

D.3. Mechanical Requirements

Intent of this section is to describe requirements which are ‘technology neutral’, but at the same time, which has bearing on life, reliability and availability of the plant. Other ‘technology specific’ requirements, shall be finalized during the stage of ‘detailed engineering’ with the approval/acceptance of NTPC.

S.No	Item	Details
1.	Direct Contact Cooler (DCC) Column	<ul style="list-style-type: none"> i) Turndown: 50% (Min), ii) Overdesign: 110% (Min), iii) Pressure Drop Across Column: 20 mbar (Max) iv) Fluid: Flue Gas & DCC CW Water / SOx NOx Scrubbing Solution,
2.	Scrubbing Column for SOx / NOx	<ul style="list-style-type: none"> v) Pressure (Operating / Design): > 0.1 Bar, vi) Temperature (Operating / Design): 100C / 150C, vii) MOC: (i) Shell: SS304L or better, (ii) Internals: SS304L or better, viii) Packing: Yes (Intalox Ultra / Nex Ring or eqv), ix) Demister: Yes (Separation Efficiency: >99%, Liquid Droplet Size: < 5 micron, Knit Mesh type), x) Design Code: ASME Section VIII, Div-1, xi) Insulation: No,
3.	CO2 Absorber Column	<ul style="list-style-type: none"> i) Turndown: 50% (Min), ii) Overdesign: 110% (Min), iii) Pressure Drop Across Column: 60 mbar (Max) iv) Fluid: Flue Gas & Solvent Solution, v) Pressure (Operating / Design): > 0.1 Bar, vi) Temperature (Operating / Design): 40-70C / 110C, vii) MOC: (i) Shell: SS304L or better, (ii) Internals: SS304L or better, viii) Packing: Yes (Metallapak Plus / Flexipac or eqv), ix) Demister: Yes (Separation Efficiency: >99%, Liquid Droplet Size: < 5 micron, Knit Mesh type), x) Design Code: ASME Section VIII, Div-1, xi) Insulation: No,
4.	CO2 Stripper Column	<ul style="list-style-type: none"> i) Turndown: 50% (Min), ii) Overdesign: 110% (Min), iii) Pressure Drop Across Column: 30 mbar (Max) iv) Fluid: CO2 Vapor & Solvent Solution, v) Pressure (Operating / Design): 1 Bar / +4 to -1 Bar, vi) Temperature (Operating / Design): 70-120C / 150C, vii) MOC: (i) Shell: SS304L or better, (ii) Internals: SS304L or better,

S.No	Item	Details
		viii) Packing: Yes (Metallapak Plus / Flexipac or eqv), ix) Demister: Yes (Separation Efficiency: >99%, Liquid Droplet Size: < 5 micron, Knit Mesh type), x) Design Code: ASME Section VIII, Div-1 xi) Insulation: Yes (Hot),
5.	Reboiler for CO2 Stripper	i) Type: Shell & Tube Heat Exchanger, ii) Thermal Capacity: 110% (Min), iii) Design Pressure: 1.5 times the operating parameters, iv) Design Temperature: 1.5 times the operating parameters, v) MOC: SS304 or better (Shell, Tube, Tube sheet, Baffles, Frames, Plate & Frame), vi) Design Code: ASME Section VIII, Div-1, TEMA-R
6.	Heat Exchangers & Condensers	i) Type: Centrifugal, ii) Design Pressure: 120% (Min) of operating parameters, iii) Design Temperature: 120% (Min) of operating parameters, iv) Other Design Considerations: (i) Pumps shall give satisfactory performance at any point on the H-Q characteristics curve over the operating range (generally 40% to 120% of rated flow), (ii) Maximum efficiency of pumps shall be preferably within 10% of the rated design flow, (iii) First critical speed shall be at 130% of the rated speed or higher, (iv) The characteristic curves of pump should be continuously rising type with decrease in flow and shut off head shall be in the range of 115% to 130% of TDH at design point, (v) NPSH margin: NPSH (A) at design flow with lowest suction level and maximum pressure drop across suction strainer shall be at least 2 times the NPSH (R) at 3% head drop. Further, NPSH (R) at 3% head break shall be well below NPSH (A) under all conditions, (vi) Minimum recirculation circuit and minimum flow protection in accordance with the pump design v) Flow Control: VFD (preferred but to finalized alongside 'Technology Provider' with approval of NTPC). vi) MOC (Process Pump): SS304 or better (Casing, Impeller, Shaft), vii) MOC (Water Pump): (i) SS304 / SS410 or better (Impeller, Shaft), (ii) CS or better (Casing), viii) Sealing (Process Pump): Double Mechanical Seal,
7.	Pumps	i) Type: Centrifugal, ii) Design Pressure: 120% (Min) of operating parameters, iii) Design Temperature: 120% (Min) of operating parameters, iv) Other Design Considerations: (i) Pumps shall give satisfactory performance at any point on the H-Q characteristics curve over the operating range (generally 40% to 120% of rated flow), (ii) Maximum efficiency of pumps shall be preferably within 10% of the rated design flow, (iii) First critical speed shall be at 130% of the rated speed or higher, (iv) The characteristic curves of pump should be continuously rising type with decrease in flow and shut off head shall be in the range of 115% to 130% of TDH at design point, (v) NPSH margin: NPSH (A) at design flow with lowest suction level and maximum pressure drop across suction strainer shall be at least 2 times the NPSH (R) at 3% head drop. Further, NPSH (R) at 3% head break shall be well below NPSH (A) under all conditions, (vi) Minimum recirculation circuit and minimum flow protection in accordance with the pump design v) Flow Control: VFD (preferred but to finalized alongside 'Technology Provider' with approval of NTPC). vi) MOC (Process Pump): SS304 or better (Casing, Impeller, Shaft), vii) MOC (Water Pump): (i) SS304 / SS410 or better (Impeller, Shaft), (ii) CS or better (Casing), viii) Sealing (Process Pump): Double Mechanical Seal,

S.No	Item	Details
		ix) Sealing (Water Pump): Mechanical Seal, x) Design Code (Process Pump): ISO 13709 / API 610, xi) Design Code (Water Pump): ASME B73.1 / ISO 5199, xii) Motor: Outdoor, Continuous, IP-65 or better, xiii) Chemical Pump: (i) Type: Reciprocating, (ii) MOC: SS304 or better,
8.	Drums & Tanks	i) Drums & Tanks (Process): (i) MOC: SS304 or better, (ii) Design Code: ASME Section VIII, Div-1, (iii) Capacity: 6 Days (Min), ii) Drums & Tanks (Water): (i) Polypropylene / HDPE MOC: SS304 or better, (ii) Capacity: 1 Day (Min), iii) Drums & Tanks (Other): To finalized at the stage of detailed engineering with approval of NTPC.
9.	Flue Gas Fan	i) Quantity: 2x 100%, ii) General Details: (i) Type: Centrifugal, (ii) Duty: Continuous, (iii) Installation: Outdoor, iii) Operating Flow: 25 TPH, iv) Operating Pressure - Inlet: 5-10 mmWC, v) Operating Pressure - Outlet: 1000 mmWC, vi) Design Flow: 105% (Min) of operating parameters, vii) Design Pressure: 105% (Min) of operating parameters, viii) Minimum Operating Load: 30%, ix) Flow Control: VFD, x) Fan Details: (i) MOC: SS304L or better (Casing, Impeller, Shaft), (ii) Speed: 1500 RPM (Max), (iii) Impeller Blades Profile: Backward, (iv) Stage: Single / Multiple, (v) Shaft Support: Simply Supported, (vi) Coupling: Flexible, (vii) Foundation: RCC, xi) Motor Details: (i) Type: VFD compliant Squirrel cage Induction Motor, (ii) Power: 3Phase, 415 VAC, (iii) Duty: Outdoor Continuous, (iv) Protection: IP-65 or better, (v) Junction Box: Capable of accepting armored aluminum cable
10	Cooling Water System	i) Heat Duty: (i) Design: 120% (Min) of operating parameters, (ii) Operating: From 'Technology Provider', ii) Design Conditions: (i) Cold Water: 33 C, (ii) Hot Water: 43 C, (iii) WBT: 28 C, (iv) RH: 95% at 40C, (v) Approach: 5C iii) CW System shall comprise of: (i) Cooling Tower: 1x100%, (ii) CW Pumps: 2x100%, (iii) Cooling Tower Blowdown (including pumps and peripherals) (iv)

S.No	Item	Details
		<p>Piping & Valves, (v) Instruments, (vi) Acid Dosing System, (vii) Inhibitor Dosing System.</p> <p>iv) Basin and sump shall be designed as per HIS (Hydraulic Institute Standard) and shall have retention time of minimum 15 minutes.</p>
11	Compressed Air System (Instrument & Plant Air)	<ul style="list-style-type: none"> i) Type: Screw ii) Quantity: 2 x 100 % (1 Working + 1 Stand Bye) iii) Capacity: 240 NM3/Hr iv) Inlet Condition: Pressure: Ambient, Temperature: 50C, RH : 95% v) Outlet Condition: Pressure: 8 Bar(G), Temp: 41C (After Cooler) vi) Minimum Operating Load: 30% or below vii) Flow Control: VFD viii) Lubrication: Non-lubricated (oil-free) ix) Duty: Continuous x) Installation: Outdoor xi) Design Standard: API 617 or Eqv xii) Process Control: AUTO Start / Stop, Control from PLC xiii) Accessories: All necessary equipment, inter/after cooler, pre-filter, silencer, instruments, piping, valves, electric hoist, accessories etc
12	Compressed Air Buffer Vessel	<ul style="list-style-type: none"> i) Number of Air Receiver Tank: 2 Nos ii) Capacity of each Air Receiver Tank: 40 Cub.Mtr iii) Material: CS (Corrosion Allowance; Min 3 mm) iv) Design Condition: (a) Pressure:10.5 BarG, (b) Temperature:75 C v) Design Code: ASME Section VIII Div I (Latest) vi) Accessories: Level Indicator, Pressure Indicator, Manhole, Safety/Relief Valve, Drain Valve
13	Instrument Air Dryer	<ul style="list-style-type: none"> i) Quantity: 2x100% (1 Operation + 1 Regeneration) ii) Capacity: 240 NM3/Hr iii) Type: Regenerative-Desiccant & Pressure Swing iv) Inlet Condition: 7.5 BarG, 41 C, 95% RH v) Outlet Condition: DP: 0.5 Bar, Dew Point: (-) 40C, Oil free vi) Dryer capacity to be specified considering regeneration air flow (not exceeding 15% of outlet air flow) vii) Installation: Outdoor viii) Accessories: Pre-filter, After-filter, Relief Valve, Drain Valve, Switch Over Valve, Drain Trap, Local Control

S.No	Item	Details
		Panel, Moisture Indicator, Pressure, Indicator, Silencer etc
14	LP Steam Pipeline & Pressure Reducing Station	<p>i) Steam Pipeline Inlet Parameter: (i) 5 TPH, (ii) 12 Bar, (iii) 200 C,</p> <p>ii) Steam Pressure Reducing Station Outlet Parameter: (i) 3.7 Bar, (ii) 150 C (to be confirmed with ‘CO2 Technology Provider’)</p> <p>iii) Steam Pipeline Length: 1,500 Meter (indicative),</p> <p>iv) Statutory Compliance: IBR,</p> <p>v) Design Velocity of Steam: 30 Mtr/Sec (Max),</p> <p>vi) Design Pressure: 150% of the operating pressure,</p> <p>vii) Pipes shall be sized to achieve minimum pressure drop,</p> <p>viii) MOC – Steam Pipeline & PRS: ASTM 106 Gr.C (Seamless) (Corrosion Allowance : 1.5 mm),</p> <p>ix) MOC - Silencer: (i) Outer casing (Shell / Head): CS (3mm corrosion allowance); (ii) Perforated plate: 304SS; (iii) Absorbing material: Glass Fibre,</p> <p>x) Accessories: Silencer, Pipes, Valves etc,</p> <p>xi) Steam Traps: Inverted Bucket type with integral or separate Y-type strainers. Y-type strainers shall have stainless steel screen of not more than 20 mesh size,</p> <p>xii) Design of Pipe Rack: As per ‘Load and Resistance Factor Design’ (LRFD) considering ‘Load Factor’ as 1.1 (Min) alongside Dead load, Wind load, Seismic load, Thermal load etc. With appropriate design, contractor can consider common rack for ‘Steam Pipe’, ‘Flue Gas Duct’ and ‘Water Pipe’ (DM, SW, Condensate, Fire Water).</p>
15	Pipeline, Ducts, Fittings & Valves	<p>i) MOC SS 304L or better: All process pipeline of CO2 capture plant, DM Water and Condensate (excluding flue gas duct, pipeline for steam, cooling water, fire water),</p> <p>ii) MOC CS or better: All pipes, ducts, gates, dampers, valves pertaining to (i) duct carrying flue gas from power plant to CO2 capture plant, (ii) pipeline for steam, cooling water, fire water etc,</p> <p>iii) Material of all other pipeline including utilities shall be as per best engineering practice and shall be finalized at the stage of detailed engineering with the approval / acceptance of NTPC,</p>

S.No	Item	Details
		<p>iv) Pipe, valve and instrument schedule and its quality plan (if any) shall be finalized at the time of detail engineering with the approval / acceptance of NTPC,</p> <p>v) Provision and operation of valve shall be in such a way that plant shall run and controlled automatically and in accordance with approved P&ID,</p> <p>vi) Scope: Pipes, pipe fitting, ducts, gates, dampers, valves, safety valves, relief valves, instrument root valves & valve actuators, orifice assembly, Stub/boss/half coupling, drains & vents along with their escape piping, steam traps, snubbers, weldolet, thermo well, hangers, supports & other accessories as required,</p> <p>vii) Design Code: All material under this sub-section shall conform to the latest editions of American National Standard Code for Pressure Piping, Power Piping, ANSI B 31.1, ANSI B16.11, and Pressure Vessel Codes, IBR and other applicable ASME, ANSI and state standards,</p> <p>viii) Pipes shall run over a pipe rack and it shall be suitably clamed with support structure. Pipe rack shall be in the scope of bidder. Piping shall cross the road over an MS structure/ rack (cross over bridge) so that movement shall not be affected. The same shall be in the scope of bidder. Concrete pedestals for pipe on the earth surface shall be in the scope of bidder,</p> <p>ix) Hot Insulation & Cladding (wherever required): Mineral/glass wool insulation with Aluminum cladding. Removal & re-installation of thermal insulation & cladding provided on/ around the new tap-off/connection points on existing feed water discharge line, in consultation with NTPC,</p> <p>x) Hydrostatic Test: All piping systems shall be hydro tested at 1.5 times the design pressure subject to regulation of 374 IBR. However, for such systems where it is practically not possible to do hydro tests, the tests as called for in ANSI B31.1& IBR in lieu of hydro test shall also be acceptable. Hydro testing, steam blowing & chemical cleaning of piping systems, after complete erection is to be carried out, which also includes supply, erection, making temporary closures, dismantling and removal of all temporary material/piping, equipment and materials from site,</p>

S.No	Item	Details
		<p>disposal of water/waste water/effluent, clean up and reinstatement of the cleaned piping system,</p> <p>xi) It is the responsibility of the Bidder to identify and obtain all necessary approvals from various Government agencies/board/statutory authorities/ IBR (CBB, Delhi / CIB of the state in which the plant is being installed) etc., as applicable.</p>
16	Fire Detection & Protection System	<p>i) Bidder shall provide both fire detection and fire protection system including fire extinguishers, as required for CO2 solvent, auxiliary chemicals, plant mechanical / electrical / C&I equipment etc, as per TAC/NFPA/IS 3034/OISD and approved/accepted by NTPC.</p> <p>ii) Fire alarm cum control panel shall be extended to and interfaced with main plant / main security PLC for information exchange. The scheme shall be approved/accepted by NTPC.</p> <p>iii) Bidder shall also provide Personal Protective Equipment to all its personal, as appropriate, with approval / acceptance of NTPC.</p>
17	Waste Handling System	Bidder shall provide requisite equipment / system so as to ensure that waste from all sources (e.g. Used Solvent, Sludge from the Reclaimer system, Filters, etc.) are handled and treated as hazardous waste.
18	CO2 Compressor	<p>i) Type: Reciprocating (non-lubricated),</p> <p>ii) Quantity: 2 x 100 % (1 Working + 1 Stand Bye)</p> <p>iii) Capacity: 1.15 x 2.08 TPH (50 TPD),</p> <p>iv) Suction Condition: Pressure/Temperature: As per technology provider for CO2 capture</p> <p>v) Discharge Condition: Pressure: 50 Bar(G), Temp: 40C (After Cooler),</p> <p>vi) Minimum Operating Load: 30% or below,</p> <p>vii) Flow Control: VFD,</p> <p>viii) Design Code: API 618,</p> <p>ix) Accessories: Knock out drum, Intercooler, Aftercoolers, PSV, Compressor Spares</p>
19	CO2 Storage Tank	<p>i) Number of Tank: 2 Nos,</p> <p>ii) Capacity of each Tank: 100 M3,</p> <p>iii) Operation Condition: (a) Pressure:50 Bar, (b) Temperature: 50C,</p> <p>iv) Design Condition: (a) Pressure: 65 Bar, (b) Temperature: 60C,</p>

S.No	Item	Details
		<p>v) Material: A-516 Grade 70 (Corrosion Allowance: Min 3 mm, vendor to provide calculation),</p> <p>vi) Design Code: ASME Section VIII Div I (Latest),</p> <p>vii) Paint (Inside Surface): (i) Base Coat: Zinc rich primer (92% zinc in dry film) – Minimum 100 micron DFT, (ii) Intermediate Coat: High Performance Epoxy - Minimum 200 micron DFT, (iii) Top Coat: Vinyl Ester Coatings - Minimum 200 micron DFT,</p> <p>viii) Paint (Outside Surface): (i) Base Coat: Zinc rich primer (92% zinc in dry film) – Minimum 100 micron DFT, (ii) Intermediate Coat: High Performance Epoxy - Minimum 200 micron DFT, (iii) Top Coat: Polyurethane - Minimum 100 micron DFT,</p> <p>ix) Surface Preparation (Inside Surface): SSPC-SP 10/NACE No. 2 (Near-White Metal Blast Cleaning) or better – after wire brushing,</p> <p>x) Surface Preparation (Outside Surface): ISO 8501-1 Sa 2½ (Very Thorough Blast Cleaning) – after wire brushing,</p> <p>xi) Primer paint shall be applied within 6 hours of surfaces preparation,</p> <p>xii) Surface preparation and painting job shall be executed by specialist agency having relevant credentials.</p> <p>xiii) Statutory Approval: PESO, ASME "U" stamp,</p> <p>xiv) Accessories, mountings and instruments shall be as indicated in the note below. Welding, Testing and Inspection procedure shall be finalized at the stage of detailed engineering.</p> <p>1. Column, Tanks and Drums shall be complete with in/out nozzles, level transmitter, level gauge, temperature & pressure transmitter, sight glass, manhole/hand hole, safety valve / pressure relieve valve, rupture disc (as required), earthing & grounding lugs and all other accessories required for the process. It shall be finalized alongside 'Technology Provider' with approval of NTPC,</p> <p>2. To be decided during detailed engineering for all Columns, Heat Exchangers, Tanks and Drums: (i) Ladder and Intermediate Landing, (ii) Elevation and Orientation of all 'Nozzles' and 'Manholes', (iii) 'Skirt Support' Structure,</p>