

	TITLE 4 X 270 MW BHADRADRI TPS TECHNICAL SPECIFICATION FOR CW/RW/PW CHLORINATION PLANT	SPECIFICATION NO. PE-TS-411-174A-A001
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SECTION – D1

STANDARD TECHNICAL SPECIFICATIONS (MECHANICAL)

**TITLE****4 X 270 MW BHADRADRI TPS
TECHNICAL SPECIFICATION FOR
CW/RW/PW CHLORINATION PLANT**

SPECIFICATION NO. PE-TS-411-174A-A001

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1.0 DESIGN PHILOSOPHY FOR CW CHLORINATION PLANT

CW Gas Chlorination Plant has been designed to dose required quantity of chlorine to Cooling Water system. Chlorine gas shall be mixed thoroughly with the water in the ejector provided in the system. The chlorine solution thus obtained shall be dosed to individual CW Pump Pit and CW forebay. System has been designed for shock dosing of chlorine at the rate of 5 ppm for half an hour once in 8 hrs. and 1 ppm chlorine dosing on continuous basis. However at a time dosing shall be done either in shock or in continuous basis. Actual dosing level shall be set by the operator based on residual chlorine measurement at the CW sump or forebay.

Two nos. of CW chlorination plant with two nos. absorption system for all 4 units, one no. RW chlorination with one nos. absorption system for all 4 units and one no. potable water chlorination plant for all 4 units shall be provided.

A. EQUIPMENT DESIGN CRITERIA

Three Nos. (2W+1S) streams of each CW gas chlorination system have been provided (3 nos for unit I & II and 3 nos for unit III & IV). Each stream shall consist of the following main equipment & accessories. Refer to the Data sheet-A, section C1-F for the technical details.

- Chlorine ton containers,
- Expansion tank
- Pipe manifold with accessories
- Evaporator,
- Chlorinator,
- CW booster pumps,
- Chlorine gas filters,
- Injector for chlorine solution preparation
- Chlorine gas leak detector & safety equipment
- Chlorine gas absorption system
- Lifting & handling devices
- Associated piping, instrumentations & Necessary controls.

1.1.1 CHLORINE TON CONTAINER

30 nos. Chlorine ton-containers (each of approximately 900 Kg, capacity) will be provided to store chlorine in liquid vapour phase for Unit 1 & 2, another 30 nos. shall be provided for Unit 3 & 4, It shall be standard chlorine ton container. Each container will be complete with built-in isolating valves (one (1) for liquid discharge and one (1) for gas withdrawal) and valve hood.

The design, fabrication and testing of cylinder/ton container shall conform to the Chief Controller of Explosives, Government of India, Department of Explosives. Nagpur.

1.1.2 PIPE MANIFOLD WITH ACCESSORIES

Chlorine manifold consisting of straight lengths of pipe, fittings, isolation valves, automatic shut-off valves, liquid expansion chamber fitted with rupture discs, pressure indicator, Temperature indicator, pressure switch, alarms, automatic change over facility of tonners, etc. will be provided. Pressure reducing & shut-off valves shall be provided in the chlorine gas line.

1.1.3 EXPANSION TANK

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Expansion tank of suitable capacity shall be provided on the common headers of the chlorine tonners. The expansion tank will be complete with all necessary accessories such as pressure switch and rupture disc. etc.

Tanks of suitable capacity shall be supplied. The volume of the tank shall be minimum 20% of the header pipe volume at highest elevated condition.

Expansion tank shall be Carbon Steel and shall be of suitable plate thickness depending on diameter and pressure conditions. The fabrication of the tank shall be normally as per ASME pressure vessel code. Sec VIII/IS 7681.

1.1.4 EVAPORATOR

Electrically heated constant temperature water bath type evaporator has been provided to vaporize liquid chlorine into the gas form before feeding the chlorinator. Each evaporator shall be sized with ample safety factor to allow for partial filling of the chlorine chamber. The electric heater shall be thermostatically controlled to maintain constant temperature. The hot water bath in the evaporator shall be vented to the atmosphere and the minimum water level in the water bath shall be maintained automatically by solenoid valve. Evaporator shall be provided with water level sight glass, gas temperature indicator, gas pressure gauge, low level alarm & switches, thermostat, on / off switch with lamps, water temperature high switch, water temperature low switch etc., & other associated instrumentations as shown in the P&I enclosed. Pressure regulating and Shut-off valves for each of the chlorine gas line from the outlet of each Evaporator shall be provided. Cathodic protection suitable to protect water bath tank and outside of evaporator shall be provided. A local ammeter shall be mounted on the evaporator as an indication of degree of cathodic protection.

1.1.5 CHLORINATOR

Vacuum solution feed type chlorinators shall be provided. Chlorine feed rate shall be manually adjusted. The chlorinator shall be provided with Rotameter and pressure and vacuum relief valve etc. The entire chlorinator shall be constructed of material completely resistant to the corrosive attack of wet or dry chlorine gas & chlorine solution.

1.1.6 BOOSTER WATER PUMPS

Booster pumps shall be provided to supply motive water for the chlorination plant. Motive water shall be tapped off from CW pumps discharge header. Pump shall be complete with suction strainers, non-return valves, isolating gate valves, pressure gauges etc. at the discharge side.

1.1.7 EJECTOR

Both water and chlorine gas shall be thoroughly mixed in the ejector and chlorine solution is then dosed at the required dosing point.

1.1.8 DIFFUSER

Diffuser shall be designed to dose concentrated chlorine solution in required quantity at each dosing point. The material of construction of the diffuser shall be MSRL/HDPE/PP. Perforated type diffuser shall be designed so that each hole takes a 1 to 2 gpm (4 to 7 LPM) at 3 to 4 M/sec velocity.

1.1.9 HOIST MONO-RAILS

Two nos. (One (1) no. for each chlorination system of Unit I&II and Unit III & IV) electrically operated monorail hoist shall be provided by bidder for CW chlorination system.

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Each electrically operated monorail hoist shall be provided for lifting the ton container. Lifting bar to grab the empty or full ton container during handling (1 No.) shall have suspension type load indicator of minimum capacity (Net) 3000 Kg.

1.1.10 WEIGHING SCALE

Two nos. (One (1) no. for each chlorination system of Unit I&II and Unit III & IV) weighing scale of 3 ton capacity of platform dial type shall be provided. Weighing scale shall be suitable for fixing on the ground.

1.1.11 OTHER MISC. ACCESSORIES

System shall also have following:

- Associated piping and valves required for the system.
- All necessary instruments and controls required for easy and safe operation of the system.

1.1.12 SAFETY & SUPERVISORY INSTRUMENT

GAS MASK & OXYGEN BREATHING EQUIPMENT

Gas mask along with breathing apparatus tank complete with full mask, full vision face pieces, air flow regulating valves & all accessories shall be provided. In addition to above, canister type breathing apparatus shall be provided in which moisture content from the wearer exhaled air react with granular chemical in breathing apparatus & liberates oxygen. The released oxygen enters a breathing bag from which the wearer can inhale.

EMERGENCY SHOWER

Emergency shower / eye wash room for personnel safety shall be provided. Bidder to consider two nos. (One (1) no. for each chlorination system of Unit I&II and Unit III & IV) Emergency shower / eye wash for CW chlorination system.

CHLORINE DETECTOR.

5 nos. of chlorine leak detector with four sensors probe shall be provided. This will detect Chlorine leakage in tonner area & chlorinator room and for audio-visual alarm for detecting chlorine leaks in the room.

EMERGENCY KIT FOR SEALING

For attending chlorine off leaking tonner. Kit shall contain container tools, eg. gaskets, yokes, hoods, clamps, studs, tie tools, mild steel channels, spanners, screws to fit chlorine container. The gasket shall be designed to control / stop leakages from chlorine containers, valves & chlorine container fusible plugs. The accessories shall conform to the details specified by alkali manufacturers' association / chlorine institute, U.S.A. Numbers shall be as indicated in specification and Chlorine Institute Manual.

2.0 CHLORINE LEAK ABSORPTION SYSTEM

An automatic chlorine leak absorption system has been provided for Chlorination plant for the tonner in service. The chlorine leak absorption system shall absorb leaked chlorine from

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the hood by means of blowers provided at the end of the duct. In the event of leakage in chlorine ton container, the alkali recirculation pump and fan shall start automatically by a signal from leak detector. The blower shall suck the leaked chlorine gas through FRP Hood & duct and shall direct chlorine to the absorption tower bottom. In the absorption tower chlorine shall be absorbed by the circulating alkali solution. The chlorine leak absorption system shall be sized for absorption & neutralisation of about one ton chlorine leakage in one hour. **All working and non-working tonners shall be connected to the chlorine leak absorption system through FRP Hood & duct.**

Minimum capacity of each caustic solution tank shall be suitable to absorb one (1) No. of completely leaked chlorine ton container plus 20% margin. Caustic concentration in tank shall not exceed 20% W/V. Each tank shall be provided with caustic charging platform with handrails & staircase, level gauges, overflow, drain with double valves, sampling connection, level switches, water filling connection etc.

The absorption system of each CW chlorination system shall mainly comprise of:

- FRP Hood covering full portion of working tonners (8 nos.) and half portion of the non – working tonners (22 nos.) in service and duct for each CW chlorination system.
- 2 Nos. (1 working + 1 stand-by) Blowers for each CW chlorination system.
- Minimum 2 Nos. (1 working + 1 stand-by) Exhaust Fans in chlorinator room considering minimum 30 air exchanges per hour for each CW chlorination system.
- One (1) no. absorption tower (FRP) with packing for each CW chlorination system.
- One (1) no. Caustic solution preparation cum recirculation tank (MSRL) for each CW chlorination system.
- 2x100% (1 working + 1 standby) alkali circulating pumps for each CW chlorination system.
- Interconnecting piping valves, ducts, control and instrumentation for each CW chlorination system.

Capacity of each exhaust fans provided in the chlorinator room for normal circulation of fresh air shall be based on a complete air change requirement of chlorination room for **30** air changes per hour. Ducting work shall be designed based on an air velocity of 10.0 M/Sec. All the associated interlocks will be provided such that the system starts automatically by a signal from leak detector.

2.0 DESIGN PHILOSOPHY FOR RW CHLORINATION PLANT

Gas Chlorination Plant has been designed to dose required quantity of chlorine to PT Plant Stilling Chambers. Chlorine gas shall be mixed thoroughly with the water in the ejector provided in the system. The chlorine solution thus obtained shall be dosed in both the stilling chamber. System has been designed for continuous dosing of chlorine at the rate of 3 ppm. However, the actual dosing level shall be set by the operator based on residual chlorine measurement at the Clarifier outlet.

3.1 EQUIPMENT DESIGN CRITERIA

Two Nos. (2W+1S) streams of gas chlorination system have been provided. Each stream shall consist of the following main equipment & accessories:

- * Expansion tank
- * Pipe manifold with accessories
- * Chlorinator,
- * RW booster pumps,
- * Chlorine gas filters,
- * Injector for chlorine solution preparation
- * Chlorine gas leak detector & safety equipment

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- * Chlorine leak absorption system
- * Lifting & handling devices
- * Chlorine ton containers
- * Associated piping, instrumentations & Necessary controls.

3.1.1 CHLORINE TON CONTAINER

6 nos. of Chlorine ton-containers (each of approximately 900 Kg, capacity) will be provided to store chlorine in liquid vapour phase It shall be standard chlorine ton container. Each container will be complete with built-in isolating valves (one (1) for liquid discharge and one (1) for gas withdrawal) and valve hood.

The design, fabrication and testing of cylinder/ton container shall conform to the Chief Controller of Explosives, Government of India, Department of Explosives. Nagpur.

3.1.2 PIPE MANIFOLD WITH ACCESSORIES

Chlorine manifold consisting of straight lengths of pipe, fittings, isolation valves, automatic shut-off valves, liquid expansion chamber fitted with rupture discs, pressure indicator, Temperature indicator, pressure switch, alarms, automatic change over facility of tonners, etc. will be provided. Pressure reducing & shut-off valves and shall be provided in the chlorine gas line.

3.1.3 EXPANSION TANK

Expansion tank of suitable capacity shall be provided on the common headers of the chlorine tonners. The expansion tank will be complete with all necessary accessories such as pressure switch and rupture disc. etc.

Tanks of suitable capacity shall be supplied. The volume of the tank shall be minimum 20% of the header pipe volume at highest elevated condition.

Expansion tank shall be Carbon Steel and shall be of suitable plate thickness depending on diameter and pressure conditions. The fabrication of the tank shall be normally as per ASME pressure vessel code. Sec VIII/IS 7681.

3.2.4 CHLORINATOR

Vacuum solution feed type chlorinators shall be provided. Chlorine feed rate shall be manually adjusted. The chlorinator shall be provided with Rotameter and pressure and vacuum relief valve etc. The entire chlorinator shall be constructed of material completely resistant to the corrosive attack of wet or dry chlorine gas & chlorine solution.

3.2.5 BOOSTER WATER PUMPS

Booster pumps shall be provided to supply motive water for the RW chlorination plant. Motive water shall be tapped off from filtered water overhead tank located at top of PT plant chemical house. Pump shall be complete with suction non-return valves, isolating gate valves, pressure gauges etc. at the discharge side.

3.2.6 EJECTOR

Both water and chlorine gas shall be thoroughly mixed in the ejector and chlorine solution is then dosed at the required dosing point.

3.2.7 DIFFUSER

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Diffuser shall be designed to dose concentrated chlorine solution in required quantity at each dosing point. The material of construction of the diffuser shall be MSRL/HDPE/PP. Perforated type diffuser shall be designed so that each hole takes a 1 to 2 gpm (4 to 7 LPM) at 3 to 4 M/sec velocity.		
3.2.8 HOIST MONO-RAILS An electrically operated monorail hoist shall be provided for lifting the ton container. Lifting bar to grab the empty or full ton container during handling (1 No.) shall have suspension type load indicator of minimum capacity (Net) 3000 Kg.		
3.2.9 WEIGHING SCALE One weighing scale of 3 ton capacity of platform dial type shall be provided. Weighing scale shall be suitable for fixing on the ground.		
3.2.10 OTHER MISC. ACCESSORIES System shall also have following: - Associated piping and valves required for the system. - All necessary instruments and controls required for easy and safe operation of the system.		
3.2.11 SAFETY & SUPERVISORY INSTRUMENT GAS MASK & OXYGEN BREATHING EQUIPMENT Gas mask along with breathing apparatus tank complete with full mask, full vision face pieces, air flow regulating valves & all accessories shall be provided. In addition to above, canister type breathing apparatus shall be provided in which moisture content from the wearer exhaled air react with granular chemical in breathing apparatus & liberates oxygen. The released oxygen enters a breathing bag from which the wearer can inhale. EMERGENCY SHOWER Emergency shower / eye wash room for personnel safety shall be provided. CHLORINE DETECTOR. 4 nos. of chlorine leak detector with two sensors probe shall be provided. This will detect Chlorine leakage in tonner area & for audio-visual alarm for detecting chlorine leaks in the room. EMERGENCY KIT FOR SEALING For attending chlorine off leaking tonner. Kit shall contain container tools, eg. gaskets, yokes, hoods, clamps, studs, tie tools, mild steel channels, spanners, screws to fit chlorine container. The gasket shall be designed to control / stop leakages from chlorine containers, valves & chlorine container fusible plugs. The accessories shall conform to the details specified by alkali manufacturers' association / chlorine institute, U.S.A. Numbers shall be as indicated in specification and Chlorine Institute Manual.		
4.0 CHLORINE LEAK ABSORPTION SYSTEM		

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An automatic chlorine leak absorption system has been provided for Chlorination plant for the tonner in service. The chlorine leak absorption system shall absorb leaked chlorine from the hood by means of blowers provided at the end of the duct. In the event of leakage in chlorine ton container, the alkali recirculation pump and fan shall start automatically by a signal from leak detector. The blower shall suck the leaked chlorine gas through FRP Hood & duct and shall direct chlorine to the absorption tower bottom. In the absorption tower chlorine shall be absorbed by the circulating alkali solution. The chlorine leak absorption system shall be sized for absorption & neutralisation of about one ton chlorine leakage in one hour. All working and non-working tonners shall be connected to the chlorine leak absorption system through FRP Hood & duct.

Minimum capacity of each caustic solution tank shall be suitable to absorb one (1) No. of completely leaked chlorine ton container plus 20% margin. Caustic concentration in tank shall not exceed 20% W/V. Each tank shall be provided with caustic charging platform with handrails & staircase, level gauges, overflow, drain with double valves, sampling connection, level switches, water filling connection etc.

The absorption system for RW chlorination system shall mainly comprise of:

- 2 Nos. (1 working + 1 stand-by) Blowers for RW chlorination system.
- Minimum 2 Nos. (1 working + 1 stand-by) Exhaust Fans in RW chlorinator room considering minimum 30 air exchanges per hour for RW chlorination system.
- One (1) no. absorption tower (FRP) with packing for RW chlorination system.
- One (1) no. Caustic solution preparation cum recirculation tank (MSRL) for RW chlorination system.
- 2x100% (1 working + 1 standby) alkali circulating pumps for RW chlorination system.
- Interconnecting piping valves, ducts, control and instrumentation for RW chlorination system.

Capacity of each exhaust fans provided in the chlorinator room for normal circulation of fresh air shall be based on a complete air change requirement of chlorination room for 30 air changes per hour. Ducting work shall be designed based on an air velocity of 10.0 M/Sec. All the associated interlocks will be provided such that the system starts automatically by a signal from leak detector.

5.0 PLANT POTABLE WATER CHLORINATION

Chlorine will be dosed (1 ppm continuous) in potable water for disinfection. Residual chlorine of 0.2 ppm will be maintained. Potable water chlorination shall be provided in clarified water pump house and dosing shall be done at discharge of tank filling pumps.

5.1 SYSTEM DESCRIPTION

There will be two (2) streams each of capacity 100 g/hr. One (1) stream will be operating and one (1) stream shall be standby. A chlorine dosing system shall be provided to dose concentrated chlorine solution in potable water pump outlet line. For this purpose, filtered water shall be taken from filtered water storage tank. Each stream will consist of followings:

5.1.1 CHLORINE CYLINDER

Two (2) no. (1w+1sb) Chlorine cylinders shall be provided. Each chlorine cylinder consists of 100 kg chlorine gas (approximately).

5.1.2 CHLORINATOR

Two (2) no. vacuum operated chlorinators shall be provided to feed the chlorine solution in potable water .The rate of chlorine dosing shall be set manually and shall remain constant

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until manually changed. The chlorinator shall be mounted directly on the chlorine cylinder and shall be equipped with necessary instrumentation for safe & reliable operation.

5.1.3 BOOSTER WATER PUMPS

Two (2) no. booster pumps (2x100%) with non-return valves sufficient to produce the required vacuum in ejector shall be provided. Interlocks shall be provided such that booster pump will trip if the potable water pump trips.

5.1.4 EJECTOR

Two (2) no. ejectors shall be provided the necessary vacuum to draw chlorine from chlorinator. Ejector shall be provided with other required instrumentation, valves for control, and interlock alarm for safe & reliable operation of the system.

5.1.5 DIFFUSERS

One (1) no. suitable diffuser shall be provided to dose chlorine in potable water line.

5.1.6 CONTROL

Control of Potable water chlorination system shall be **DCS based**. Potable water chlorination shall be located in clarified water pump house.

NOTE: Pipe routing shall be decided during detailed engineering, however bidder will consider 12 m static head + 10% margin during pump selection.