard.

- Physical check and functional/ operation check to ensure the item is fit for assembly on the switch board cubicle.

1.6.7.2 Site tests

The following minimum tests/ checks shall be conducted at site. Any other tests/ checks as per the manufacturer's recommendation shall also be carried out

a) S.N. General

i) Check name plate details according to specification
ii) Check for physical damage
iii) Check tightness of all bolts, clamps and connecting terminals
iv) Check earth connections
v) Check cleanliness of insulators and bushings
vi) Check heaters are provided
vii) HV test on complete switchboard with CT and breaker/ contactor in position
viii) Check all moving parts are properly lubricated
ix) Check for alignment of busbars with the insulators to ensure alignment and fitness of insulators
x) Check for interchangeability of breakers/ contactors
xi) Check continuity and IR value of space heater
xii) Check earth continuity for the complete switchgear board

b) S.N. Circuit Breaker/ Contactors

i) Check alignment of trucks for free movement
ii) Check correct operation of shutters
iii) Check slow closing operation (if provided)
iv) Check control wiring for correctness of connections, continuity and IRvalues
v) Manual operation of breakers completely assembled
vi) Power closing/ opening operation, manually and electrically at extremecondition of control supply voltage
vii) Closing and tripping time
viii) Trip free and anti-pumping operation
ix) IR values, resistance and minimum pick up voltage of coils
x) Simultaneous closing of all the three phases
xi) Check electrical and mechanical interlocks provided
xii) Checks on spring charging motor, correct operation of limit switchesand time of charging
xiii) Check SF_6 pressure/ vacuum (as applicable)
xiv) All functional checks

c) S.N. Current Transformers

i) Insulation resistance between windings and winding terminals to body
ii) Polarity tests
iii) Ratio identification checking of all ratios on all cores by primary injection of current
iv) Magnetisation characteristics (Knee point) and secondary winding resistance
v) Spare CT cores to be shorted to earth

d) S.N. Voltage Transformers

i) Insulation resistance test
ii) Ratio test on all cores
iii) Polarity test
iv) Line connections as per connection diagram

e) S.N. Cubicle Wiring

i) Check all switch developments
ii) It should be made sure that the wiring is as per relevant drawings. Allinterconnections between panels shall similarly be checked
iii) All the wires shall be meggered to earth
iv) Functional checking of all control circuit e.g. closing, tripping interlock, supervision and alarm circuit including proper functioning of component/equipment
v) Check terminations and connections

vi) Wire ducting
vii) Gap sealing and cable bunching

f) S.N. Relays

i) Check internal wiring
ii) Insulation resistance between all terminals and body
iii) Insulation resistance between AC to DC terminals
iv) Check operating characteristics by secondary injection
v) Check minimum pick up voltage of DC coils
vi) Check operation of electrical/ mechanical targets
vii) Check CT connections with particular reference to their polarities fordifferential type relays
viii) Relay pickup & timing test as per Relay settings

g) S.N. Meters

i) Insulation resistance of all insulated portions
ii) heck CT and VT connections with particular reference to their polarities for power type meter

1.6.8 415V Switchgear and Bus duct

1.6.8.1 415V Switchgear (Table 1/2)
(MCC, PCC, ACDB, DCDB, Local push button station, Local motor starters)

Items/ Components/ Sub-system	Tests/ Checks													
	Make, Model, Type, Rating and TC	Dimensions and Finish	Electrical properties	Mechanical properties	Chemical properties	Functional and Operational features	Item to conform to relevant standards	Pretreatment as per IS 6005	Paint shade, adhesion, thickness and finish	Functional checks	Milli-volt drop Test	IR – HV – IR Test	Degree of protection Routine test	All Routine tests as per relevant standards
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 (IS:943, IS:10912, IEC: 660)	Y	Y	Y	Y			Y							
Air circuit breaker(IS:13947)	Y	Y				Y	Y			Y	Y			Y
Energy meters (IS:722)	Y	Y				Y	Y			Y				Y
Power and auxiliary contactor (IS:13947)	Y	Y				Y	Y			Y				
Protection and auxiliary relays (IS:3231)	Y	Y				Y	Y			Y				Y
Control and selector switches (IS:6875)	Y	Y				Y	Y			Y				
CT and VT (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							

Y =Test applicable

Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.8.1 415V Switchgear (Table 2/2)
(MCC, PCC, ACDB, DCDB, Local push button station, Local motor starters)

Items/ Components/ Sub-system	Tests/ Checks													
	Make, Model, Type, Rating and TC	Dimensions and Finish	Electrical properties	Mechanical properties	Chemical properties	Functional and Operational Features	Item to conform to relevant standards	Pretreatment as per IS: 6005	Paint Shade, Adhesion, Thickness and	Functional checks	Milli-volt drop Test	IR – HV – IR Test	Degree of Protection - Routine test	All Routine tests as per relevant standards and
Fuse (IS:13703)	Y	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							
415V Switchgear (IS:8623)	Y	Y				Y	Y	Y	Y	Y	Y	Y	Y	Y

Y =Test applicable

Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.8.2 415V Bus duct

Items/ Components	Tests/ Checks														
	Dimension and surface finish	Make, Type, Rating and Test certificate (TC)	Electrical properties	Mechanical properties	Chemical properties	Item to conform to relevant IS	WPS approval, Welder qualification	Weld quality check (DP test and X-ray)	Paint shade, Thickness, Adhesion and finish	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
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 and GI earthing flat (IS:2629/ 2633/ 4749)	Y	Y				Y						Y			
Space heater and Thermostat		Y	Y												
LT busduct (IS:8623 Part 2)	Y	Y				Y	Y	Y	Y	Y	Y		Y	Y	Y

Y = Test applicable

Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.8.3 Type test (Category-II)

All 415V Switchgears and bus duct supplied shall be of type tested quality.

a) Type test reports for the following tests shall be submitted on each type and rating of 415V switchgear and AC, DC distribution boards:

   i) Short time withstand test with circuit breaker mounted inside the switchgear panel

   ii) Temperature rise test

   iii) Arc test at rated short circuit capacity

   iv) Type II - Short circuit co-ordination test for any three ratings of MCC module

   v) Test sequence-1 and combined test sequence shall be carried out on each rating of circuit breaker mounted inside the panel

   vi) Degree of protection test

b) Type test reports for the following tests shall be submitted on each type and rating of 415V bus duct:

   i) Heat run test on an assembly of representative sections and fittings

   ii) Short circuit test for a duration and current on an assembly of representative section

   iii) One minute high potential power frequency voltage withstand test

   iv) Air and water tightness test on a typical section

1.6.8.4 Site tests

The following minimum tests/ checks shall be conducted at site. Any other tests/ checksas per the manufacturer's recommendation shall also be carried out

a)

S.N.	General
i)	Check name plate details according to specification
ii)	Check for physical damage
iii)	Check tightness of all bolts, clamps and connecting terminals
iv)	Check earth connections
v)	Check cleanliness of insulators and bushings
vi)	Check heaters are provided
vii)	HV test on complete switchboard with CT and breaker/ contactor inposition
viii)	Check all moving parts are properly lubricated

	ix)	Check for alignment of busbars with the insulators to ensure alignmentand fitness of insulators
	x)	Check for interchange ability of breakers/ contactors
	xi)	Check continuity and IR value of space heater
	xii)	Check earth continuity for the complete switchgear board
b)	S.N.	Circuit Breaker/ Contactors
	i)	Check alignment of trucks for free movement
	ii)	Check correct operation of shutters
	iii)	Check slow closing operation (if provided)
	iv)	Check control wiring for correctness of connections, continuity and IRvalues
	v)	Manual operation of breakers completely assembled
	vi)	Power closing/ opening operation, manually and electrically at extremecondition of control supply voltage
	vii)	Closing and tripping time
	viii)	Trip free and anti-pumping operation
	ix)	IR values, resistance and minimum pick up voltage of coils
	x)	Simultaneous closing of all the three phases
	xi)	Check electrical and mechanical interlocks provided
	xii)	Checks on spring charging motor, correct operation of limit switchesand time of charging
	xiii)	Check SF_6 pressure/ vacuum (as applicable)
	xiv)	All functional checks
c)	S.N.	Current Transformers
	i)	Insulation resistance between windings and winding terminals to body
	ii)	Polarity tests
	iii)	Ratio identification checking of all ratios on all cores by primary injection of current
	iv)	Magnetisation characteristics (knee Point) and secondary winding resistance
	v)	Spare CT cores, if any to be shorted and earthed
d)	S.N.	Voltage Transformers
	i)	Insulation resistance test
	ii)	Ratio test on all cores
	iii)	Polarity test
	iv)	Line connections as per connection diagram
e)	S.N.	Cubicle Wiring
	i)	Check all switch developments
	ii)	It should be made sure that the wiring is as per relevant drawings. Allinterconnections between panels shall similarly be checked

	iii)	Insulation resistance of all wires with respect to earth
	iv)	Functional checking of all control circuit e.g. closing, tripping interlock, supervision and alarm circuit including proper functioning of component/equipment
	v)	Check terminations and connections
	vi)	Wire ducting
	vii)	Gap sealing and cable bunching
f)	S.N.	Relays
	i)	Check internal wiring
	ii)	Insulation resistance between all terminals and body
	iii)	Insulation resistance between AC and DC terminals
	iv)	Check operating characteristics by secondary injection
	v)	Check minimum pick up voltage of DC coils
	vi)	Check operation of electrical/ mechanical targets
	vii)	Check CT connections with particular reference to their polarities fordifferential type relays
	viii)	Relay pickup & timing as per Relay settings
g)	S.N.	Meters
	i)	Insulation resistance of all insulated portions
	ii)	Check CT and VT connections with particular reference to theirpolarities for power type meter
h)	S.N.	Bus duct
	i)	Visual inspection
	ii)	Power frequency voltage withstand test
	iii)	Insulation resistant measurement of equipment and all wiring
	iv)	Milli-volt drop

1.6.9 Power and Control Cables :

1.6.9.1 11kV, 6.6kV and 3.3kV Power Cables (Table 1/2)

Item/ Components/ Sub-system	**Tests/ Checks**													
	Make, Type, Rating and TC	Dimension/ surface finish	Mechanical properties	Chemical composition	Spark test	Curing properties	Electrical properties	Hot set test, Eccentricity and Ovality	Lay length and sequence	Armour coverage, cross over, looseness, gap between two wire	Sequential marking/ surface finish/ cable length	Tensile strength and elongation before and after ageing on outer sheath and insulation	Thermal stability on outer sheath	Metallic screening (if applicable)
Aluminium (IS-8130)	Y	Y	Y	Y			Y							
Semi conducting compound	Y		Y			Y	Y							
XLPE compound(IS-7098-Part-II)	Y		Y			Y	Y					Y		
FRLS HR PVC compound (IS- 5831, ASTM-D2843, ASTM-2863, IEC-754 Part-1)	Y		Y									Y	Y	
Triple extrusion and curing/ Manufacturing of core		Y			Y			Y	Y					
Copper tape	Y	Y	Y				Y							
Polyster tape	Y	Y												
Armour wire/strip	Y	Y	Y											
Copper tapping	Y	Y						Y						
Inner sheath	Y	Y												
Armouring										Y				Y
Outer sheathing		Y									Y	Y	Y	
Power cable (Finished) (IS :7098 Part-II) IEC:332, IS-5831, ASTM-D2843, ASTM-2863, IEC-754 Part-1) Cable Drum Rewinding	Y								Y	Y	Y	Y	Y	
Wooden drum (IS:10418)/ Steel drum		Y												

Y =Test applicable

Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.9.1 11kV, 6.6kV and 3.3kV Power cables	**(Table 2/2)**			
	Tests/ Checks			
Item/ Components/ Sub-system	Anti termite coating on wooden drums	Constructional requirements feature as per specification	Routine and acceptance test as per relevant standard and specification	FRLS tests
Aluminium (IS-8130)				
Semi conducting compound				
XLPE compound (IS-7098- Part-II)				
FRLS HR PVC compound (IS-5831, ASTM-D2843, ASTM-2863, IEC-754 Part-1)				Y
Triple extrusion and curing/ Manufacturing of core				
Copper tape				
Polyster tape				
Armour wire/strip				
Copper tapping				
Inner sheath				
Armouring				
Outer sheathing		Y		Y
Power cable (Finished) (IS : 7098 Part-II) IEC: 332, IS-5831, ASTM-D2843, ASTM-2863,IEC-754 Part-1) Cable Drum Rewinding		Y	Y	Y
Wooden drum(IS-10418) /Steel Drum	Y			
Y =Test applicable				

Notes	
1)	Additional acceptance tests like FRLS, thermal stability, tensile strength and elongation after ageing shall be done on one sample/ lot
2)	Length measurement/ surface finish/ eccentricity/ ovality shall be checked on one length/ size/ lot
3)	Routine test shall be carried out on each drum length as per specifications.
4)	MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.9.2 1.1 kV PVC and XLPE cables (Table1/2)

Item/ Components/ Sub-system	Tests/ Checks												
	Make, Rating, Type and TC	Dimension/surface finish	Mechanical properties	Chemical composition	Electrical properties	Spark test	Hot set test (XLPE)	Lay length/ sequence	Armour coverage, cross over, looseness,Gap between two armour wire/ strip	Sequential marking/ surface finish/ cable length	Tensile strength, elongation before and after ageing of insulation and outer sheath	Thermal stability of insulation and outer sheath *
Aluminum (IS-8130)	Y	Y	Y	Y	Y							
PVC compound (IS-5831)	Y		Y		Y						Y	
XLPE compound (IS-7098 Pt-I)	Y		Y		Y		Y				Y	
FRLS HR PVC compound (IS-5831)ASTM-D-2843/ ASTM-D-2863 IEC-754 Part-I	Y		Y								Y	
Armour wire/strip (IS-3975)	Y	Y	Y									
Insulated core		Y				Y	Y					Y
Laid up core		Y						Y				
PVC Inner sheath		Y										
Armouring		Y							Y			
Outer sheath		Y								Y	Y	Y
Finish cable (IS-1554 and 7098 – Part-1) ASTM-D-2843/ ASTM-D-2863 IEC-754 Part-I Swedish Chimney SS 4241475 for (F3 category) Flammability test IEC-332 Part –3 Cat-B Cable Drum Rewinding	Y	Y							Y	Y	Y	Y
Wooden drum (IS-10418) / Steeldrum		Y										

Y =Test applicable

Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.9.2 1.1 kV PVC and XLPE CABLES	(Table 2/2)			
	Tests/ Checks			
Item/ Components/ Sub-system	Anti termite treatment on wooden drums	Constructional/ requirement as per specification	Routine and acceptance test as per relevant standard and specification	FRLS Tests
Aluminum (IS-8130)				
PVC Compound (IS-5831)				
XLPE Compound (IS-7098 Pt-I)				
FRLS PVC Compound (IS-5831) ASTM-D-2843/ASTM-D-2863 IEC-754 Part-I				Y
Armour wire/strip (IS-3975)				
Insulated Core				
Laid up core				
PVC Inner sheath				
Armouring				
Outer sheath				Y
Finish cable (IS-1554 & 7098 – Part-1) ASTM-D-2843/ASTM- D-2863 IEC-754 Part-I Swedish Chimney SS 4241475 for (F3 category) Flammability test IEC-332 Part –3 Cat-B Cable Drum Rewinding		Y	Y	Y
Wooden drum (IS-10418) / Steel drum	Y			
Y =Test applicable				

Notes	
1)	(*) Not applicable for XLPE insulation
2)	Additional acceptance tests like FRLS, thermal stability, tensile strength and elongation after ageing shall be done on one sample / lot.
3)	Length measurement / surface finish shall be checked on one length/ size/ lot
4)	Routine test shall be carried out on each drum length as per specifications.
5)	MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.9.3 1.1 kV PVC Control cables (Table 1/2)

Item/ Components/ Sub-system	Tests/ Checks										
	Make, Type, Rating, Test certificate (TC)	Dimension/ surface finish	Mechanical properties	Chemical composition	Electrical properties	Spark test	Lay length/ sequence	Armour coverage, cross over, looseness, gap between two armour wire	Sequential marking/ surface finish/ cable length	Tensile strength, elongation before and after ageing of insulation and outer sheath	Thermal stability of insulation and outer sheath
Copper conductor (IS-8130)	Y	Y	Y	Y	Y						
PVC compound (IS-5831)	Y		Y		Y					Y	
FRLS PVC compound IS-5831 ASTM-D-2843/ ASTM-D-2863 IEC-754 Part-1	Y		Y							Y	
Armour wire/strip (IS-3975)	Y	Y	Y								
Insulated core		Y				Y	Y				
Laid up core		Y					Y				
PVC Inner sheath		Y									
Armouring		Y						Y			
Outer sheath		Y							Y	Y	Y
Finished cable (IS-1554) ASTM-D-2843/ ASTM-D-2863 IEC-754 Part-1 Swedish Chimney: SEN SS 424-1475(F3 category) Flammability test IEC-332 Part-3 Cat-B Cable Drum Rewinding	Y	Y						Y	Y	Y	Y
Wooden drum(IS:10418)/ Steel drum		Y									

Y =Test applicable

Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.9.3 1.1 kV PVC Control cables	(Table 2/2)			
	Tests/ Checks			
Item/ Components/ Sub-system	Anti termite treatment on wooden drums	Constructional feature as per specification	Routine and Acceptance test as per relevant standard and specification	FRLS test
Copper conductor (IS-8130)				
PVC compound (IS-5831)				
FRLS PVC compound IS-5831 ASTM-D-2843/ ASTM-D-2863 IEC-754 Part-1				Y
Armour wire/strip (IS-3975)				
Insulated core				
Laid up core				
PVC Inner sheath				
Armouring				
Outer sheath				Y
Finished cable (IS-1554) ASTM-D-2843/ ASTM-D-2863 IEC-754 Part-1 Swedish Chimney: SEN SS 4241475 (F3 category) Flammability test IEC-332 Part-3 Cat-B Cable Drum Rewinding		Y	Y	Y
Wooden drum(IS : 10418) / Steel drum	Y			
Y =Test applicable				

Notes	
1)	Additional acceptance tests like FRLS, thermal stability, tensile strength and elongation after ageing shall be done on one sample/ lot
2)	Length measurement / surface finish shall be checked on one length/ size/ lot
3)	Routine test shall be carried out on each drum length as per specifications.
4)	MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.9.4 Type tests (Category-I)

The type tests on one drum out of every ten (10) drums or less for each type and size ofcables shall be conducted.

a) Annealing test (for copper) as per IS:8130

b) Tensile test (for Aluminium) as per IS:8130

c) Wrapping test (for Aluminum) as per IS:8130

d) Conductor resistance test as per IS:8130

e) Test for armour wires/ strips as per IS:3975 - The hard drawn aluminium wires armour (in case of single core cables) shall also comply with the tensile test and wrapping test as per IS:8130.

f) Test for thickness of insulation and sheath - Requirement and methods of test for the thickness of insulation and sheaths shall be as per relevant IS. The calculated diameter over stranded core and "Calculated nominal diameter under outer sheath" shall, however, be determined by the method given in Appendix "A" of IEC-60502.

g) Tensile strength and elongation test for insulation and sheath - The value of tensile strength and elongation at break-point shall not be less than 125kg/cm^{2}and 150% respectively for the type 'A' and type ST1 PVC compounds. For XLPE insulation these tests shall be carried out in accordance with IS:7098 (Part-III). The tensile strength and elongation at a break shall not be less than 125kg/cm^2 and 200% respectively.

h) Ageing test for insulation and sheath - The ageing test shall be carried out as per the procedures laid down in relevant IS, however the period of test shall be 168 hours, instead of 120 hours. The test value obtained for the tensile strength and elongation must not differ from the corresponding values obtained before ageing by more than ±25% in case of type ST2 PVC and XLPE compounds and by morethan ±20% in case of type A, and type STI PVC compound.

i) Loss of mass test - This test is to be carried out on the PVC insulation and sheaths as per IEC-60540. The maximum permissible loss of mass shall be 2mg/cm^2.

j) Shrinkage test - This test shall be carried out on the PVC insulation and sheath. The test procedures and test values shall comply with IS:5831.

k) Cold bend test - This test is to be carried out upto 6mm^2 cables size in accordance with IS:5831.

l) Cold impact test - This test shall be carried out on the PVC insulation and sheath in accordance with IS-5831.

m) Heat shock test for PVC insulation and sheath - This test shall be carried out as per IEC-60540 and IEC-60502.

n) Thermal stability test for PVC insulation and sheath - This test shall be carried out in accordance with IEC-60540/60540A and shall pass the minimum requirement of 100minutes.

o) Test for bleeding and blooming of pigments for PVC - This test shall be carriedout as per IS :5831.

p) Fire resistance test - This test shall be carried out in accordance with relevantclause of IS:5831.

q) Measurement of insulation resistance - This test shall be carried out as perIS:5831. The volume resistivity of the PVC insulated cables shall not be less than $1x10^{14}$ ohm-cm at $27^{o}C$ and $1x10^{11}$ ohm-cm at $70^{o}C$.

r) High voltage test - This test shall be performed as per IS:1554 (Part-I).

The cable with insulation/ sheath material other than PVC shall be subject to all the tests mentioned in their respective Indian or International Standards to which they are conforming. In that case if any of the above test is not applicable, the same will not be carried out.

s) Hot set test for insulation - This test shall be carried out as per IEC-60540 and shall pass the requirement given in IEC-60502.

t) Partial discharge test - This test shall be carried out in accordance with IEC-60540 and IEC-60502. The test requirements are as given in IEC-60502.

u) Bending test - The method and test requirement shall be as per IEC-60502 and on completion of this test, the sample be subject to partial discharge measurement and comply with the requirements.

v) Tan delta measurement as a function of voltage and capacitance measurement - This test shall comply with clause 16.1.6 of IEC-60502.

w) Tan delta measurement as a function of temperature - This test shall comply with clause 16.1.7 of IEC-60502.

x) Heating cycle test plus partial discharge test - This test shall be carried out as per IEC-540 and IEC-502.

y) Impulse withstand test - This test shall be carried out as per IS:7098 (Part-II). The impulse withstand voltage shall be 75 kV.

z) High voltage test - This test shall be performed as per IS:7098 (Part –II). The normal sequence of electrical test shall be as per clause 16.1.1 of IEC-60502.

1.6.9.5 Type test (Category-I) - Additional type tests on flammability

a) The oxygen index test shall be carried out as per ASTM-D-2863. The minimum oxygen index shall be 29.

b) Accelerated water absorption test and dielectric retention test - This test shall be carried out in accordance with NEMA-WC-5 irrespective of thickness of insulation (applicable for the thermoplastic material only).

c) Temperature index test for sheath - As per ASTM-D-2863 at different temperature upto 250^0C. However, the test shall be carried out by extrapolation method beyond temperature at which the material of sheath may startdeformation as per BICC Hand Book Chapter-6 on cables in fire. The number ofmeasurements up to 200^oC (room temperature, 50^oC, 100^0C, 150^0C and 200^0C) plotted on a graph and than extrapolated. The minimum temperature index shall be 250^oC.

d) Flammability of finished cables - The test shall be carried out as per requirement of Swedish Standards SS-4241475 class-F3, IEEE-383, IEC-60332 and IEC- 60331 (for fire survival cables only) and cables should meet the requirement ofall the above standards as mentioned in the respective category of cables.

e) Acid gas generation during fire of sheath - The test shall be carried out as per IEC-60754-1 as well as per BS or other standard applicable for evaluation of halogen gases and the requirement of maximum halogen gases liberated shall be less than as mentioned elsewhere in the respective category of cables.

f) Smoke generation by sheath under fire - The test shall be carried out as per ASTMD-2843.

g) Test for rodent and termite repulsion property of sheath - The details to be given by the manufacturer.

1.6.9.6 Site tests

The following minimum tests/ checks shall be conducted at site. Any other tests/ checksas per the manufacturer's recommendation shall also be carried out

a) Insulation resistance test

b) High voltage test

1.6.10 Installation of Cables, Earthing system and Lightning Protection system

Items/ Components/ Sub-systems	Tests/ Checks													
	Make, Type, Model, Rating and TC	Dimension	Pre-treatment of sheet	Paint shade, paint thickness, adhesion	IP protection	Bought out items/ Bill of material	HV and IR	Galvanize test	Functional test as per specification	Proof load	Deflection test	Constructional feature as per specification	All Routine and acceptance tests	Item conform to relevant standard
Switch box/ Junction box/ Receptacles (IS-513, IS:5, IS:2629, IS:2633, IS:6745)	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	
Cable glands (BS:6121)	Y	Y												Y
Cable lug (IS:8309)	Y	Y												Y
Lighting wire (IS:694)	Y	Y										Y		Y
Flexible conduits	Y	Y										Y		Y
Conduits (Galvanize and Epoxy) IS:9537, IS:2629, IS:2633 and IS:6745	Y	Y	Y					Y					Y	
RCC hume pipe (IS:458)	Y	Y												Y
Cable termination and Straight through joint (VDE-0278)	Y	Y			Y	Y						Y	Y	
Cable Trays, Flexible supports system and accessories IS:513, IS:2629, IS:2633 and IS:6745	Y	Y	Y			Y		Y		Y	Y	Y	Y	
Trefoil clamp	Y	Y												Y
GI flats for earthing and lightning protection (IS:2062, IS:2629, IS:6745 and IS:2633)	Y	Y	Y					Y						Y
GI wire (IS-280)	Y	Y	Y					Y						Y

Y =Test applicable

Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.10.1 Type test (Category-II)

i) All cable trays, supports and accessories etc supplied shall be of type testedquality.

ii) Cable termination kit and straight through joints shall be tested as per IS:3573 for 3.3kV and 11kV class.

iii) Fire proof cable penetration system shall be tested for the following tests:

- Accelerated ageing test
- Water absorption test
- Fire rating test
- Hose stream test
- Vibration test followed by fire rating test

iv) Galvanizing tests

The quality of galvanizing shall be inspected visually and shall be smooth, continuous, free from flux stains.

In addition following tests shall be conducted :

- Uniformity of coating – The coating of any article shall withstand for 1 minute dips in standard copper sulphate solution without the formation of an adherent red spot of metallic copper upon the basic metal.

- The quality of cadmium/ zinc plating on items with screw threads shall be inspected visually and shall be free from visible defects such as unplated areas, blisters and modules.

- In addition, the plating thickness shall be determined microscopically/ chemically or electronically.

v) Welding

The quality of welding shall be visually inspected, particular attention being paidto the following points.

- The welded joints shall be continuous along its length on both sides and of uniform width and thickness. It should be free from blow holes.

- The weld metal shall be properly fused with the parent metal without undercutting.

- The outside surface of the weld shall be clean. All slag shall have been removed. All welding shall be regularly checked for cracking using magnetic particle inspection or their equivalent technique.

vi) Physical and dimensional checks for all items

vii) Deflection test for cable trays

viii) Following tests shall also be carried out on each type of equipment, devices and materials/ items supplied:

- Physical and Dimensional checks

- Check/ measurement of thickness for Nickel chrome plating for cable glands and tinning for cable lugs.

- Check chemical composition of brass parts for cable glands

- Hardness check on gaskets

- Test for uniformity of galvanization

1.6.10.2 Site tests

The following minimum tests/ checks shall be conducted at site. Any other tests/ checksas per the manufacturer's recommendation shall also be carried out

i) Cables

a) Check for physical damage.

b) Check for insulation resistance before and after termination/ jointing.

c) HT cables shall be pressure tested (test voltage as per IS:7098) before commissioning.

d) Check of continuity of all cores of the cables.

e) Check for correctness of all connections as per relevant wiring diagrams. Any minor modification to the panel wiring like removing/ inserting, shorting, change in terminal connections, etc shall be carried out.

f) Check for correct polarity and phasing of cable connections.

g) Check for proper earth connections for cable glands, cable boxes, cable armour, screens etc.

h) Check for provision of correct cable tags, core ferrules, tightness of connections.

ii) Cable trays/ supports and accessories

a) Check for proper galvanizing/ painting and identification number of the cable trays/ supports and accessories.

b) Check for continuity of cable trays over the entire route.

c) Check that all sharp corners, burrs, and waste materials have beenremoved from the trays supports.

d) Check for earth continuity and earth connection of cable trays.

iii) Earthing and Lightning protection system

a) Earth continuity checks.

b) Earth resistance of the complete system as well as sub-system.

1.6.11 DC Storage Battery

1.6.11.1 Lead-Acid type battery

Item/ Components/ Sub-system	Tests/ Checks										
	Dimensions and finish	Conformance to relevant drawing	Chemical composition	Lead coating thickness (minimum 25 microns, IS:6848and Adhesion check	Conformance to CPWD Specification for teak wood	Paint process checks, paint shade, thickness, adhesionand finish	Constructional requirements as per specification	Insulation Resistance	Marking (Routine and Acceptance test)	Checking of polarity and absence of short circuit (Routine and Acceptance test)	Test for capacities for 10 hours discharge rate along with the test for voltage during discharge (Acceptance test)
Container and Lids (IS:1146)	Y	Y									
Vent plugs	Y	Y									
Sealing compound (IS:3116)		Y	Y								
Positive and Negative plates		Y	Y								
Separators (IS:6071)	Y	Y									
Electrolyte (water/ sulphuric acid) (IS:1069/ 266)		Y	Y								
Inter-cell connectors and fasteners	Y	Y		Y							
Battery stand	Y	Y			Y	Y					
Cell insulators	Y	Y						Y			
Stack assembly	Y	Y									
Lead-Acid battery (IS:1652)	Y						Y		Y	Y	Y

Y =Test applicable

Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.11.2 Ni - Cd type battery (Table 1/2)

Items/ Components/ Sub-system assembly	Tests/ Checks									
	Dimensions and finish	Impact strength	Conformance to relevant part drawing and Manufacturer's standards	Resistance to alkali	Chemical composition	Nickle plating thickness	Paint shade, thickness, adhesion and finish	Air pressure test after heat sealing	Marking and mass (Routine and Acceptance test)	Air pressure test (Acceptance test)
Container and Lids (IS:1146)	Y	Y	Y	Y						
Vent Plugs	Y		Y	Y						
Perforated steel strips	Y		Y	Y		Y				
Active material for positive and negative Plates			Y		Y					
Separators	Y		Y	Y						
Electrolyte			Y		Y					
Inter-cell connectors and fasteners	Y		Y	Y		Y				
Battery stand	Y			Y			Y			
Cell Insulators	Y		Y	Y						
Stack assembly	Y		Y					Y	Y	
Ni-Cd Battery (IS:10918)	Y								Y	Y

Y =Test applicable

Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.11.2 Ni- Cd type battery (Table 2/2)				
Items/ Components/ Sub-system assembly	Tests/ Checks			
	Retention of charge test (Acceptance test)	AH test (Acceptance test)	Insulation Resistance (Acceptance test)	Polarity and absence of short circuit (Routine and Acceptance test)
Container and Lids (IS:1146)				
Vent Plugs				
Perforated steel strips				
Active material for positive and negative Plates				
Separators				
Electrolyte				
Inter-cell connectors and fasteners				
Battery stand				
Cell Insulators				
Stack assembly		Y		Y
Ni-Cd Battery (IS:10918)	Y	Y	Y	Y
Y =Test applicable Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.				

1.6.11.3 Type test (Category-II)

All batteries supplied shall be of type tested quality.

1.6.11.3.1 Lead -Acid Plante battery

i) Type test reports for the following shall be submitted for purchaser's approval :

a) Container (Rubber and Plastic containers)

- High voltage test
- Drop ball test
- Plastic Yield test
- Acid resistance test
- Hydraulic thrust endurance test.

b) Cells and batteries

- Tests for capacities for 10 hr and 30 minutes discharge rates and test for voltage during discharge.
- Ampere hours and watt-hour efficiency test.
- Tests for retention of charge.
- Endurance tests.

ii) Acceptance Tests - All acceptance tests as listed below shall be carried out on sample cell selected at random by the purchaser before dispatch and at site after completion of installation.

- Verification of markings.
- Verification of dimensions.
- Test for capacities for 10 hrs discharge rate along with the testfor voltage during discharge.

If a battery fails to meet the guaranteed requirements, the purchaser shall havethe option of asking to replace the same.

1.6.11.3.2 Nickel-Cadmium battery

i) Type test reports for the following shall be submitted for purchaser's approval :

- Life cycle test
- Tests for capacities for 5 hr. and ½ hr. discharge rates and test for voltage during discharge
- Ampere hours and watt-hour efficiency test
- Tests for retention of charge
- Endurance tests
- Discharge performance at low temperature

ii) Acceptance Tests - All acceptance tests as listed below shall be carried out on sample cell selected at random by the purchaser before dispatch and at site after completion of installation.

a) Physical examination
b) Dimensions, mass and layout
c) Marking
d) Polarity and absence of short circuit.
e) Air pressure test
f) Ampere - hour capacity
g) Retention of charge

h) Insulation resistance
i) Test for capacities for 5 hrs. and ½ hr. discharge rates and test for voltage during discharge

If a battery fails to meet the guaranteed requirements, the purchaser shall havethe option of asking to replace the same.

1.6.11.4 Site tests

The following minimum tests/ checks shall be conducted at site. Any other tests/ checksas per the manufacturer's recommendation shall also be carried out

- Physical examination
- Dimensions, mass and layout
- Marking
- Polarity
- Insulation resistance
- Impedance measurement

1.6.12 Battery Charger

Item/ Components/ Sub-system	Tests/ Checks												
	Make, Model, Type, Rating and Finish	Chemical and Mechanical tests	Sheet steel pretreatment and painting process	Conform to relevant standard	Dimensional check and paint shade, thickness, adhesion and finish checks	Complete physical examination for constructional features of battery charger as per specification	Temperature rise test	Dynamic response test	Ripple content test, load limiter and Annunciator and AVR operation test	Operational and functional checks	HV and IR test	Burn-in test at 50^0C for 48 hrs.	Degree of protection test .
Rectifier transformer (IS:2026)	Y			Y			Y				Y		
Electronic components including potentiometer (vernier type)	Y			Y									
PCB and electronic cards	Y			Y									
19"standard racks for electronic card	Y					Y							
Control and selector switches (IS:6875)	Y			Y						Y			
Indicating meters (IS:1248)	Y			Y						Y			
Indicating lamps (IS:13947)	Y			Y						Y			
Air break switches/ Fuses(IS:13947/ 13703)	Y			Y						Y			
Control terminal blocks (IS:13947)	Y			Y									
Control transformer (IS:12021)	Y			Y						Y			
Push buttons (IS:4794)	Y			Y						Y			
MCB (IS:8828)	Y			Y						Y			
PVC insulated copper control wires (IS:694)	Y			Y									
Sheet steel (IS:513)	Y	Y	Y	Y									
Synthetic rubber gaskets	Y	Y		Y									
Annunciator	Y									Y		Y	
Battery charger	Y				Y	Y	Y	Y	Y		Y	Y	Y

Y =Test applicable

Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.12.1 Type test (Category-II)

All battery chargers supplied shall be of type tested quality.

Type test reports for the following shall be submitted for purchaser's approval :

i) Complete physical examination
ii) Temperature rise test at full load.
iii) Temperature rise test of rectifier assembly at 200% of full load.
iv) Insulation resistance test.
v) High voltage (power frequency) test on power and control circuits exceptlow voltage electronic circuits.
vi) Ripple content test at no load, half load and full load
vii) Automatic voltage regulator operation test at specified AC supplyvariations at no load, half load and full load
viii) Load limiter operation test
ix) Efficiency and power factor measurement.
x) Input and output surge withstand capability test. Surge voltage as per ANSI-C37.90a shall be applied for period not less than 2 second at the following points of the charger operating at 50^0C at full load :

- Across each AC input phase
- Across AC input line to ground.
- Across DC output terminals.
- Across each DC output terminal to ground

The charger shall not exhibit any component damage and there shall beno change in performance as per tests at (vii) and (viii).

xi) Environmental tests - Steady state performance tests (vii) and (viii) shall be carried out before and after each of the following tests.

a) Soak Test - The electronic modules shall be subjected to continuous operation for a minimum period of 72 hours. During last 48 hours,the ambient temperature shall be maintained at 50^0C. The 48 hourtest period shall be divided into four equal 12 hour segments. The input voltage during each 12 hours shall be nominal voltage for 11 hours followed by 110% of nominal voltage for 30 minutes, followedby 90% of nominal voltage for 30 minutes.

b) Degree of protection test.

1.6.12.2 Site tests

The following minimum tests/ checks shall be conducted at site. Any other tests/ checks as per the manufacturer's recommendation shall also be carried out

j) Complete physical examination
ii) Checking of proper operation of annunciation system
iii) Temperature rise test at full load for 30 min

iv) Insulation resistance test
v) Automatic voltage regulator operation
vi) Load limiter operation.
vii) Dynamic response test - overshoot/ undershoot in output voltage of the charger asa result of sudden change in load from 100% to 20% and 20% to 100% shall be measured with the batteries connected and disconnected. Output voltage of the charger connected with battery shall be within 94% to 106% of the voltagesetting in above conditions and shall return to, and remain, within the limits specified as mentioned elsewhere, in less than 2seconds (as applicable).
viii) Regenerative / pumping back to grid test.

1.6.13 Protection and relay panel for generator, generator transformer and UATs

Items/ Components/ Sub-systems	Tests/ Checks													
	Make, Type, Model, Rating and TC	Electrical Properties			Dimensions and Finish	Functional and operational features	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint shade, thickness, adhesion and finish	Functional checks	HV and IR test	Degree of Protection - Routine test		All Routine tests as per relevant standards
Protective relays (IS:3231/ 8686)	Y				Y	Y	Y			Y		Y		Y
Auxiliary relays (IS:3231/ 8686)	Y				Y	Y	Y			Y		Y		Y
Control and 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
LT fuses (IS:13703)	Y				Y	Y	Y							
Energy meters (IS:722)	Y				Y	Y	Y							Y
Transducers (IEC:60688)	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							
Complete Panel (IS:3427)	Y				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Test realy kit	Y									Y				Y

Y =Test applicable

Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.13.1 Type test (Category-II)

The Protection and Relay panels shall be of type tested quality.

i) For various bought out items like CT, VT, relays etc. for which identification can be physically verified and test certificate from manufacturer can be co-related, following shall be indicated in the QP.

- Review of manufacturer's TC as per relevant standard and compliance to requirements of this specification
- Physical check and functional/ operational check to ensure that item is fitfor assembly on the switch board cubicle.

ii) For all other items where identification has not been envisaged by manufacturers,a certificate of conformance to be obtained from manufacturer, and component identification shall be tagged as per approved drawing/ schematic. Either of the following or both shall be adopted .

- Random sample to be tested either in-house or at an independentlaboratory for all tests envisaged in relevant standard.
- Physical check and functional/ operation check to ensure the item is fitfor assembly on the panel.

1.6.13.2 Site tests

The following minimum tests/ checks shall be conducted at site. Any other tests/ checksas per the manufacturer's recommendation shall also be carried out

a) Cubicle Wiring

i) It should be made sure that the wiring is as per relevant drawings. All interconnections between panels shall similarly be checked
ii) Insulation resistance of all the wires with respect to earth
iii) Functional checking of all control circuit e.g. closing, tripping interlock, supervision and alarm circuit including proper functioning of component/ equipment
iv) Check terminations and connections
v) Wire ducting
vi) Gap sealing and cable bunching

b) Relays

i) Check internal wiring
ii) Insulation resistance between all terminals and body
iii) Insulation resistance between AC and DC terminals
iv) Check operating characteristics by secondary injection
v) Check minimum pick up voltage of DC coils

vi) Check operation of electrical/ mechanical targets
vii) Check CT connections with particular reference to their polarities for differential type relays
viii) Pickup & timing test as per Relay settings
ix) Configuration checks & communication checks.

c) Meters

i) Insulation resistance of all insulated portions
ii) Check CT and VT connections with particular reference to theirpolarities for power type meter

d) General

i) Wiring check in conformity with schematics.
ii) Insulation check.
iii) Primary injection test.
iv) Secondary injection test.
v) On load test.
vi) DC sequential test.

1.6.14 Emergency Diesel Generating Set

1.6.14.1 Diesel Engine

Items/ Components	Tests/ Checks										
	Material test	DP or MPI	UT (on forging and piston bonding)	Balancing	Hydraulic, water fill test	Assembly, Fit up	Dimension	Functional/ Operation test	Performance test as per BS-5514/ or equivalent IS/ ISO Standard including Governing test for 3 hours at full load and one hour at 10%	Fuel consumption (lit/ Kwh), rated power measurement, rated speed	All other tests (if applicable) as per specification and 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

Y =Test applicable

Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.14.2 Alternator															**(Table 1/2)**
Items/ Components	**Tests/ Checks**														
	Visual	Dimension	Make, Type, Rating, TC, General physical inspection	Mechanical, Chemical properties	NDT, DP or MPI, UT	Metallography	Electrical characteristics	Welding/ Brazing (WPS/ PQR)	Heat treatment	Magnetic characteristics.	Hydraulic, Leak, Pressure test	Thermal characteristics	Run out	Dynamic balancing	
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						
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 and machining of stator, rotor, terminal box	Y	Y			Y				Y						
Wound stator	Y	Y					Y	Y							
Wound exciter	Y	Y					Y	Y							
Rotor complete	Y	Y					Y						Y	Y	
Exciter, Stator, Rotor, Terminal box	Y	Y					Y								
Accessories, RTD, BTD, CT, AVR. Brushes, Diodes, Space heater, antifriction, bearing, cable glands, lugs, gaskets etc.	Y	Y	Y												
Alternator (IS:4722)	Y	Y	Y				Y								

Y =Test applicable Y1 = for HT Machines only

Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.14.2 Alternator	**(Table 2/2)**			
Items/ Components	**Tests/ Checks**			
	All tests as per IS:4722	Vibration	Over speed	Tan delta, shaft voltage and polarization index
Plates for stator frame, end shield, spider etc.				
Shaft				
Magnetic Material				
Rotor copper/ aluminum				
Stator copper				
SC Ring				
Insulating material				
Tubes for cooler				
Sleeve bearing				
Stator/ Rotor, Exciter coils				
Castings, stator frame, terminal box and bearing housing etc.				
Fabrication and machining of stator, rotor, terminal box				
Wound stator				
Wound exciter				
Rotor complete				
Exciter, Stator, Rotor, Terminal box				
Accessories, RTD, BTD, CT, AVR. Brushes, Diodes, Space heater, antifriction, bearing, cable glands, lugs, gaskets etc.				
Alternator (IS:4722)	Y	Y	Y	Y1

Y =Test applicable Y1 = for HT Machines only

Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.14.3 Final assembly

Items/ Components	Tests/ Checks									
	Material test	Dimension	WPS, PQR, Welding	NDT, DP or MPI, UT	Check completeness	Hydraulic, Leak, Pressure test	Functional test	All Routine test as per Specification /IS	No load test for one hour of the DG set assembly	Clearances and alignment
Base frame	Y	Y	Y	Y	Y					
Fuel tank	Y	Y	Y	Y	Y	Y				
Battery (IS:1691)								Y		
Battery charger								Y		
Control panel								Y		
Assembled DG set		Y			Y		Y	Y	Y	Y

Y =Test applicable

Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.14.4 Type test (Category-II)

All DG sets and accessories supplied shall be of type tested quality.

Type test reports for the following shall be submitted for purchaser's approval :

a) Measurement of resistance and air gap
b) Phase sequence test
c) Regulation test
d) Measurement of open circuit and short circuit characteristics
e) Efficiency test
f) Temperature rise test
g) Momentary overload test
h) Over speed test
i) High Voltage test
j) Insulation resistance test (both before and after high voltage test)
k) Noise level as per IS:12065

l) Vibration as per IS:12075
m) Determination of deviation of voltage waveform from sinusoidal
n) Degree of protection test on control panel for IP-52

1.6.14.5 Site Tests

The following minimum tests/ checks shall be conducted at site. Any other tests/ checksas per the manufacturer's recommendation shall also be carried out

a) Visual Test

b) Electrical Tests

i) Calibration of instruments, relays etc.
ii) Primary and secondary injections tests of protective devices.
iii) Function, interlock test of control panel
iv) Insulation resistance measurement of power and control circuits.

c) Mechanical Tests

i) Trial run of engine
ii) Governor testing
iii) Over speed trip test
iv) Load pick up and load rejection tests
v) Load test and temperature rise measurement of engine and alternator

1.6.15 Electro Static Precipitator (ESP) – Electrical				
1.6.15.1 General				
Items/ Components	**Tests/ Checks**			
	Visual	Make, Type, Rating etc.	Final Inspection as per IS/ IEC /BS	Remarks
TR Set	Y	Y		Refer table for TR
ESP insulator (IEC 168/ 273, IS 2544)	Y	Y	Y	ESP insulators shall be additionally subjected to high temperature test on sample basis as per mutually agreed upon procedure.
Electrostatic Precipitation Management System	Y	Y		Refer table for annunciation, control, PLC Panel
Microprocessor based rapper controller	Y	Y		Refer table for annunciation, control, PLCPanel
Disconnecting switch (IS 13947)	Y	Y	Y	
Heaters (IS 4159/ BS 6351)	Y	Y	Y	

1.6.15.2 Transformer Rectifier (TR) Set												**(Table 1/2)**
Items/ Components	**Tests/ Checks**											
	Visual	Dimensional and physical	Make, Type, Rating	Mechanical, chemical Properties	Electrical	Electronics	Welding	NDT	Pretreatment of tank	Painting	All tests as per IS2026	All tests as per IEC-146
Thyristor	Y	Y	Y			Y						Y
Contactor	Y	Y	Y		Y							
Switch Fuse Unit	Y	Y	Y		Y							
HRC Fuse	Y	Y	Y		Y							
Current Transformer	Y	Y	Y		Y							
Overvoltage Protector	Y	Y	Y		Y							
Measuring Instruments	Y	Y	Y		Y							
Control Transformer	Y	Y	Y		Y							
Bushings	Y	Y	Y		Y							
Dial Thermometer	Y	Y	Y		Y							
Resistor wire wound	Y	Y	Y		Y							
Sudden Pressure Relay	Y	Y	Y		Y							
PVC insulated copper wire (ISI Marked)	Y	Y	Y		Y							
Terminal Block	Y	Y	Y		Y							
Gasket	Y	Y	Y	Y								
Electrolytic copper	Y	Y	Y	Y								
Capacitor, Resistor	Y	Y	Y	Y	Y	Y						
PCB	Y	Y	Y		Y							
Insulated conductor	Y	Y	Y	Y	Y							
Laminations	Y	Y	Y	Y	Y							
Press board, paper	Y	Y	Y	Y	Y							
Insulating oil (Silicon)	Y		Y	Y	Y							

1.6.15.2 Transformer Rectifier (TR) Set												**(Table 2/2)**
Items/ Components	**Tests/ Checks**											
	Visual	Dimensional and physical	Make, Type, Rating	Mechanical, Chemical Properties	Electrical	Electronics	Welding	NDT	Pretreatment of tank	Painting	All tests as per IS2026	All tests as per IEC-146
Radiator	Y	Y	Y	Y				Y				
Transformer Tank	Y	Y	Y	Y			Y	Y		Y		
Panel Fabrication	Y	Y	Y	Y			Y		Y	Y		
Electronic Cards	Y	Y	Y		Y	Y						
Linear Reactor, Choke	Y	Y	Y	Y	Y							
Transformer Assembly	Y	Y		Y	Y							
Control Panel	Y	Y	Y	Y	Y	Y				Y		
HV, TR Set	Y	Y	Y		Y	Y				Y	Y	
ESP Controller (Separate QP)	Y	Y	Y		Y	Y	Y		Y		Y	

1.6.15.3 Annunciation, Control, PLC Panel

Items/ Components	Tests/ Checks												
	Visual	GA, BOM ,Lay out of components	Dimensions, General physical inspection	Paint shade, thickness, adhesion	Component Rating, Make, Type	Wiring	IR and HV	Review of TC for instruments	Accessibility of devices	Illumination	Functional check for control element ,	Test as per IEC:1131 *	Routine and acceptance tests as per IS 8623
Annunciation, Control, PLC Panel	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes

1)	Detailed procedure of Burn-in and Elevated temperature test shall be as per Quality Assurance Programme
2)	(*) Applicable for PLC
3)	MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

1.6.15.4 VFD Module				
Attributes/ Characteristics / Items/ Components/ Sub-system assembly	Visual & Dimensional checks	Make / Type/ Rating etc.	Final Inspection as per IS/ 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 Panel

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

2) Make of all major Bought-out Items will be subject to purchaser's approval.

3) Note: MQP shall be submitted by the manufacturer comprising the tests/checks as stipulated in the matrix/table attached for the specific item/component by the respective manufacturer.

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