PROJECT :- ENNORE 2X660 MW

CUSTOMER :- TANGEDCO

CONTRACTOR :- DESEIN

PURCHASE SPECIFICATION
FOR
STEAM & WATER ANALYSIS SYSTEM

C O P

REVISIONS :

APPROVED

(Punit P Singh)

PREPARED	ISSUED	DATE
PRK	416	23-01-2018

CONTENTS

SECTION- A

GENERAL INSTRUCTIONS TO BIDDERS:

All required documents against this Tender/Specification shall be submitted in English only.

Introduction: Bidders are required to offer SWAS to be used in Power Plant applications.

In order to accept the Technical offers / proposals from Bidders for the project mentioned in this Specification (refer Sections C, D, E, F, G, H & I), certain Pre-qualification criteria are required to be met by Bidder.

Pre-qualification requirements are clearly mentioned in AA of Section-B of this Specification. Bidder to read the same carefully and submit the details/documents required for BHEL's acceptance.

In case Bidder does not include the details or meet the requirements of Pre-qualification requirements, their offer will be summarily rejected and Bidder's Technical offers will not be evaluated.

Evaluation methodology: BHEL shall initially open Bidder's PQR documents as per Section-B of this specification for review & acceptance. Only after acceptance of PQR documents, BHEL shall open Bidder's technical offers for evaluation. Technically acceptable vendors will be proposed to customer / End user for vendor approval. Commercial bids of only accepted/approved vendors by End users/Customers, shall be considered by BHEL for further processing.

Bidders are required to submit offers as detailed below:

A. Documents pertaining to Pre-Qualification requirements for AA of Section-B along with point-wise compliance to be uploaded as Part-I Bid.
B. Technical offers/proposals for the Project, whose requirements are mentioned in Sections C &D to be submitted along with point-wise compliance and uploaded as Part-II Bid.

Note 1:-Whenever required during evaluation of PQR and Technical offers/bids, vendor is required to be present at BHEL Electronic Division, Bangalore, for discussions. Further in the event of order, during approval of the Vendor documents by End users/Customers, Vendor shall accompany BHEL representative for discussions.

Note 2:- Technical Clarifications w.r.t specifications (if any) shall be discussed with only those vendors who quote for this tender. Deviations w.r.t Annexure-'C' and Annexure-'D' in the Purchase Specification is not acceptable. Offer of bidder will be rejected in case deviations observed w.r.t Annexure 'C' and Annexure-'D' in the Purchase Specification.

SECTION- B

AA. Pre-Qualification Requirements (PQR) of Bidders for SWAS:

1. "The bidder should have executed / completed work of "Design, supply, erection & commissioning of SWAS (Including Sample Handling System and Analysers) in a Coal Fired Thermal Power Plant minimum of 500 MW rating for at least 2 units and working satisfactorily for at least two (02) years as on date 28.06.2013". To qualify to this point bidder to submit the performance certificate from the End users.
2. Original Equipment (Sample Handling System) Manufacturers based outside India, who are making offer for this tender shall have authorized representatives in India for support related to Documentation, Erection, Commissioning & post commissioning services. The Indian representative should have the team of experienced service engineers on payroll. Not Applicable for Indian SHS Manufacturers.
3. For bidder/OEM/System Integrator offering upgraded / latest models of various analysers, PQR of equivalent previous model is acceptable subject to meeting PQR indicated in clause AA. 1. In such cases OEM shall certify that offered model is upgraded version of previous model. Confirmation from bidder/OEM/System Integrator is required.
4. Analysers / SHS OEM shall furnish an undertaking that in case of change in Indian representative / agent / System Integrator, OEM shall continue to support supplies made by previous representatives/agents / System Integrator w.r.t to field service and supply of spare parts.
5. BHEL shall issue call for service / commissioning with 07 days' notice. Bidder shall agree to visit BHEL project sites within above notice period.
6. BHEL shall submit credentials/details furnished by Bidder (SHS/System Integrator) vendor with their offers to customer and await customer's decision for a maximum of one month from the date of PQ bid opening. If approval is not received within above period, BHEL shall treat the offer as "NOT Meeting PQ" criteria and offer shall be rejected. Confirmation from bidder is required.
7. In case Customer/End user does not accept the offered makes of analysers, bidders offers will be acceptable only if they agree to supply Analysers of customer approved make of Analysers without any commercial implications to BHEL.

Important Note: In case Bidder does not submit details mentioned in above clauses (AA) or meet the requirements of Pre-qualification requirements (AA), Offers will be summarily

rejected and Bidder's Technical offers/proposals will not be evaluated. Please read carefully the GENERAL INSTRUCTIONS in Section A of this specifications.

Note: A point-wise compliance to be submitted for SECTION-B along with all relevant documents.

PROJECT :- ENNORE 2X660 MW

CUSTOMER :- TANGEDCO

CONSULTANT :- DESEIN

SCOPE OF SUPPLY

REVISIONS :	APPROVED (Punit P Singh)		
	PREPARED	ISSUED	DATE
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SECTION C

SCOPE OF SUPPLY FOR ENNORE 2X660 MW

SL NO	ITEM DESCRIPTION	UNITS	QTY PER SET	TOTAL QTY
1	**SAMPLE HANDLING SYSTEM -**			
a	PRIMARY RACKS (With IBR certified Isolation , Blowdown Valves & IBR certified Cooler Coils, Cooler coils Inconel 625 material) . Pl. also Refer Annexure C. Deviation W.r.t Annexure C is not acceptable.	NO.	2	4
b	WET PANEL - ENCLOSED TYPE WALKWAY THROUGH PANEL	NO.	1	2
c	DRY PANEL	NO.	1	2
d	CHILLER UNIT - 2x100% REDUNDANT - Min. 5 TR rating (With 25% extra Capacity)	NO.	1	2
e	STAND ALONE PANEL WITH ALL SAMPLING ACCESSORIES FOR MOUNTING 2 Conductivity Analysers - ACW PUMP DISCHARGE SERVICES (Refer SWAS Scheme Page 19 of 24)	Set	1	2
f	STAND ALONE PANEL WITH ALL SAMPLING ACCESSORIES FOR MOUNTING 1 pH Analyser, 1 Conductivity Analyser, 1 Residual Chlorine Analyser and 1 Salinity Analyser - CW PUMP DISCHARGE SERVICES (Refer SWAS Scheme Page 20 of 24)	Set	1	2
h	STAND ALONE PANEL WITH ALL SAMPLING ACCESSORIES FOR MOUNTING 1 pH Analyser, 1 Residual Chlorine Analyser and 1 Turbidity Analyser - CW BLOWDOWN SERVICES (Refer SWAS Scheme Page 22 of 24)	Set	1	1
i	STAND ALONE PANEL WITH ALL SAMPLING ACCESSORIES FOR MOUNTING 2 pH ANALYSERS -DE- SALINATION PLANT O/L HDR SERVICES (Refer SWAS Scheme Page 23 of 24)	Set	1	1
j	STAND ALONE PANEL WITH ALL SAMPLING ACCESSORIES FOR MOUNTING 2 pH ANALYSERS - FILTERED WATER STORAGE TANK OUTLET SERVICES (Refer SWAS Scheme Page 24 of 24)	Set	1	1
2	**ANALYSERS - MICROPROCESSOR BASED WITH DIGITAL COMMUNICATION FACILITY LIKE RS485/Modbus/Profibus and HART (Selection of Communication details will be finalised during detailed Engg)**			
a	CONDUCTIVITY(SPECIFIC, CATION) ANALYSER - SINGLE CHANNEL	NOS.	26	52
b	CONDUCTIVITY(SPECIFIC) ANALYSER FOR HOTWELL - SINGLE CHANNEL	NOS.	2	4
c	pH ANALYSER- SINGLE CHANNEL	NO	21	37
d	DISSOLVED OXYGEN ANALYSER- SINGLE CHANNEL	NOS.	8	16
e	SODIUM ANALYSER(MULTI CHANNEL- 3 CHANNEL)	NO	1	2
f	SILICA ANALYSER (MULTI CHANNEL- 3 CHANNEL)	NO	3	6
g	HYDRAZINE ANALYSER - SINGLE CHANNEL	NO	3	6
h	AMMONIA ANALYSER	NO	1	2
i	TURBIDITY ANALYSER	NO	2	3
j	CHLORIDE ANALYSER	NO	1	2
k	RESIDUAL CHLORINE ANALYSER	NO	2	3
l	SALINITY ANALYSER	NO	1	2
3	LOOSE SUPPLY ITEMS AS PER ANNEXURE-A	ST	1	2
4	Mandatory Spares as per Annexure- B	ST	1	1
5	COMMISSIONING SPARES- Reagents / Calibratiors / Standard Solution as required for commissioning & Handing over of System to Owner	ST	1	2
6	CONSUMABLES OTHER THAN CHEMICAL REAGENTS LIKE PH CELL , DO Sensors ,ETC	ST	1	2
7	CONSUMABLES I.E. CHEMICAL REAGENTS FOR 1 YEAR OPERATION	ST	1	2
8	ANNUNCIATOR - Microprocessor based Minimum 96 Points, Window size : 70 mm x 50 mm	ST	1	2
9	O & M MANUALS / DOCUMENTATION CHARGES	LOT	1	2
10	TEST, CALIBRATION & GUARANTEE CERTIFICATES AS PER APPROVED QUALITY CHECKLIST/ PLAN	LOT	1	2
11	SUPERVISION OF ERECTION, TOTAL COMMISSIONING AND HANDING OVER OF SWAS SYSTEM	ST	1	2
12	Price for one line of High Pressure & High Temp. - Primary & Secondary cooling to be considered along with other instruments as per P&ID applicable for the project.	ST	1	1
13	Price for one line of Low Pressure & Low Temp. - Secondary cooling to be considered along with other instruments as per P&ID applicable for the project.	ST	1	1
14	Sample/Metering Pump with MCB & Starting panel - Suitable for metering sample (Refer SWAS Scheme Page 21, 24 of 24)	No.	3	4
15	Following activities will be in Vendor's scope :-			
	i. Supervision of erection, Total commissioning & Handing over of the system to the End user.			
	ii. Erection of inter connecting cabling / tubing between wet & dry panel, chiller & wet panel etc.			
	iii. Complete Erection of Chiller system including proper insulation of pipes between chiller & wet panel.			
	iv. Vendor to also consider 1 no. of Gas filling at Site for Chiller during Commissioning/Handing over. This shall be in addition to Gas filling done at OEM works for inspection.			
16	Note:-			
	1.0 Vendors to quote unit rates for all above items individually.			
	2.0 Vendors who do not quote prices as per pt. 1.0, shall be disqualified.			
	3.0 BHEL shall use unit rates indicated above for quantity addition/deletion required during execution.			
	4.0 Bidders to quote item wise prices for all the items indicated above. Evaluation for L1 shall be done considering offered prices for all items indicated above however Items in sl. No.12, and 13 shall be ordered only if required.			

ANNEXURE - "A"

Pl. aslo refer Tech spcs for material

LOOSE SUPPLY ITEMS FOR SWAS

SL. NO	DESCRIPTION	QTY / UNIT
1	Power Cable to SWAS panels	25 Meter
2	Power Cable to Chiller(3 phase 3 wire)	25 Meter
3	Special Cables between wet and dry panel . (for each cell / analyser Combination)	30 Meter/ run
4	All cabling and Tubing(along with connection fitttings) between wet and dry panel	30 Meter / run
5	Cooling water header, A 106 Gr. B, 2 " NB Sch 40 (between nearest tapping point & chiller and chiller & Wet panel)+ Elbows (20 Nos) and Bends(10 Nos) .	60 Meter
6	Blow down header(Wet Panel) , SS316, 2" NB SCH 40 + Elbows (3 nos.)	20 Meter
7	Blow down header (Primary Racks) , SS 316 , 2" NB SCH 80 + Elbows (3 Nos)	20 Meter
8	Recoverable drain header , SS 316 , 2" NB SCH 40 + Elbows (3 Nos.)	20 Meter
9	Waste Drain header (analyser Panel) A 106 Gr. B , 2" NB SCH 40 + Elbows (6 Nos.)	30 Meter
10	Waste drain header(Primary Racks)) , A 106 Gr. B , 2" NB SCH 40 + Elbows (3 Nos)	30 Meter
11	Waste drain header (wet panel) , A 106 Gr. B , 2" NB SCH 40 + Elbows (3 Nos)	20 Meter
12	Furniture:-	
i	STEEL ALMIRAH - Size - 900 (W) x 450(D) x1800(H) mm	2 Nos.
ii	OPERATOR CHAIRS	1 No.
iii	WORKBENCH FOR CALIBRATION & TESTING - Size - 1500(W) x 1000(D) x 800(H) mm	1 No.
Note :-		

1.0 Vendors to quote unit rates for all items individually.

2.0 Vendors who do not quote prices as per pt. 1, shall be disqualified.

3.0 BHEL shall use unit rates indicated above for quantity addition/deletion required during execution.

4.0 In addition to the set of flanges(mating & counter) which is mounted on the header in panel/rack , vendors to consider one additional set of mating & counter flanges for all headers,as indicated above.

5.0 For Tubing between wet and dry panel suitable connectors shall be provided.

6.0 Insulation of pipe between Chiller and Wet Panel shall be done at site by bidder.

ANNEXURE - "B"

MANDATORY SPARES FOR SWAS

SL. NO	DESCRIPTION	TOTAL QTY
a.	High pressure reducing elements for sample flow.	10% spare of qty installed.
b.	Ion exchange columns with resin as utilized with cation conductivity analysers	4 Nos.
c.	Conductivity cells as utilised with conductivity monitors	Two nos of each type
d.	pH flow-through type cells used with pH monitors	Two nos. of each type
e	Chemical reagents for all analysers	12 months continuous operation of all analysers from date of taking over.
f	Chemical reagents for colorimetric silica analyzers	12 months continuous operation of all analysers from date of taking over.
g	Electronic Modules	One (1) no. for each type of Analyser.
h	Pressure gauge, solenoid valves, temperature gauge, Back Pressure regulating valves, 3 way grab valves, needle valves, isolation valves, PRV, flow switch, flow indicator and temperature switch, erection hardware's, valves in SWAS.	Two (2) no. of each type
i	Primary coolers/secondary coolers.	Three (3) No of each type

ANNEXURE 'C'	
Sl. No.	Description
1	Complete piping, tubing, fittings, valves, blow down valves, sample relief valves, shell relief valves, filters and other wetted parts in the sampling and analyzing system shall be of Swagelok, Dr Thiedig or Parker make only.
2	All critical components like PRV, Back pressure regulator, thermal shutoff valve etc shall be of Sentry, Lowe or Dr Thiedig make only.
3	Primary and Secondary Sample coolers shall be of Forbes Marshall, Steam Equipment (Panflow, USA), Sentry, Lowe or Dr Thiedig make only with Third Party Certification like Third party (TUV/ Lloyd) design Validation for ASME Design and IBR Form IIIC certification for material & design tractability.
4	Inconel – 625 coil primary coolers will be supplied for all high pressure and temperature sampling lines.
5	Laser cutting will be carried out at only those fabricators, which is having laser cutting machine for stainless steel sheet metal for more than 1.5 mm thickness.
6	Vendor shall use Swagelok / Parker De-burring tool to remove burrs on tubing.
7	Vendor shall supply Pressure Gauge, Temperature Gauges, Rota Meters, switches, transmitters, Temperature elements and any other instruments & Chiller as per TANGEDCO approved sub vendor list in line with technical specification.
8	Analysers with sensors shall be provided from approved vendor list enclosed subject to compliance of specification
9	Authorisation certificate of analyser manufacturer shall be taken from analyser manufacturer for their tie-up with SWAS suppliers.
10	Analyser manufacturers or their authorised representative shall be present during commissioning of SWAS and provide the necessary support as & when required at site.

REF:- ENNORE/416/SWAS/TR

SECTION D

TECHNICAL REQUIREMENTS & ANALYSER SPECIFICATIONS

CHAPTER-5

STEAM AND WATER ANALYSIS SYSTEM

5.00.00 Design criteria for continuous on line analytical measurements of important plant media such as water, steam and flue gas shall be based on microprocessor based instruments only.

5.01.00 General Requirements

a) Separate Steam and Water Analysis System shall be furnished for continuous monitoring and control of water and steam purity in the plant cycle of each unit and at other important points as specified in this specification. The SWAS System and Analytical lab may preferably be located on the "0" M floor in TG building.

b) The sampling system shall obtain samples from steam and water system, which shall be adequately conditioned and fed to analyzers for continuous analysis and provide parallel facility for grab sampling as specified.

The analyzer outputs from SWAS shall be used for providing -

i) Continuous monitoring of various parameters using SWAS OS as specified herein with additional isolated analog outputs of 4-20mA, DC for each parameter for monitoring in plant monitoring system i.e DDCMIS.

ii) Alarm for all significant parameters measurements which exceed their permissible limits including those of sample conditioning system, with repeat facility in the Central Control Room in the form of potential free contacts and for hooking up to plant monitoring system.

This will enable the plant chemist and operators either to make adjustments in the water and steam conditioning system or to modify plant-operating procedure so as to minimize equipment damage due to corrosion, scaling etc.

c) The Bidder shall furnish all analyzers/monitors including sample conditioning components and other devices as specified in the sample stream detail table. The bidder shall furnish all required accessories for completeness of the analyzers furnished by him even though this may not be specifically stated in other clauses of this specification.

d) The system shall be furnished complete with sample conditioning devices and monitoring instruments (for temperature, pressure, flow & sample), analyzers, transmitters, indicators, alarm initiating devices, interlocks, isolated 4-20 mA DC for plant monitoring system and all required accessories to provide a complete and integrated sampling and analysis system as per the intent and requirements of this specification. Sample line diagrams shall be used to implement the design at system level that shall be subject to Owner approval. All necessary piping, tubing, fittings and valves etc. shall be furnished.

e) The system shall be designed in accordance with the recommendations in ASME PTC 19.11 Part II, Water and Steam in Power Cycle, ASTM standards - 31 water and ASTM D1066-69 standard method of sampling steam.

f) The Bidder shall be fully responsible on system basis, for proper engineering, selection of hardware, manufacture, testing, installation, commissioning and satisfactory functioning of complete and fully operational steam and water analysis system, meeting the intent of this specification. All system components and accessories required for completeness of this system shall be furnished by the Bidder although these may not be individually specified herein.

g) The equipment shall be constructed to operate accurately and safely under the operating conditions described or implied in this specification, without undue heating, vibration, wear, corrosion or other operating troubles.

h) All parts subject to high pressure or temperature or other severe duty shall be of materials suitable for the service.

i) All piping, tubing, fittings, valves, filters and other wetted parts in the sampling and analyzing system shall be of type 316 stainless steel or other suitable material for the service approved by the Owner. No plastics or rubber shall be permitted except within analyzers as furnished by the manufacturer.

j) All SWAS system components and accessories shall be from the latest proven product range of qualified manufacturers. The SWAS components and accessories shall be of specified makes and models or other owner approved makes and models, fully meeting the qualifying requirements.

   i) To ensure operation under adverse conditions the equipments mounted outside the Sampling and Analysis Room shall be designed for outdoor conditions.
   ii) Sample room located instruments and electronic hardware will be required to operate normally in an air-conditioned area.

   However, they shall also be able to operate indefinitely with ambient room temperature between + 5 deg. C to + 55 deg. C and relative humidity upto 95%, during air conditioning failure.

k) One WORK STATIONS-based operator station with A4 sized B&W LaserJet printer for water chemistry parameters as a part of performance calculations & optimization package (Hooked up to the DDC MIS through redundant “OPC, MODBUS or DDCMIS TCP/IP network etc”) and one no. SWAS OWS shall be kept in SWAS/Chemical Express lab room as specified in chapter 4. Specification for WORK STATIONS and printer shall be same as specified else where in the specification. Work Station in BHEL Scope

l) All the analysers should work with sample temperature of 40-45 deg.C with out chilled water requirement.

m) **Alarm Annunciation:**

HW Alarm annunciator shall have adequate/required points (80 or more which shall be finalized during detailed engineering.

5.02.00 Sample Conditioning System

a) General

i) Sample conditioning system shall be designed and constructed to receive and condition all samples (listed in the enclosed Sample Stream Specification) as required by the respective analyzers connected to the sample streams. This will include all conditioning as specified herein and shall cover the following:

- Sample filtering
- Primary and final sample cooling and temperature control
- Pressure reduction and control as required
- Flow rate control
- Pressure & Temperature protection
- Other treatment as required by individual analyzers or specified herein.

ii) The sample conditioning system shall provide samples at 25°C or a preset temperature required by the analyzer within tolerance of + 1°C, at a pressure of about 2 kg/cm^2 and at flow rates as required by individual analyzers/streams.

iii) Sample line to analyzer elements shall incorporate an anti-syphon design to prevent possibility of running dry because of a broken or plugged sample line.

iv) Sample conditioning system shall be designed and constructed to fully meet the intent and requirements of this specification.

Suitable arrangement shall be made by the bidder to condition the sample by way of providing chiller and isothermal bath.

v) The cooling/chilled water header shall be provided with pressure gauge, temperature gauge and flow switch and isolating valves.

vi) Provision shall be made for heat exchanger shell drain which will be connected to drain header.
Potential free contact shall be provided for annunciating loss of cooling/chilled water.

b) <u>Sample Filters</u>

Sample particulars removal shall be accomplished by passing all sample through cartridge filters with type sintered 316 stainless steel body. Removable type filter element shall be capable of retaining particles of 40 micron and larger. These elements shall be installed downstream of solenoid operated sample shut of valves at each branch of analyser sample stream.

c) <u>Sample Cooler</u>

All samples having a temperature in excess of 45°C shall be cooled by use of sample cooler.

The sample cooler shall use DMCW water (softened water) as cooling water. This cooling water is tapped from DMCW water system whose temperature may vary from 20°C to 40°C. A maximum cooling water temperature of 40°C shall be considered for design of sample cooling system. Capacity of cooler shall be adequate to cool the sample within 5°C of cooling water inlet temperature considering the combined flow of each analyzer connected to sample cooler and one manual grab sample at flow rate of 500 cc per minute assuming adequate flowing factor. Cooler capacity calculations shall be submitted by bidder.

Provision shall be made for adjusting the temp. of each sample individually at an optimum value.

Sample cooler shall be of submerged Helical coil type of shell and tube design with removable shell. The sample tube shall be of seamless with no welds and other joint inside the cooling jacket. Unions shall be provided to facilitate removal of coils. All sample tubing and fittings, other components shall be constructed of type 316 stainless steel. Cooler design shall conform to requirements of ASTM D1192-64 (Equipment for sampling industrial water and steam). IBR certificate is required wherever applicable. The shell relief valve shall be built in type.

d) **Isothermal Bath** Not Applicable, Individual cooler shall be provided along with chiller

In isothermal bath each sample stream shall be finally cooled to the required temperature as specified by the analyzer manufacturer and as approved during engineering within a variation +1 Deg. C before passing sample to the respective measuring cells. This shall be accomplished in isothermal bath by counter current heat exchange of each sample against the flow of chilled water at 20 Deg. C. The chilled water for isothermal bath shall be provided by package refrigeration unit (chillers).

Sufficient heat exchange capacity shall be provided to obtain the required temperature at sample outlet for maximum flow rate required by the analyzers and grab samples requirements considering adequate fouling factor at both ends of the coils. Capacity calculations shall be furnished.

Provision shall be made of adjusting each sample temperature individually.

Temperature control shall be provided to maintain the isothermal bath temperature at the required value.

Temperature control system shall be provided to maintain the isothermal bath temperature at the required value as mentioned below:-

i. A Temperature control system shall maintain the isothermal bath temperature at 20 drg C ± 1 deg C and sufficient heat exchanger capacity shall be provded to maintain the temperature of all sample stream at 25

deg C ± 1 deg C under all operating conditions with adequate margin for future expansion.

ii. Isothermal bath temperature shall be maintained by a local Temperature controller modulating a three way –mixing valve, which mix the chilled water from the chiller with the recirculed water from the isothermal bath.

iii. The chilled water isothermal bath shall include the following:-

- Automatic water makeup
- Bath Temperature Gauge
- Bath water level Gauge
- Drain and overflow connection for bath
- Chilled water Recirculation System

iv. Temperature Switch shall be provided to annunciate high chilled water Temperature on the Dry panel and in DDCMIS.

e) Chiller

Two (2) 100% capacity water cooled chillers shall be provided for the SWAS package.

Chiller Tank shall be SS316 material

Each chiller unit shall be designed with sufficient refrigeration capacity to ensure each sample stream temperature to 25 deg. C ± 1 deg. C when all streams are simultaneously at maximum flow rate and maximum temperature. The chiller capacity shall have a provision of 25% spare capacity for future samples.

All components of chiller shall be compatible to work with DMCW.

Suitable temperature monitoring and control systems shall be provided for maintaining the chilled water temperature at chiller outlet at 20 deg. C or at a designed preset value and within the desired band. The compressor shall be readily accessible for service and shall include low noise hermetically sealed motors. Compressor assembly shall also include crank case heaters, suction and discharge valves, oil sight glasses, forced feed lubrication system and an integrated motor protection system alongwith the necessary instruments.

The condenser shall be water cooled, cleanable shell and tube with water regulating valve. The cooling water shall be supplied from closed cooling water system.

Chiller shall be of the direct expansion type with refrigerant tubes inside a shell, completely insulated and to be constructed in accordance with the ASME code for unfired pressure vessels.

Refrigerant circuit shall be complete with a thermostatic expansion valve, liquid line solenoid valve, sight glasses, filter-dryer, refrigerant shut-off and charging valves.

The chiller water pump shall be of the centrifugal type, close coupled, bronze fitted construction, complete with motor. Pump & motor shall be designed for continuous operation. Vibration dampeners shall be mounted between the packaged chiller and the channel base.

DM Cooling water and chilled water piping shall be provided with block valves.

The Bidder shall provide detailed calculation for chiller capacity and other technical particulars like foundation details/mounting etc. and the same shall be subject to Owner's approval.

The chiller system shall be provided with 100% redundant chilled water pumps with suction and discharge pressure gauges and temperature gauges; Chilled water circulation pump with 100% standby facility; Storage tank automatic water make up with manual by-pass facility, temperature indicator, level gauge and drain and overflow connection, in addition to any other instruments/equipments required for smooth, convenient operation of the system, which shall also be furnished by the Bidder.

f) Sample Pressure Conditioning

The pressure reduction of samples shall be accomplished by using high pressure reducing element. All samples after high pressure reducing element shall be provided with back pressure regulating valves.
Each sample line shall include a safety relief valve down stream of the control valve.

For samples with pressure less than 2 kg/cm^2, suitable field mounted pumps shall be provided by bidder as part of the sampling system.

g) High Pressure reducing element

Pressure reduction of samples shall be accomplished by means of a variable rod-in-tube capillary capable of discharging low flow at low pressure into a sample stream as per requirement of analyzers. These pressures reducing element shall be conveniently located for removal and cleaning.

h) Pressure regulating valves

The pressure regulating valves shall be furnished for all samples to maintain constant sample flow at a pre-set sample pressure. Variation in sample flow to individual analyzer shall not exceed 5% when total sample flow is increased or decreased due to change in number of individual analyzers utilizing a particular sample. Valve shall be back pressure regulating type.

i) Sample system thermal shutoff valve, temperature switches, pressure gauge, Flow switches and flow indicator

The temperature gauge shall be 100 mm size, gas filled type thermometer with SS armoured capillary of suitable length required for installation in wet panel. It shall include contacts of adequate current rating. The contacts shall be multiplied by a relay and relay contacts to be used for alarm.

Thermal shut-off valve shall be provided for shut down of high temp. sample and to protect the analysers.

The pressure gauge shall be 100 mm dial size. Sample rate of flow indicator shall be purge type meter with 75 mm scale length, panel mounting bezel and SS float body.

Flow switches shall be provided on the primary cooling water outlet and on the chilled water outlet as indicated in the drawings for SWAS. Accuracy/repeatability shall be ± 2 %. Make & model of flow switches shall be of Owners approved one. Temperature switches shall be provided on the sample lines as indicated in the drawings for SWAS. All switches shall be repeatable within ± 1.0% of full scale range.

j) Grab samples

Grab sample valves shall be arranged to allow grab sample flow to be directed to either a drain header or through a grab sample nozzles to samples trough. Enough flexible tubing shall be furnished to allow sample collection without splashing.

k) Sample table

All steam and water analyzers should be installed in a room. This arrangement would help better maintenance and better control of water chemistry.

For measurement of conductivity of condensate water in the hotwell, direct mounting type conductivity cells shall be used. For all measurements other than conductivity of condensate water in hot well, sample shall be brought to the sample table, where sample shall be cooled and their pressure reduced and flow regulated before being led to the respective sensors for analysis of different parameters. For make up DM water sample stream, sample extraction pump shall be provided.

The core of sampling system is the high pressure sample cooler. One or two high pressure shut off valve depending upon sample inlet pressure shall be provided in the sampling line at the inlet of the cooler. Another high pressure shut off valve for blowing down the sampling line shall be connected before sampling line shut off valves. An indicator shall be provided to measure the temperature of a sample after cooler. One signaling contact for alarm and protection (to operate solenoid valves) at high temperature shall be provided in this temperature gauge. The required contact multiplication shall be done through relays mounted inside the analyzer panel by bidder. This measurement point is to be followed by high pressure reducing element, pressure reducing valve, safety shut off valve and safety relief valve, pressure gauge and multi valve manifold. The multi valve manifold and fittings are liable to be subjected to high pressure in the line when the valves are closed. Thus the pressure rating of these valves and all associated fitting should be same as that of the root valve in the corresponding sample line. This multi valve manifold should have separate outlets leading to individual analyzers. The flow of sample to individual analyzers should be indicated by a flow meter. The flow, temperature and pressure indicators and needle valves should be mounted on the front of vertical portion of sample table for ease of operation as well as for proper layout.

Two numbers of cation exchange columns (one working and one standby) should be provided with manual switching for each cation conductivity measurements. Bidder shall provide all equipment necessary for bringing cooling water to sample table from one common point of cooling water supply line. Flow switch shall be provided for signaling loss of cooling water flow at each cooler outlet. During collection of grab samples, flow of sample to analyzers shall not be affected.

5.03.00 Steam and Water Analysis System (SWAS) Panels

a) Design Consideration for SWAS Panel and

Accessories

The SWAS Panels shall have two sections namely sample conditioning section and analyzer section . The first section shall be the wet section of SWAS panels which shall be called as the "Sample Table". The second section shall be the dry section housing the analytical transmitters, signal conditioning devices and other requisite accessories.

All monitoring instruments and controls for sampling system shall be located on the front panel and shall be grouped accordingly to function in a logical and orderly fashion. There shall be a general progression of flow from top-to-bottom and left-to-right to minimize sample line length, purge times and material exposed to sample. Similarly, the conditioning components for each stream shall be grouped together wherever possible.

Indicating instruments such as pressure, temperature and flow shall be arranged in a vertical line directly above the grab sample valve. Sufficient clearance shall be maintained between instruments banks of adjacent sample points so that there is no confusion in reading these instruments.

b) <u>Ease of Maintenance</u>

Sample conditioning, analyzer, panels shall be designed for ready access of components. Panel design shall ensure that:-

i) Parts subject to wear, corrosion or other deteriorations or requiring adjustments, inspection or repair are readily accessible and capable of convenient removal, when required.

ii) Individual components or groups of components mounted on sub-panels can be removed for replacement or repair without the need of prior removal of components of other healthy streams.

iii) Flow meters, pressure gauges and temperature indicators can be removed for repair or replacement from the front of the panel without disturbing any piping.

iv) Filter elements and pressure reducing elements can be easily disassembled for periodic cleaning.

The general arrangement drawings of panels as well as location and spacing of all instruments and equipment shall be subject to Owner approval. SWAS panels shall be designed based on human engineering considerations fully keeping in view the convenience of operation and maintenance personnel.

Each sample inlet shall be provided with bulkhead type tubing connection and an isolation valve or block valve suitable for sample operating conditions.

A blowdown connection and suitable blow down valve shall be furnished upstream of each isolating valve. Blow down valves shall be manifolded into a suitable blow down header.

Strainers, filters, relief valves etc. shall be provided as specified and as required to properly protect the coolers, valves, analyzer elements etc.

All drains shall be piped into two separate drain headers. One header shall be called "Waste Drain Header" and will receive all drains which contain substances not wanted in the plant heat cycle water. The other header shall be called "recoverable drain header" and will receive all other drains not containing unwanted substances. All drains shall be headered as indicated above. Vendor shall pipe the waste drain header to the building drain system.

c) Constructional Features

The SWAS panel (wet panel) shall be constructed of 3 mm thick steel plates except for the extreme top of the Sample Table and Analyzer Panel (Dry Panel) which shall be of 2 mm sheet steel. The counter top, sample sink and front section above the counter top shall be 2.5 mm type 316 stainless steel.

The sample table shall be of free standing, totally enclosed panel whereas the Dry Panel shall be of free standing, totally enclosed construction with back doors. General constructional features described in chapter -6, Vol V of this specification shall apply.

All SWAS panels shall be furnished with 100 mm base angle for bolting to 100 mm high concrete curb. The foundation details shall be as approved by the Owner during detailed engineering.

Panel sections shall be reinforced to ensure true surfaces and adequate support for instruments and equipment. All equipment and piping shall be firmly anchored and supported from within the respective panel section to ensure vibration free operation.

Doors and equipment arrangement shall be such that all items are readily accessible for maintenance and repair. The arrangement and spacing of the equipment shall be acceptable to the Owner.

Doors shall have concealed type hinges and three point type latches to assure tight closing. Doors shall have turned back edges and additional bracing where required to assure rigidity.

The SWAS panels and equipment shall be suitably braced to prevent damage during shipping and handling. These additional supports shall be removed after final installation.

Exterior joints shall be continuous seam welded and ground smooth. Interior joints shall be neatly finished in a manner so as to eliminate hazards to personnel.

All surfaces shall be free from waves, bellies, or other imperfections. All stainless steel surfaces shall have uniform finish. All exterior steel surfaces shall be sand blasted, ground smooth, filled, primed, sanded and finished with a smooth backed enamel. The final color shall be as specified in chapter 6.

d) One teak wood laminated work tables 1x2 meters, two nos. industrial grade high adjustable wheeled swivel chairs, two vertical cabinets 1000 x 480 x 2000 mm made of sheet steel (18 gauge sheet thickness) and equipped with safety locks, one shelf 200 x 500 x 200 mm with partitions made of steel, Operating work station table & printer table shall also be provided by bidder. Thickness of steel almirah/cabinet sheet shall be 18 gauges. All items shall be placed in SWAS air conditioned room.

e) SWAS panels shall be placed in separate SWAS room, SWAS room shall be divided in two part i.e one part shall be air conditioned for SWAS dry panel & Chemist and other part non air conditioned for wet pael & chiller unit. Necessary exhaust fans with louvers shall be provided by bidder in SWAS wet panel room.

5.04.00 Piping, Tubing and Accessories

a) All internal piping, tubing and system components required for making the system complete shall be shop installed and tested as per applicable codes, prior to shipment to project site.

b) All tubing and wiring shall be located behind the face of the panel with projections allowed only for indicator faces, valve handles, manual grab sample lines etc. The physical arrangement of the tubing and wiring shall, in all cases, be so as to permit easy access for maintenance of all items of equipments.

c) All piping and tubing materials, fabrication, erection and application of piping materials shall be in accordance with the latest applicable requirements of the code for pressure piping (ANSI B 31.1,B36.19) and all other applicable regulations.

d) Unless otherwise specified, fittings used with pipe 50 mm and smaller shall be socket welding type, and fittings used with larger pipe shall be butt-welding type. All fittings shall be constructed of materials equivalent to the pipe with which they are used.

e) All piping and tubing shall be neatly installed and securely braced to ensure adequate mechanical rigidity. Routing and support of tubing shall be such that expansion and contraction of tubing or equipment mounted in the sample table do not impose any excessive stress on the tubing.

f) Special tools shall be used for all bending and forming operations. Bends in tubing shall be based on the requirements of the Code for Pressure Piping (ANSI B 31.1), concerning tube thinning at the bends. Tubing shall be carefully handled to avoid flat spots, kinks and short bends. Any tubing so damaged shall not be used in this sample table.

g) All piping and tubing shall be blown with oil free compressed air after installation and before attachment to equipment at either end.

h) All piping and tubing terminal connections shall be suitably capped after completion of installation and tests to prevent entry of foreign materials during transit, storage etc.

i) All piping and tubing shall be installed so as to ensure easy accessibility for any maintenance or repair that may be required. High density tubing runs shall not interfere with accessibility to any system component and shall not impair system function.

j) All sample piping shall be three fourth inch NB seamless type of material ASTM A213 TP316H, conforming to ANSI 36.19.

k) All fitting shall be socket welding type and of material ASTMA 182 F316H conforming to ANSI B16.11.

l) All process connection, piping, valves etc. of SWAS analysers shall be conform to ANSI/ISA SP 77.70 – 1994 (R 2005) “Fossil Fuel Power Plant Instrument piping Installation”, ANSI B 31.1 “Power Piping”, PTC 19.11.1997 & IBR.

5.05.00 Material Specifications for Pipe Lines

The piping to be furnished and installed for water and steam analysis system shall be as indicated below:-

	Piping System	**Material**
a)	Piping from the sample inlet bulk-head fittings the shut-off valve for low pressure samples	Stainless Steel, ASTM A-213 Type 316, 16 BWG tubing
b)	Piping from the sample inlet bulk-head fittings to the pressure reducing valves for high pressure samples and sample blowdown piping	Stainless Steel, ASTM A-213 Type 316H, 14 BWG tubing

	Piping System	Material
c)	Blowdown header	Stainless Steel, ASTM A-312 Type 316, Sch. 160
d)	Miscellaneous drains receiver header	Stainless Steel, ASTM A-312 Type 316, 16 BWG tubing
e)	Piping from the shut-off valves for low pressure samples and from the pressure reducing valves for high pressure samples to the terminal points including branch piping and the closed cooling water grab sample piping	Stainless Steel, ASTM A-312 Type 316, 16 BWG tubing
f)	Closed cooling water piping except grab sample	Stainless Steel, ASTM A-312 Type 316, Sch. 40
g)	Sample through drain piping and waste header piping	Carbon Steel, ASTM A-53 Gr. A, Sch. 40

5.06.00 Valves and Fittings

All valves & fittings shall be furnished as required. All other valves and fittings required for making the system complete as per the intent of this specification shall also be furnished by the Bidder. The make, model and technical features of all valves furnished by the Bidder shall be subject to Owner's approval.
All fitting shall be socket welding type and of material ASTMA 182 F316H conforming to ANSI B16.11.

5.07.00 Wiring

All control and instrumentation wiring used within the SWAS panel sections shall conform to NEC and NEMA standards. All measurement and control circuits shall be factory wired and tested by energizing at operating voltage.

All electric connections shall be made between devices within the SWAS panel sections and shall be made to suitable terminal blocks, if devices are to be connected to equipment outside the SWAS panel.

All electrical connections shall enter and leave through the top or bottom of the panels as indicated during detailed engineering.

High impedance circuits shall be connected using shielded or co-axial wire suitable for the service. Terminals shall be furnished for termination of shield.

Wiring in the sampling section shall be routed in covered metallic trays located as distant as is practicable from sampling lines and drains with due care taken to isolate electric wiring, termination etc. from liquid areas.

5.08.00 POWER SUPPLY

Power supply to all instruments and control systems shall be separately fused with MCB and it should be possible to disconnect any instrument without interrupting power supply to any other equipment/device. Static Switch Shall be provided for Power supply.

UPS shall provide power supply to the complete SWAS system.

5.09.00 LIGHTING AND RECEPTACLES

Sample table and analyzer section shall be provided with rapid start, low noise, fluorescent strip fixtures installed in a continuous row along the top of each section. The panel shall have a ceiling mounted LED lamps for illumination. Light switches shall be provided within the panel sections at suitable locations.

Universal type Three receptacles shall be provided on the front of the sample table below the work surface. These will be equally spaced. Two more receptacles shall be provided inside the sample table and one receptacle shall be installed inside the panel.

Wiring for lighting and receptacles shall be run in flexible metallic conduits.

5.10.00 GROUNDING

One earthing terminal with accessories shall be provided at each end of strip for connecting G.I. earthing strip of 50 x 6 mm size.

5.11.00 Technical Specifications of Conductivity Analyser

Pl. also Refer Annexure D

All analysers shall have Digital communication facility like RS 485 / HART/Modbus/ Profibus. One of the communication method is finalised during detailed Engg E

a)	Applicable standard	ASME PTC 19.11-1970 except as modified in this specification.
b)	Type:	
	i) Cell	Flow through type/ removable type (withdraw able with sealing valve)
	ii) Monitors	Electronic (Microprocessor based) indicating type with multi range facility
c)	Material :	
	i) Cell	Epoxy resin/SS316
	ii) Electrode	Platinised/SS316
	iii) Monitors body	Carbon steel/Aluminum/Polycarbonate
d)	Monitor output	i) 4-20 mA D.C. with HART protocol spare out put ii) 4-20mA DC with HART protocol for DDCMIS Output load : 500Ω
e)	Power supply	240V, AC, 50 Hz from UPS
f)	Accuracy	± 1% of full scale span
g)	Stability	± 1% of full scale per month non-cumulative
h)	Repeatability	± 0.3% of span

i) Annunciation contacts from monitors

i)	Number	2SPDT
ii)	Type	Snap action micro switch
iii)	Rating	5 amp, 240 V, 0.2 Amp, 220V DC

j) Connection:

i)	Cell	On line/pipe mounted (ON LINE in sample table) 1/4 (Quarter) inch NPT (F) SCRD for on-line type and Three quarter (3/4) inch NPT (M) SCRD for pipe mounted.
ii)	Monitors	flush panel mounting

k) Electrical — Half (1/2) inch NPT (F) SCRD

l) Accessories

i) Automatic temperature compensation in the range 0-100°C
ii)Ammonia (NH3) removal equipment.
iii) Sample coolers
iv) Flow and pressure regulators
v) SS316 impulse tubing and fittings
vi) Isolation & drain valves as required
vii)Other accessories as required
viii)Adequate length of cables for connecting coils to monitors
ix) Sample rate set valves
x) Alarm settings and Alarm indications on monitor.

Note: For cation conductivity measurement - cation column resin should change its colour indicating depletion of its capacity and shall be regenerative type resin and not replaceable type. Column caps shall be SS316. This shall be complied for cation conductivity.

m) Other particulars — Cell shall be suitable for maximum pressure of 7 kg/cm^2 and maximum temp. of 100°C

n) Response time — $\leq$ 3 seconds

5.11.01 CONDUCTIVITY COMPARATOR Not Applicable

Applicable Standard	:	ASME PTC 19-11-1970 except as modified this specification
Type of cells	:	Flow through type / removable type with draw able with sealing valve)
Transmitter	:	Electronic (Micro processor based) indicating type with multi range facility pipe mounted.
Material of Cell body	:	SS316
Material of cell Electrode	:	Platinised/SS316
Output	:	4 to 20mA DC isolated with HART output

Power Supply	:	240V AC, 50 Hz. From UPS
Accuracy	:	+/-1% of full scale span.
Stability	:	±1% of full scale per month non-cumulative
Repeatability	:	+/-1% of span
Protection class	:	IP - 65
Process connection	:	¼ inch NPT (F) / SCRD for on line type. ¾ inch NPT (M) SCRD for pipe mounted
Electrical connection	:	½ inch NPT (F) SCRD

Accessories : Automatic temp. Compensation in the range of 0-100 Deg.C

5.12.00 Technical Specification of pH Cell and Transmitters Pl. also Refer Annexure D

a) Applicable Standard — pH electrodes shall conform to IS: 6804-1972 except as modified in this specification

b) Type:

i) Cell — Measuring and Reference Electrode Combination with Flow through type (SS316/Polypropylene flow chambers) for power plant's steam & water application. Sensor shall not be affected by flow variation. Sensor shall be designed for power plant applications.

ii) Monitors — Electronic (microprocessor based) indicating type with adjustable range facility.

c) Material:

i)	Measuring & reference	Toughened sensitive
ii)	Electrode	pH glass
iii)	Monitor body	Carbon steel/Aluminum/Polycarbonate

d) Monitor output

i) 4-20 mAmp D.C. with HART protocol spare out put

ii) 4-20mA DC with HART protocol for DDCMIS
Output load : 500Ω

e)	Power supply	240V AC, 50 Hz from UPS
f)	Accuracy/repeatability	+ 0.03 pH/+0.02PH
g)	Resolution	+ 0.01 pH or 1 mV. 1C
h)	Stability	0.02 pH per week

i) Annunciation contacts from monitors:

	i)	Number	2 SPDT 'Hi' and 'Lo'
	ii)	Type	Snap action micro switch
	iii)	Rating	5 amp, 240V AC, 0.2 Amp, 220V DC
j)	Connection:		
	i)	Process	One-quarter (1/4)inch NPT(F) SCRD ON-LINE
	ii)	Electrical	Half (1/2) inch NPT(F) SCRD
k)	Mounting:		
	i)	Cell	Pipe Mounted
	ii)	Monitors	Flush panel mounting
l)	Accessories	i)	Automatic temperature compensation with fast response integral temperature sensors in the range 0-100°C
		ii)	Co-axial cable as required
		iii)	Sample coolers
		iv)	low and pressure regulators
		v)	Standard pH solutions
		vi)	SS316 impulse tubing and fittings
		vii)	Isolation & drain valves as required
		viii)	Electrode holders
		ix)	Other accessories as required
		x)	Sample rate set valves
		xi)	Alarm settings and indications on monitor.
		xii)	RFI/EMI shielded, weather and corrosion proof casing

5.13.00 Technical Specification of Dissolved Oxygen Analyser Pl. also Refer Annexure D

a)	Applicable Standards		ASTM PTC 19.11-1970 except as modified in this specification
b)	Type		Microprocessor based Electro-chemical
c)	Material		Die-cast aluminum/SS/Polycarbonate
d)	Output	i)	4-20 mAmp DC spare output
		ii)	4-20 m Amp, DC Isolated output for DCS.
e)	Supply		240V AC, 50 Hz from UPS
f)	Accuracy		± 5 % of reading
g)	Response:		
	i)	Sensitivity	± Two (2) per cent overall
	ii)	Time (sensor)	Less than 30 seconds for 90% step change.
h)	Connection:		

	i)	Process	One quarter (1/4) inch NPT(F) SCRD
	ii)	Electrical	Half (1/2) inch NPT (F) SCRD
i)	Accessories	i)	Sample cooler assembly with shut off valve at cooling water inlet, with thermometer and reducing valve at sample outlet.
		ii)	Flow stabilizer
		iii)	Automatic temperature compensation
		iv)	Other accessories as required
		v)	Calibration device.
j)	Ranges		As per sample stream detail table
k)	Mounting		Flush
l)	Annunciation contacts:		
	i)	Number	2 SPDT
	ii)	Type	Snap action microswitch
	iii)	Rating	5 Amp 240V AC, 0.2 amp 220V DC

5.14.00 Technical Specification of Silica Analyzer (SI OX) Pl. also Refer Annexure D

a)	Applicable standard		ASME PTC 19.11-197 except as modified in this specification
b)	Type		Multi Channel (max of each Three channel) Colorimetric Analyzer (with auto reagent shut off feature in case of sample loss or power loss) built in phosphate inhibition feature. Micro processor based.
c)	Material:		
	i)	Case	Die cast aluminum
d)	Cycle/Response Time		Twelve (12) minutes Maximum
e)	Analyser output	i)	4 to 20 m Amp DC for spare output
		ii)	4 to 20 m Amp DC Isolated output for DCS/PLC
f)	Power supply		240V AC, 50 Hz from UPS
g)	Accuracy		± 1% of span
h)	Repeatability		± 2% of full scale
i)	Sensitivity		0.2 micrograms/liter
j)	Connection:		
	i)	Process	Quarter (1/4) inch NPT(F) SCRD
	ii)	Electrical	Half (1/2) inch NPT (F) SCRD
k)	Ranges		As per sample stream detail table

l)	Mounting		Flush
m)	Annunciation contacts:		
	i)	Number	2 SPDT
	ii)	Type	Snap action micro switch
	iii)	Rating	5 amp 240V AC 0.2 Amp 220V DC
n)	Accessories	i)	Automatic temperature compensation between 5 to 50 deg C
		ii)	Automatic zeroing provision
		iii)	SS316 tubing & vessels
		iv)	All chemical reagents for 12 months operation of the analyzer
		v)	Sample rate set values
		vi)	Comprehensive diagnostic and alarm features.
		vii)	**Auto sampling facility with necessary valves & solenoids in the sample lines** shall be provided.

5.15.00 Technical Specification of Hydrazine Analyzer Pl. also Refer Annexure D

i)	Type		Microprocessor based Electrochemical
ii)	Case material		Die-cast aluminum/SS/Polycarbonate
iii)	Analyzer output	i)	4-20 mA DC for spare output
		ii)	4-20 mA DC isolated output for DDCMIS
iv)	Power supply		240V AC, 50 Hz from UPS
v)	Accuracy		±2% of full scale
vi)	Response Time		<4 minutes.
vii)	Sensitivity		1.0 microgram/liter
viii)	Annunciation contacts:		
	-	Number	2 SPDT
	-	Type	Snap action micro switch
	-	Rating	5A 240V AC, 0.2 A, 220V DC
	-	Mounting	Flush mounting
ix)	Accessories	i)	Flow regulator
		ii)	Flow gauges
		iii)	Other accessories as required
		iv)	Sample rate set valves
		v)	Chemical reagents as applicable for 12 months consumption

5.16.00 Technical Specification of Sodium Ion Analyzer Pl. also Refer Annexure D

i)	Type	Microprocessor based Continuous flow through sample type with sodium responsive

		electrode and reference electrode having pH adjustment facility (Max 3 streams)
ii)	Case material	Die-cast aluminum/SS/Polycarbonate
iii)	Analyzer power supply	240V AC, 50 Hz from UPS
iv)	Analyzer output	i) 4-20 mA DC for spare output ii) 4-20 mA DC isolated output for DDCMIS
v)	Accuracy	Better than ± 5% of full scale
vi)	Response Time	6 minutes. max
vii)	Sensitivity	0.1 ppb
viii)	Annunciation contacts:	
	- Number	2 SPDT
	- Type	Snap action microswitch
	- Rating	5A 240V AC, 0.2A, 220V DC
	- Mounting	Flush
ix)	Terminal points	All components piped & wired to terminal points
x)	Accessories	i) Flow regulator ii) Flow gauges iii) Sample rate set valves iv) Other accessories as required to make the system complete v) Chemical reagents as applicable for 12 months consumption

5.17.00 Technical Specification of Phosphate Analyzer

i)	Type	Microprocessor based Continuous flow through sample type with colorimetric detection system (Max 3 streams)
ii)	Case material	Die-cast aluminum/SS/Polycarbonate
iii)	Analyzer power supply	240V AC, 50 Hz from UPS
iv)	Analyzer output	i) 4-20 mA DC for spare output ii) 4-20 mA DC isolated output for DDCMIS
v)	Accuracy	Better than ±4% of full scale
vi)	Sensitivity	Better than 1 ppm
vii)	Annunciation contacts:	
	- Number	2 SPDT
	- Type	Snap action micro switch
	- Rating	5A 240V AC, 0.2A, 220V DC
	- Mounting	Flush
viii)	Terminal points	All components piped & wired to terminal points
ix)	Accessories	i) Flow regulator

ii) Flow gauges
iii) Sample rate set valves
iv) Other accessories as required to make the system complete
v) Chemical reagents as applicable for 12 months consumption

5.18.00 Technical Specification of Chloride Analyzer Pl. also Refer Annexure D

i)	Type	Microprocessor based Continuous flow through sample type.
ii)	Analyzer power supply	240V AC, 50 Hz, Single Phase from UPS
iii)	Analyzer output	i) 4-20 mA, DC spare output ii) 4-20 mA, DC isolated output for DDCMIS
iv)	Accuracy	Better than ±10 % of full scale
v)	Sensitivity	Better than 1 ppm
vi)	Range	As per Requirements.
vii)	Annunciation contacts:	
	- Number	As per schedule, 2 SPDT
	- Type	Snap action micro switch
	- Rating	5A, 240V AC, 0.2A, 220V DC
	- Mounting	Flush
viii)	Terminal points	All components piped & wired to terminal points
ix)	Accessories	i) Flow regulator ii) Flow gauges iii) Sample rate set valves iv) Other accessories as required to make the system complete

5.19.00 Technical Specification of Chlorine Analyzer

i)	Type	Microprocessor based Continuous flow through sample type with automatic temperature compensation.
ii)	Analyzer power supply	240V AC, 50 Hz, Single Phase from UPS
iii)	Analyzer output	i) 4-20 mA, DC spare output ii) 4-20 mA, DC isolated output for DDCMIS
iv)	Accuracy	0.005 mg/ltr. or 1% of range.
v)	Sensitivity	0.001 mg/ltr. (1 ppb)
vi)	Range	As per schedule.
vii)	Annunciation contacts:	
	- Number	As per schedule, 2 SPDT

-	Type	Snap action micro switch
-	Rating	5A, 240V AC, 0.2A, 220V DC
-	Mounting	Flush

viii) Terminal points — All components piped & wired to terminal points

ix) Accessories
i) Flow regulator
ii) Flow gauges
iii) Sample rate set valves
iv) Other accessories as required to make the system complete

5.20.00 Technical Specification of Residual Chlorine Analyser Pl. also Refer Annexure D

SENSOR

Method	:	Amperometric
Electrodes	:	Gold Cathode/Silver Anode
Cell Material	:	PVC
Electrolyte	:	Potassium Bromide

TRANSMITTER

Type	:	Microprocessor Based with self diagnostic features
Transmitter Output	:	4 – 20 mA
Enclosure Protection	:	IP65
Enclosure Material	:	Polyester coated Al.
Electrical Connection	:	½" NPT (F)
Mounting	:	FIELD
Display Type	:	LCD
Display Details	:	4 digit backlit LCD matrix
Diagnostics	:	Required
Meter Range	:	0-1 mg/l
Resolution	:	0.01 ppm
Area Classification	:	SAFE
Electromagnetic Compatibility	:	BUILT – IN
Temp. Compensator	:	AUTO – BUILT – IN
Temp. Compensating element	:	PT100

5.21.00 Technical Specification of Turbidity Analyser Pl. also Refer Annexure D

SENSOR

Reference type	:	On Line
Operating principle	:	Alternating Light Source
Cleaning	:	Self Cleaning
Electrode holder – type	:	Flow Through
Body Material	:	CPVC
Process Connection	:	½" NPT (F)

Pre Amplifier	:	Built-In

TRANSMITTER

Type	:	Microprocessor Based
Transmitter Output	:	4-20 mA DC
Enclosure Protection	:	IP65
Enclosure material	:	polycarbonate
Electrical connection	:	½" NPT (F)
Local Indicator	:	Provided (LCD Display)
Accuracy	:	0.2 NTU or ± 2% of reading
Repeatability	:	± 0.1% of span
Temp. compensator	:	built-in
Cable between transmitter & sensor	:	To be provided

5.22.00 All analysers shall be supplied with chemicals/regents required for 12 months operation. Bidder shall also provide start up kits, buffer solution for pH and conductivity analyzer. The analyser supplier shall submit the preparation procedure / formula of the reagent to be used in analyser solution.

5.26.00 SWAS Sample Stream Details Table

Sample No.	Sample Stream	Type of Measurement	Range of Monitor/ Indicator	Alarm	Output to SWAS OS	O/P to Distributed Control System
1)	Make-up DM Water	a) GRAB	-	-	-	-
		b) Conductivity (Specific & Cat ion)	0-10 Micro (Mho/cm)	Yes	Yes	Yes
		c) pH	6-14 pH	Yes	Yes	Yes
		d) Silica	0-0.1 ppm	Yes	Yes	Yes
2)	Hot well both side condensate	a) Conductivity (Insertion Type)	0-10 Micro mhos/cm	Yes	Yes	Yes
3)	Condensate Pump discharge	a) GRAB	-	-	-	-
		b) pH	6-14 pH	Yes	Yes	Yes
		c) Dissolved oxygen	0-20 ppb 0-200 ppb 0-1000 ppb	Yes	Yes	Yes
		d) Conductivity	0-10 Micro mhos/cm	Yes	Yes	Yes
		e) Cation cond.	0-10 Micro-mhos/cm	-	-	Yes
		f) Silica	0-100 ppb	Yes	Yes	Yes
		g) Sodium ion	0 to 1000 ppb	Yes	Yes	Yes
		h) Chloride	0-10 ppb	Yes	Yes	Yes
4)	Deaerator I/L	a) GRAB	-	-	-	-
		b) Dissolved oxygen	0-20 ppb 0-100 ppb	Yes	Yes	Yes
		c) Silica	0-100 ppb	Yes	Yes	Yes
		d) pH	0- 14 pH	Yes	Yes	Yes
5)	Common discharge Header Deaerator	a) GRAB	-	-	-	-
		b) Dissolved oxygen	0-20 ppb 0-100 ppb	Yes	Yes	Yes
		c) Sp. Conductivity	0-1/ 10 μS/cm	Yes	Yes	Yes
		d) pH	0- 14 pH	Yes	Yes	Yes
6)	Feedwater Economiser Inlet	a) GRAB	-	-	-	-
		b) pH	6-14 pH	Yes	Yes	Yes

Sample No.	Sample Stream	Type of Measurement	Range of Monitor/ Indicator	Alarm	Output to SWAS OS	O/P to Distributed Control System
		c) Conductivity (Specific & Cat ion)	0-10 Micro mhos/cm	Yes	Yes	Yes
		d) Hydrazine	0-50 ppb 0-100 ppb	Yes	Yes	Yes
		e) DO2	0-20ppb	Yes	Yes	Yes
		f) Turbidity		Yes	Yes	Yes
		g) Silica	0-50, 100 ppb	Yes	Yes	Yes
		h) Ammonia		Yes	Yes	Yes
7)	Boiler Separator outlet steam at LTSH inlet	a) GRAB	-	-	-	-
		b) Conductivity (Specific & Cation)	0-100 Micro mhos/cm	Yes	Yes	Yes
		c) Hydrazine	0-50 ppb 0-100 ppb	Yes	Yes	Yes
		d) Silica	0-50, 100 ppb	Yes	Yes	Yes
8)	Boiler saturated steam	a) GRAB	-	-	-	-
		b) Conductivity (Specific & Cation)	0-100 Micro mhos/cm	Yes	Yes	Yes
		c) pH	6-14 pH	Yes	Yes	Yes
9)	Main steam	a) GRAB	-	-	-	-
		b) Conductivity	0-10/0-1 Micro mhos/cm	Yes	Yes	Yes
		c) After cation	0-1/0-2 Micro mhos/cm	Yes	Yes	Yes
		d) Silica	0 to 100 ppb	Yes	Yes	Yes
		e) pH	6-14 pH	-	-	Yes
		f) Sodium ion	0 to 1000 ppb	Yes	Yes	Yes
10)	HRH Steam	a) GRAB	-	-	-	-
		b) pH	6-14 pH	Yes	Yes	Yes
		c) Sp. Conductivity	0-10 Micro mhos/cm	Yes	Yes	Yes
11)	Out let of Condenser	a) GRAB	-	-	-	-

ENNORE 2X660 MW SWAS

Sample No.	Sample Stream	Type of Measurement	Range of Monitor/ Indicator	Alarm	Output to SWAS OS	O/P to Distributed Control System
	Polishing unit					
	At O/L Header	b) pH	6-14 pH	Yes	Yes	Yes
	At O/L Header	c) Sp. Conductivity	0-10 Micro mhos/cm	Yes	Yes	Yes
	At O/L header	d) Silica	0-100 ppb	Yes	Yes	Yes
	At O/L header	e) Sodium ion	0 to 10 ppb	Yes	Yes	Yes
	At O/L Header	f)Cation conductivity	0-1/10 Micro mhos/cm	Yes	Yes	Yes
	At O/L Header	g) Dissolved oxygen	0-20 ppb 0-100 ppb	Yes	Yes	Yes
	I/L & O/L of each stream	h)Cation conductivity	0-1/10 Micro mhos/cm	Yes	Yes	Yes
12)	Condenser Cooling Water discharge	a) GRAB	-	-	-	-
		b) Conductivity	0-10 Micro (Mho/cm)	Yes	Yes	Yes
		c) pH	6-14 pH	Yes	Yes	Yes
		d) Chlorine	Bidder to Specify	Yes	Yes	Yes
13)	DMCW (SG & TG) Water	a) GRAB	-	-	-	-
		b) Conductivity	0-10 Micro (Mho/cm)	Yes	Yes	Yes
		c) pH	6-14 pH	Yes	Yes	Yes
14)	Boiler blow down to condenser - Drain to condenser from Boiler condensate pumps	a) GRAB		-	-	-
		b) Conductivity		Yes	Yes	Yes
15)	Condenser Tube Leak detection at each inlet & outlet CW line.	a) Cation Conductivity (Insertion /Retractable Type)	0-1/10 Micro mhos/cm	Yes	Yes	Yes

Note : 1) The above indicated quantity are minimum and if the process requirement calls for any other services for measurement and performance of the plant the same shall be included in addition to the above services.

2) The system shall be designed to provide 20% more than the maximum sample flow requirement.

ENNORE 2X660 MW SWAS

8.00.00 DRAWINGS AND DOCUMENTS

Bidder shall furnish following drawings and documents after award of contract:

a) Final version of all the drawing and document furnished along with bid
b) Drawing and document submission schedule
c) Power supply scheme
d) Interconnection and wiring diagram.
e) Spare part list
f) Consumable list
g) QAP
h) Inspection and Test report
i) Training details
j) O&M Manual
k) Any other scheme, data, drawing, document, etc required to establish product quality and completeness of supply

NOTE: - Vendors need to offer all components/accessories required to meet the intent of the specification. If it is found, at any stage of procurement /commissioning, that some components./accessories have not been offered/supplied, same shall be supplied without any cost/time implication to BHEL to meet the system / product requirement.

Important Note: Mandatory Spares shall be sent in pre-decided lots in containers / secure boxes distinctly marked in Red colour with boldly written "S" mark on each face of the containers /secure boxes.

SECTION - E

2 X 660 MW ENNORE SEZ SUPERCRITICAL TPP PROJECT AT ASH DYKE OF NCTPS,CHENNAI

SWAS SCHEME

REV.	DATED.	ALTD	CHD	APPD
06	24.01.18	VKV	SCS	SCS
1.	REVISED IN LINE WITH CUSTOMER COMMENTS RECVD VIDE dtd. 23.10.2017.			
05	04.10.2017	SK -SD-	SCS -SD-	SCS-SD-
1.	REVISED IN LINE WITH AS PER CUSTOMER COMMENTS RECVD VIDE LTR No. D.358/2017,dt.31.08.2017.			
04	17.08.17	AC -SD-	SK -SD-	SCS-SD-
1.	REVISED AS PER CUSTOMER'S COMMENTS DTD 03.03.17.			
03	03.12.16	AC -SD-	SK -SD-	SCS-SD-
1.	REVISED AS PER CUSTOMER'S COMMENTS RECEIVED LTR NO:SE/E/Th& HyP /EE/E/AEE/E/F.En SEZ STPP/D. 19 /2016 dtd. 18.11.2016.			
02	28.08.15	AC -SD-	SK -SD-	SCS-SD-
1.	REVISED AS PER DISCUSSION IN MEETING HELD AT CHENNAI DTD 09.07.2015.			
01	03.07.2015	VS-SD-	AC/SK-SD-	SCS-SD-
1.	REVISED IN LINE WITH AS PER CUSTOMER COMMENTS LTR No. CE/P/SE/E/T&H(P)/EE-8 & EE7/F/D18/15 DTD: 25.06.2015.			

JOB NO. 412

STATUS CONTRACT

PRINT SCALE

PROJECT– 2 X 660 MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI

OWNER	TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LIMITED	
OWNER'S CONSULTANT	DESEIN PRIVATE LIMITED DESEIN HOUSE, NEW DELHI	
EPC CONTRACTOR	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA	DEPT CODE: I

	NAME	SIGN	DATE
DSGN	AC	-sd-	01.06.15
CHD	SK	-sd-	01.06.15
APPD	SCS	-sd-	01.06.15

TITLE: SWAS SCHEME

DEPT. / SIGN / DATE

SCALE

DRAWING NO. PE-DG-412-145-I110

SHEET 1 OF 24 REV 06

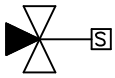
LEGEND :


ISOLATING VALVE
(NORMALLY OPEN)


ISOLATING VALVE
(NORMALLY CLOSED)


PRESS REDUCING VALVE


BACK PRESS REGULATOR



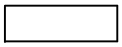
SOLENOID OPERATED VALVE


SAFETY RELIEF VALVE


3 WAY ISOLATING VALVE


SAMPLE COOLER


SAMPLE FILTER


EXPANDER


FLOW INDICATOR
WITH REGULATING VLV

QDV — QUICK DISCONNECTION VALVE

CC — CATION COLUMN

CE — CONDUCTIVITY ELEMENT

pHE — pH ELEMENT

DOE — DISSOLVED O2 ELEMENT

DOT — DISSOLVED O2 TRANSMITTER

CT — CONDUCTIVITY TRANSMITTER

CCT — CAT. CONDUCTIVITY TRANSMITTER

pHT — pH TRANSMITTER

SiT — SILICA ANALYSER TRANSMITTER

NaT — SODIUM ANALYSER TRANSMITTER

NH3T — AMMONIA TRANSMITTER

CIT — RESIDUAL CHLORINE ANALYSER TRANSMITTER

SaIT — SALINITY ANALYSER TRANSMITTER

A — ANALYSER IN DRY PANEL

PG — PRESSURE GAUGE

TG — TEMPERATURE GAUGE

TS — TEMPERATURE SWITCH

FS — FLOW SWITCH

FI — FLOW INDICATOR

LI — LEVEL INDICATOR

——— IMPULSE LINE

– – – CABLE

CR — CONTROL ROOM

DDCMIS — DISTRIBUTED DIGITAL CONTROL MONITORING & INFORMATION SYSTEM

OWS ALARM — ALARM ON OWS IN CONTROL ROOM

INDICATES RESPECTIVE SCOPE

EDN — BHEL–EDN

B(T) — BHEL–TRICHY

CUST — CUSTOMER

01 HzT — HYDRAZINE TRANSMITTER

02 TSV — THERMAL SHUT–OFF VALVE (NORMALLY OPEN)

04 CldT — CHLORIDE ANALYSER TRANSMITTER

BHEL	TAMILNADU GEN & DIST. CORPORATION 2 X 660 MW ENNORE SEZ STPP	TITLE:– SWAS SCHEMES LEGEND	DRG. NO. PE–DG–412–145–I110 SHEET 2 OF 24 | REV 06

Important Notes Indicated below, Vendor read carefully and incorporate the same

NOTES : 01

1. ONE SET OF ALARM CONTACTS OF 2SPDT TYPE SHALL BE PROVIDED WITH EACH ANALYSER/MONITOR. TWO Nos. 4–20 mA SIGNAL FROM ALL ANALYSERS SHALL BE HOOKED–UP, ONE TO DDCMIS FOR MONITORING PURPOSE AS WELL AS ALARMS & ONE AS SPARE.
2. ALL FIELD SAMPLING LINE SHALL BE OF ANNEALED SEAMLESS SS316H CONFORMING TO ANSI 36.19 AND 3/4" (i.e. 20NB). INSIDE THE SWAS RACKS/PANELS, 1/4" O.D. TUBING SHALL BE USED. FOR SEA WATER APPLICATION, SS316L SHALL BE PROVIDED. 06 02
3. ALL SAMPLING LINES SHALL BE ADEQUATELY SLOPED TOWARDS THE SAMPLING PANEL.
4. ALL PRIMARY COOLERS IN FIELD SHALL BE PLACED IN THE PRIMARY COOLER PANELS.
5. SAMPLE TEMP SHALL BE AROUND 45 DEG C AT PRIMARY COOLER OUTLET AND SAMPLE TEMP AT SECONDARYCOOLER OUTLET SHALL BE 25°C.
6. SAMPLE ENTRY IN PANEL SHALL BE FROM ''TOP'' AND CABLE ENTRY FROM ''BOTTOM''.
7. SAMPLE TEMP HIGH ALARM SHALL BE PROVIDED IN DDCMIS AND SWAS ALARM ANNUNCIATOR (WITH MINIMUM 80 POINTS).
8. THE SAMPLE CONDITIONING SYSTEM SHALL PROVIDE SAMPLES AT A PRESSURE OF ABOUT 2 KG/CM2 AND AT FLOW RATES AS REQUIRED BY INDIVIDUAL ANALYZERS/STREAMS AS PER TECHNICAL SPECIFICATION. PRESSURE REDUCING VALVES (HIGH TEMPERATURE & LOW TEMPERATURE) SHALL BE PROVIDED TO COMPLY THE TECHNICAL SPECIFICATION REQUIREMENTS.
9. WET PANEL SHALL BE "CLOSED TYPE" AND SHALL BE CONSTRUCTED AS PER TECHNICAL SPECIFICATION. DRY PANEL SHALL BE ENCLOSED TYPE WITH ADEQUATE & SAFE PANEL ILLUMINATION.
10. ONE OWS WITH A4 SIZED B&W LASER JET PRINTER SHALL BE PROVIDED FOR SWAS SYSTEM AS PER TECHNICAL SPECIFICATION. (SHALL BE PART OF HMI SUPPLIER). OWS BHEL scope of supply
11. THE SYSTEM SHALL BE DESIGNED IN ACCORDANCE WITH THE RECOMMENDATIONS IN ASME PTC 19.11 Part II,WATER ANS STEAM IN POWER CYCLE, ASTM STANDARDS– 31 WATER AND ASTM D1066–69 STANDARD METHOD OF SAMPLING STEAM AS PER TECHNICAL SPECIFICATION.
12. FITTINGS IN THE FIELD FOR SAMPLE PIPING SHALL BE SOCKET WELDING TYPE.
13. ALL PROCESS CONNECTION, PIPING, VALVES ETC. OF SWAS ANALYSERS SHALL BE CONFORM TO ANSI/ISA SP 77.70–1994 (R 2005) FOSSIL FUEL POWER PLANT INSTRUMENT PIPING INSTALLATION, ANSI B 31.1 ?POWER PIPING?, PTC 19.11.1997 AS PER TECHNICAL SPECIFICATION.
14. THE SYSTEM SHALL BE DESIGNED TO PROVIDE 20% MORE THAN THE MAXIMUM SAMPLE FLOW REQUIREMENT AS PER TECHNICAL SPECIFICATION.
15. KKS TAGS WILL BE PREFIXED WITH "10" AND "20" FOR UNIT 1 AND 2 RESPECTIVELY. COMMON SYSTEM SHALL BE PREFIXED WITH "90". 04
16. MATERIAL FOR BLOW DOWN HEADER SHALL BE ASTM A–312 TYPE 316 STAINLESS STEEL AS PER TECHNICAL SPECIFICATION.
17. MULTI–STREAM ANALYZERS SHALL BE PROVIDED WITH MAX THREE STREAM ANALYZERS IN LINE WITH TECHNICAL SPECIFICATION.
18. SAMPLE EXTRACTION PUMPS SHALL BE PROVIDED FOR SAMPLE STREAMS WITH PRESSURE LESS THAN 2KG/CM2.
19. TWO NOS. CATION EXCHANGE COLUMNS(ONE WORKING AND ONE STAND–BY) SHALL BE PROVIDED WITH MANUAL SWITCHING FOR EACH CATION CONDUCTIVITY MEASUREMENT.
20. ALL PIPING, TUBING, FITTINGS, VALVES, FILTERS AND OTHER WETTED PARTS IN THE SAMPLING AND ANALYZING SYSTEM SHALL BE OF TYPE SS316 OR OTHER SUITABLE MATERIAL FOR THE SERVICE APPROVED BY THE OWNER. NO PLASTICS OR RUBBER SHALL BE PERMITTED EXCEPT WITHIN ANALYZERS AS FURNISHED BY THE MANUFACTURER AS PER TECHNICAL SPECIFICATION.
21. STORAGE TANK AUTOMATIC WATER MAKE UP WITH MANUAL BYPASS FACILITY, TEMPERATURE INDICATOR, DRAIN AND OVERFLOW CONNECTION, IN ADDITION TO ANY OTHER INSTRUMENTS/EQUIPMENTS REQUIRED FOR SMOOTH, CONVENIENT OPERATION OF THE SYSTEM SHALL BE PROVIDED AS PER TECHNICAL SPECIFICATION.
22. SAMPLE COOLERS FOR SWAS SHALL BE AS PER TANGEDCO'S APPROVED VENDOR LIST. 04

BHEL	TAMILNADU GEN & DIST. CORPORATION 2 X 660 MW ENNORE SEZ STPP	TITLE:- SWAS SCHEMES NOTES	DRG. NO. PE–DG–412–145–I110 SHEET 2a OF 24 REV 06

NOTES:

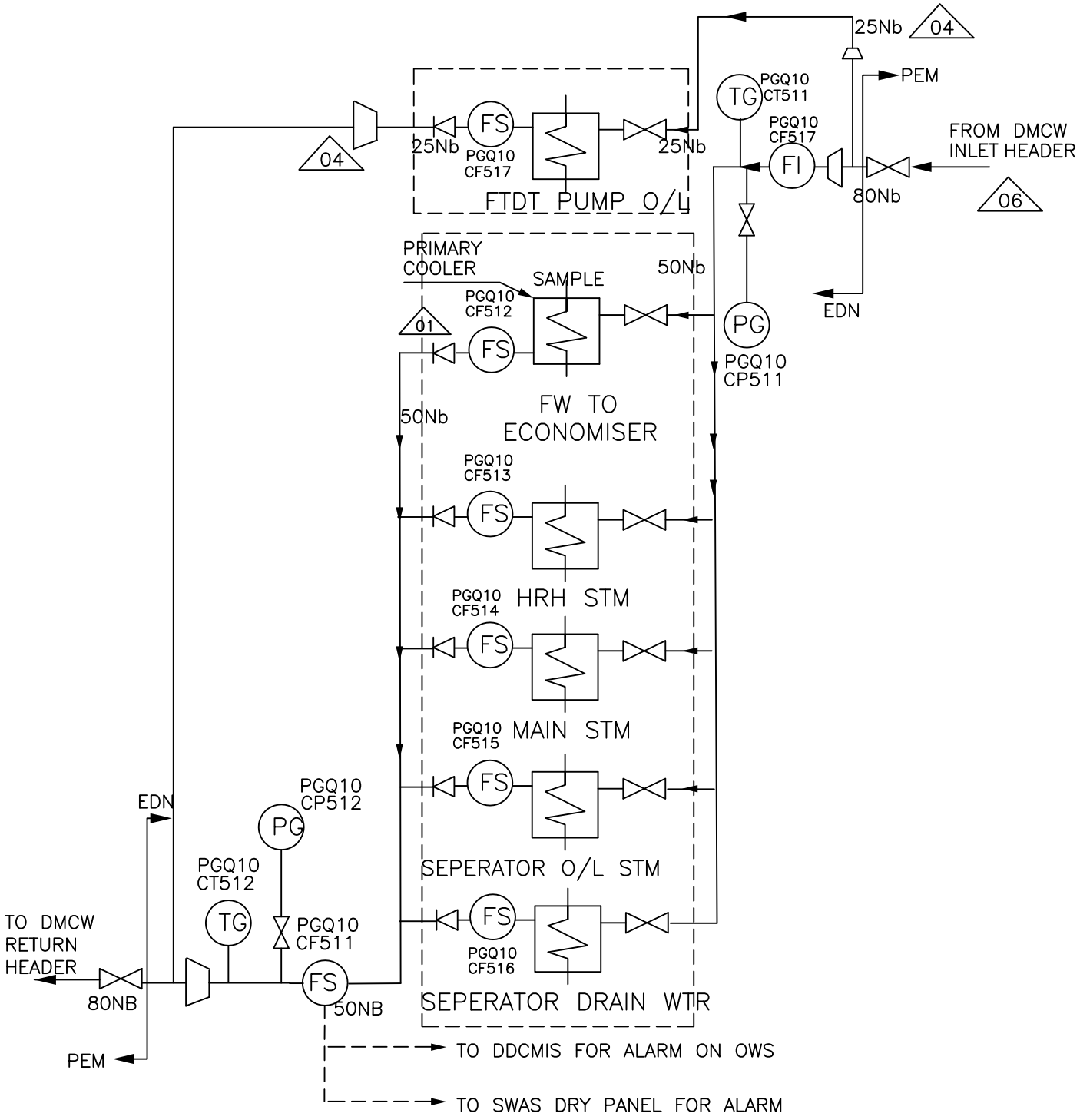
1. SUITABLE EXPANDER(S) SHALL BE PROVIDED TO ERECT THE TEMPERATURE GAUGE. 02
2. PRIMARY COOLERS SHALL BE LOCATED AT FIELD.
3. EXPANDER/ REDUCER FOR CONNECTGON OF DMCW PIPE TO SWAS COOLERS WILL BE IN SWAS VENDOR SCOPE.
4. MATERIAL OF DMCW PIPING WITH FLANGES (MATING AND COUNTER) SHALL BE ASTMA-312 TYPE 316. 04

REFERENCE DRG :

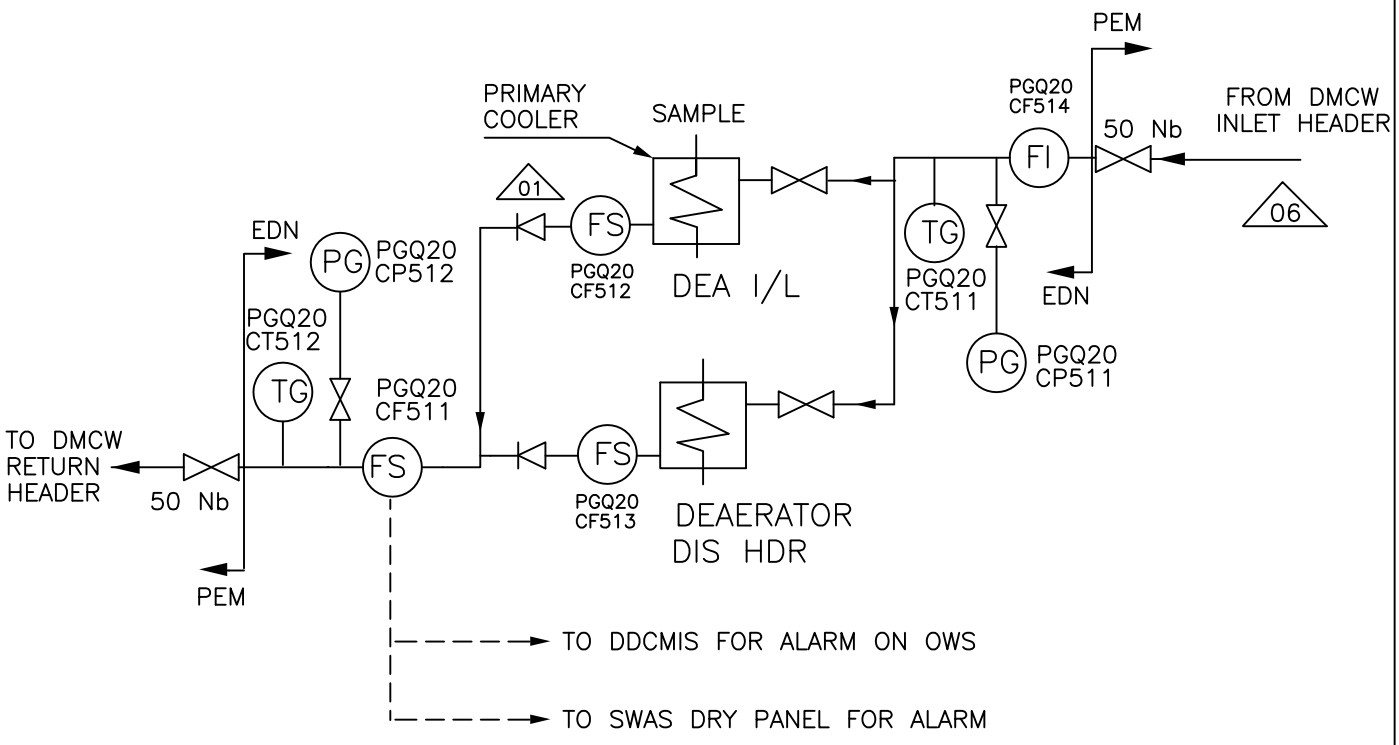
P&ID OF DMCW SYSTEM : PE-DG-412-179-N001

DMCW DESIGN PRESSURE: 12.0kg/cm2

DMCW DESIGN TEMPERATURE: 60 DEG C



TAMILNADU GEN & DIST. CORPORATION	TITLE:- SWAS SCHEMES	DRG. NO. PE-DG-412-145-I110	
2 X 660 MW ENNORE SEZ STPP	DMCW SCHEME FOR PRIMARY COOLERS	SHEET 3 OF 24	REV 05



NOTES:

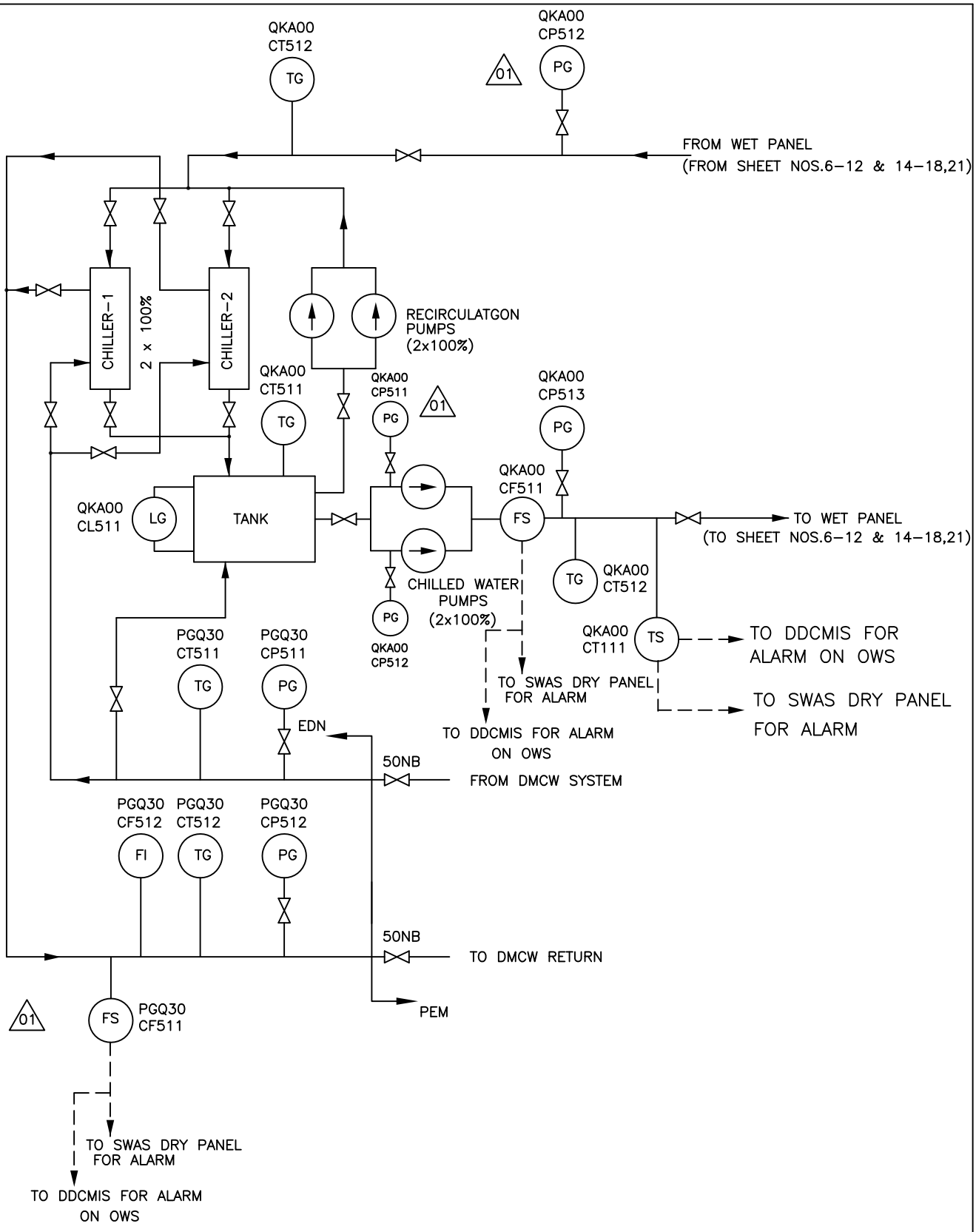
1. SUITABLE EXPANDER(S) SHALL BE PROVIDED TO ERECT THE TEMPERATURE GAUGE.
2. PRIMARY COOLERS SHALL BE LOCATED IN FIELD.
3. MATERIAL OF DMCW PIPING WITH FLAGES (MATING AND COUNTER) SHALL BE ASTMA–312 TYPE 316.

REFERENCE DRG :

P&ID OF DMCW SYSTEM : PE–DG–412–179–N001

DMCW DESIGN PRESSURE: 12.0kg/cm2
DMCW DESIGN TEMPERATURE: 60 DEG C

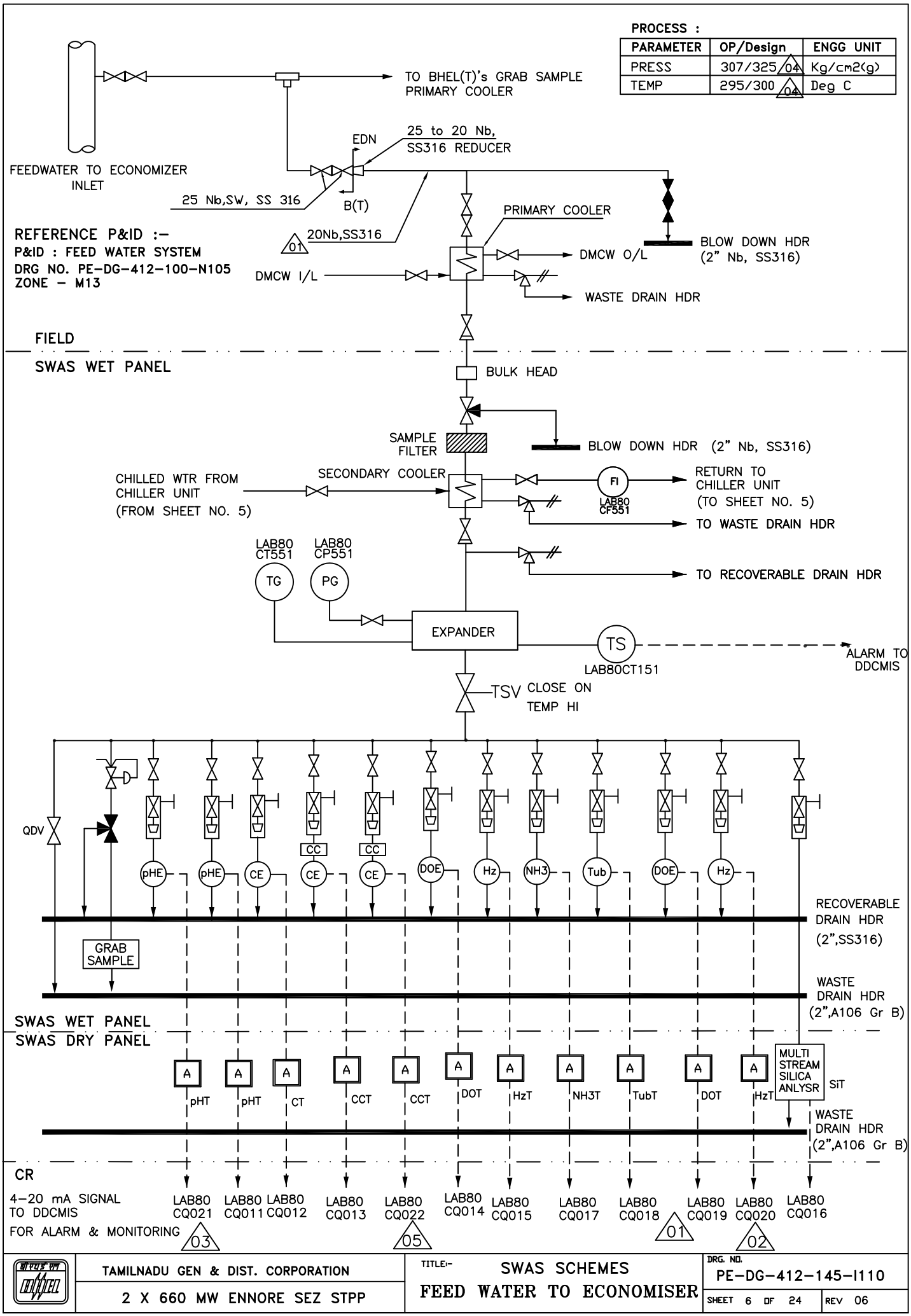
BHEL	TAMILNADU GEN & DIST. CORPORATION	TITLE:- SWAS SCHEMES	DRG. NO. PE–DG–412–145–I110
	2 X 660 MW ENNORE SEZ STPP	DMCW SCHEME FOR PRIMARY COOLERS	SHEET 4 OF 24 REV 05

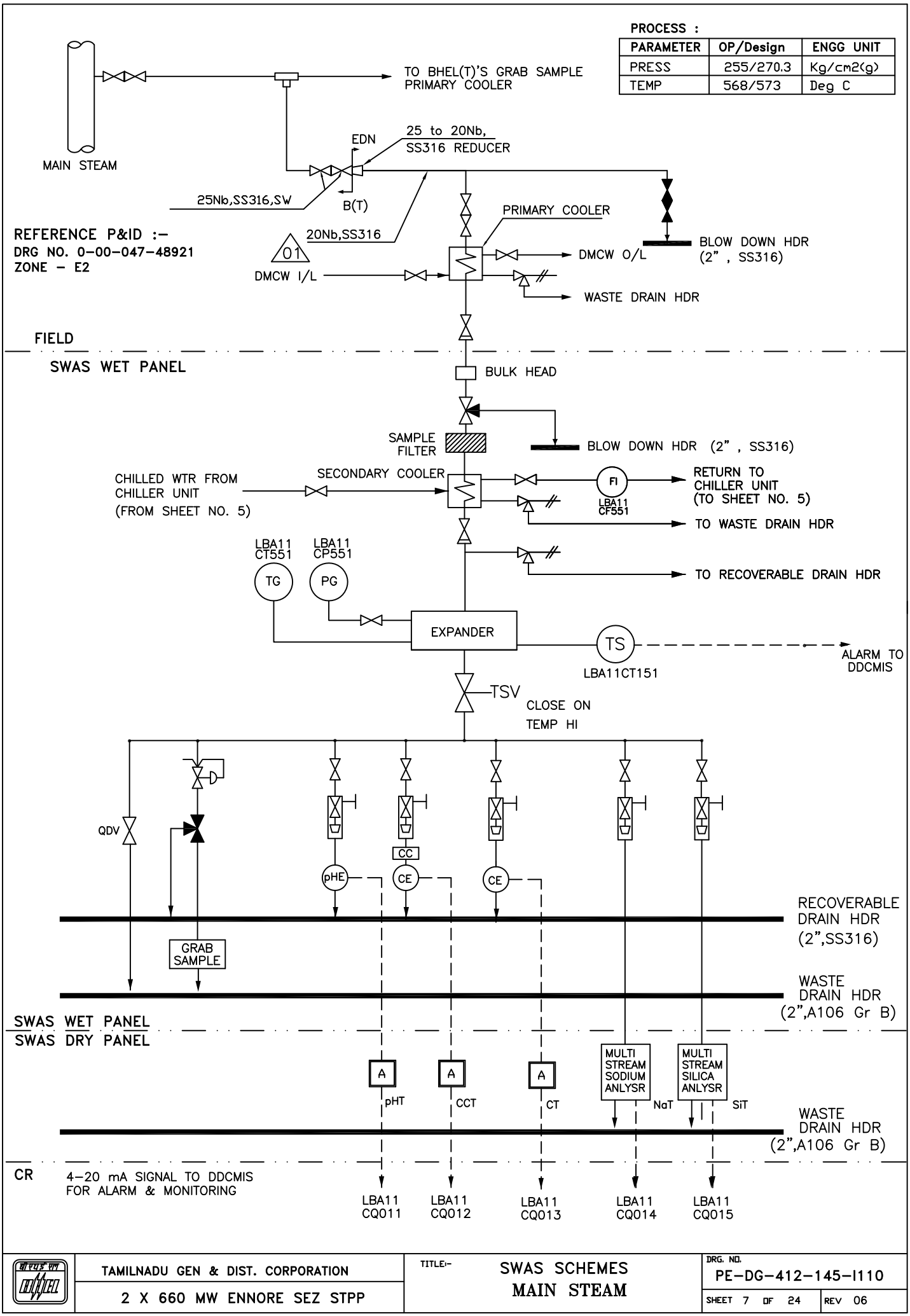


NOTES

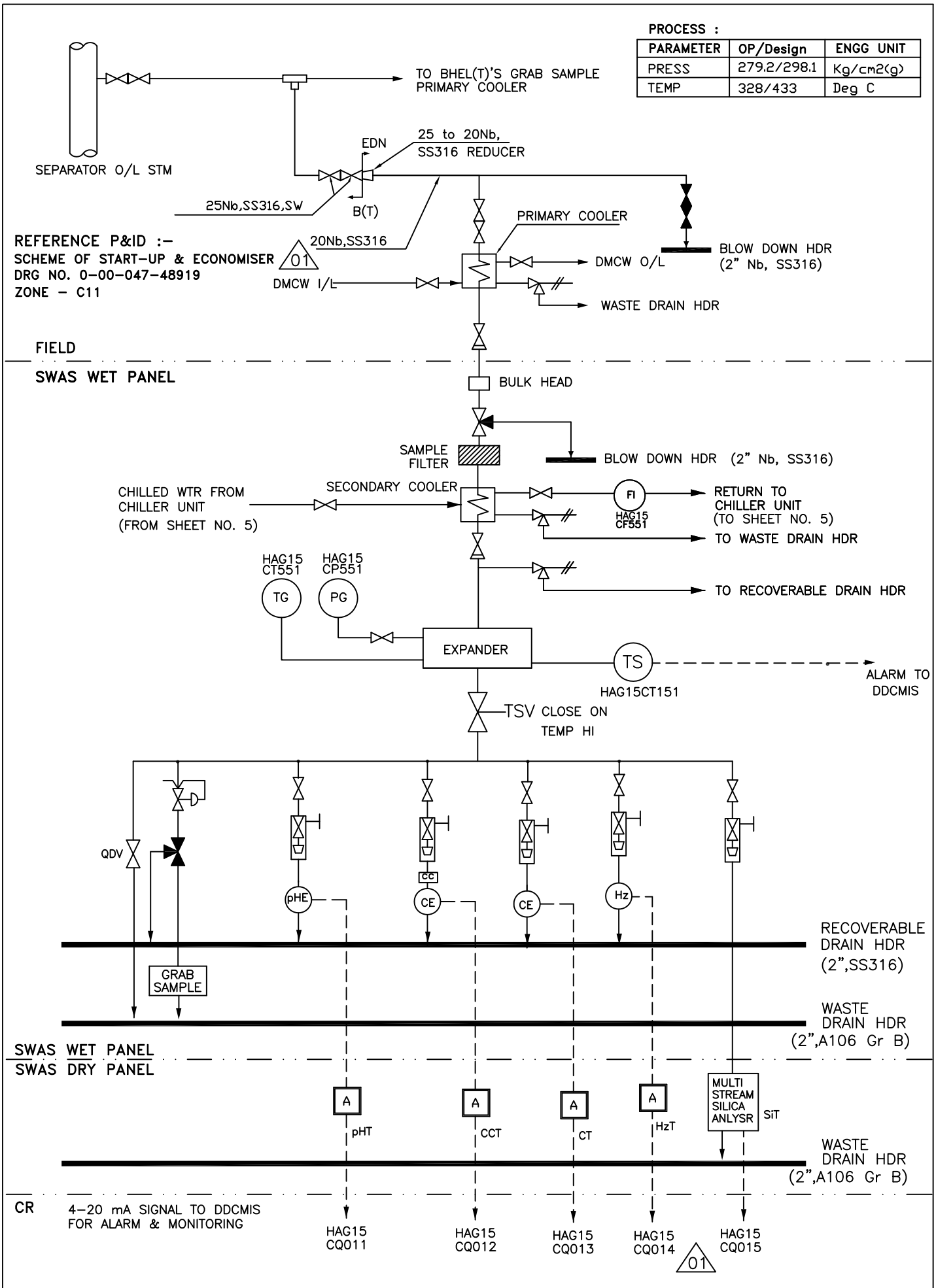
1. ALL SECONDARY COOLERS ARE LOCATED IN SWAS WET PANELS.
3. MATERIAL OF DMCW AND CW PIPING WITH FLAGES (MATING AND COUNTER) SHALL BE ASTMA–312 TYPE 316.

BHEL	TAMILNADU GEN & DIST. CORPORATION 2 X 660 MW ENNORE SEZ STPP	TITLE:– SWAS SCHEMES CHILLED WATER SCHEME FOR SECONDARY COOLERS	DRG. NO. PE–DG–412–145–I110 SHEET 5 OF 24 REV 05

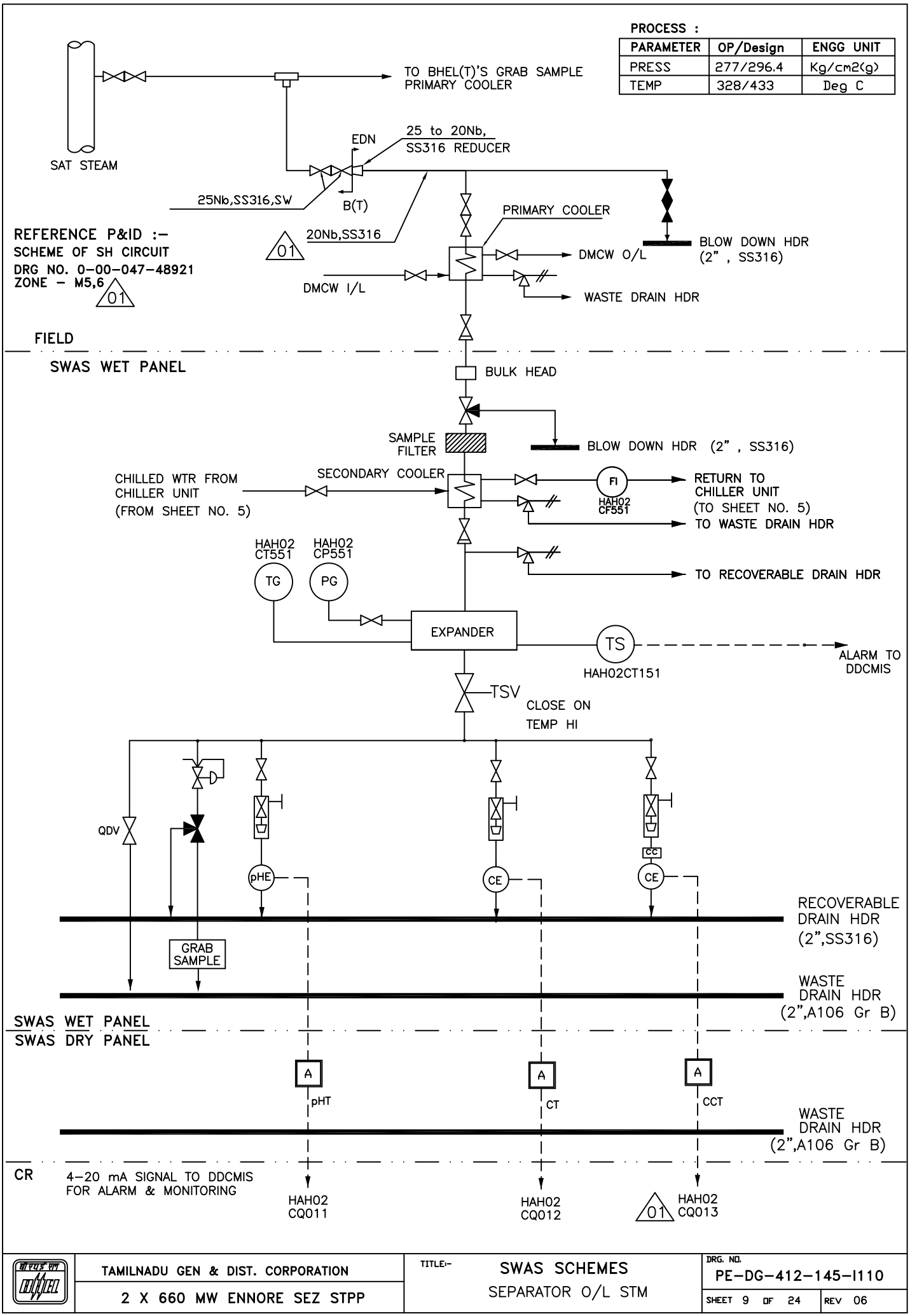

PROCESS :
PARAMETER | OP/Design | ENGG UNIT
PRESS | 307/325 04 | Kg/cm2(g)
TEMP | 295/300 04 | Deg C
TO BHEL(T)'s GRAB SAMPLE PRIMARY COOLER
FEEDWATER TO ECONOMIZER INLET
EDN
25 to 20 Nb, SS316 REDUCER
25 Nb,SW, SS 316
B(T)
01 20Nb,SS316
PRIMARY COOLER
BLOW DOWN HDR (2" Nb, SS316)
DMCW O/L
DMCW I/L
WASTE DRAIN HDR
REFERENCE P&ID :-
P&ID : FEED WATER SYSTEM
DRG NO. PE-DG-412-100-N105
ZONE - M13
FIELD
SWAS WET PANEL
BULK HEAD
SAMPLE FILTER
BLOW DOWN HDR (2" Nb, SS316)
CHILLED WTR FROM CHILLER UNIT
(FROM SHEET NO. 5)
SECONDARY COOLER
FI
LAB80 CF551
RETURN TO CHILLER UNIT
(TO SHEET NO. 5)
TO WASTE DRAIN HDR
LAB80 CT551
LAB80 CP551
TG
PG
TO RECOVERABLE DRAIN HDR
EXPANDER
TS
LAB80CT151
ALARM TO DDCMIS
TSV CLOSE ON TEMP HI
QDV
pHE
pHE
CE
CC
CE
CC
CE
DOE
Hz
NH3
Tub
DOE
Hz
RECOVERABLE DRAIN HDR (2",SS316)
GRAB SAMPLE
WASTE DRAIN HDR (2",A106 Gr B)
SWAS WET PANEL
SWAS DRY PANEL
A pHT
A pHT
A CT
A CCT
A CCT
A DOT
A HzT
A NH3T
A TubT
A DOT
A HzT
MULTI STREAM SILICA ANLYSR
SiT
WASTE DRAIN HDR (2",A106 Gr B)
CR
4-20 mA SIGNAL TO DDCMIS FOR ALARM & MONITORING
03
LAB80 CQ021
LAB80 CQ011
LAB80 CQ012
LAB80 CQ013
05
LAB80 CQ022
LAB80 CQ014
LAB80 CQ015
LAB80 CQ017
LAB80 CQ018
01
LAB80 CQ019
LAB80 CQ020
02
LAB80 CQ016
TAMILNADU GEN & DIST. CORPORATION
2 X 660 MW ENNORE SEZ STPP
TITLE:-
SWAS SCHEMES
FEED WATER TO ECONOMISER
DRG. NO.
PE-DG-412-145-I110
SHEET 6 OF 24
REV 06



TAMILNADU GEN & DIST. CORPORATION	TITLE:- SWAS SCHEMES MAIN STEAM	DRG. NO. PE-DG-412-145-I110	
2 X 660 MW ENNORE SEZ STPP		SHEET 7 OF 24	REV 06



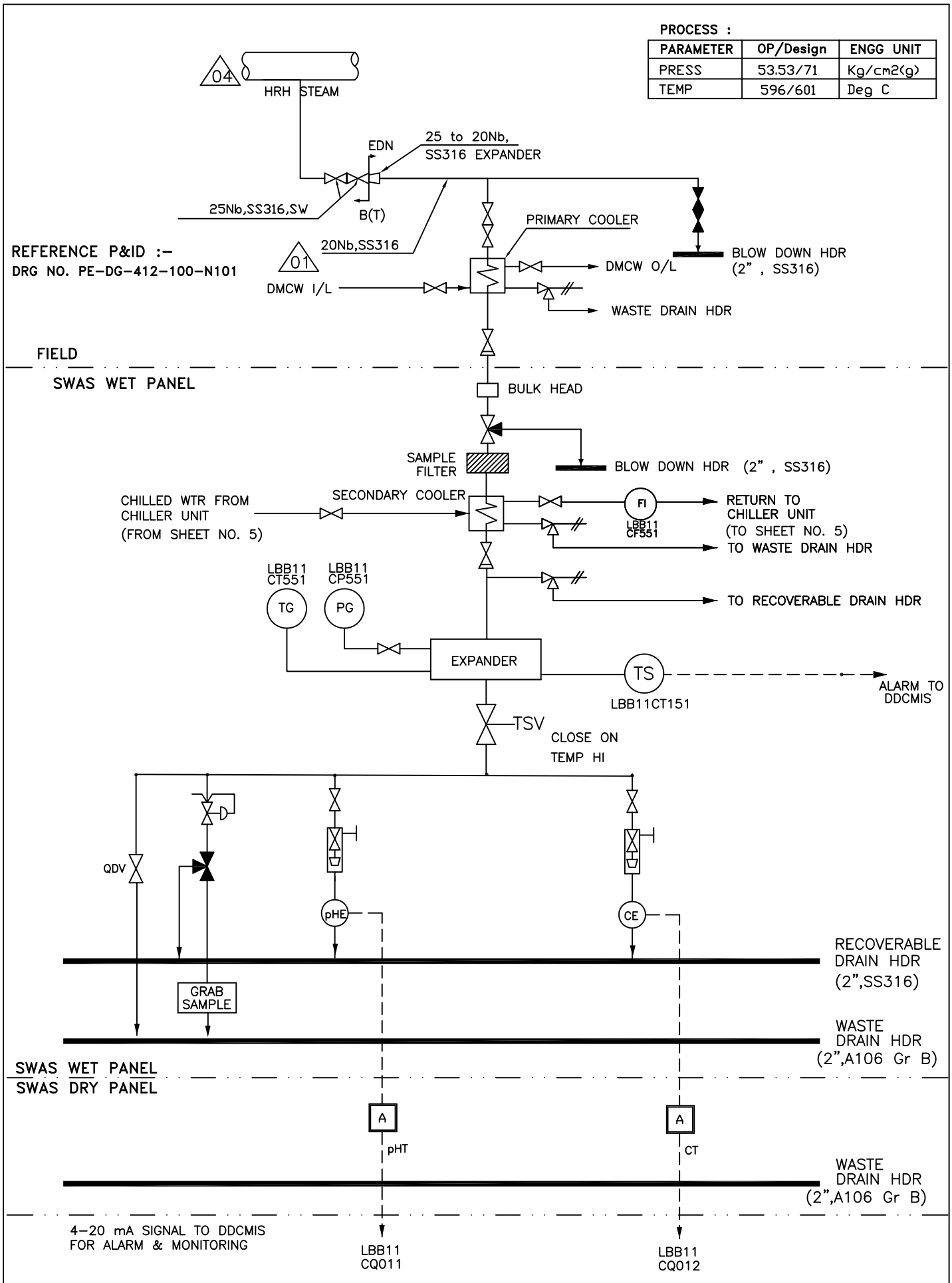
BHEL	TAMILNADU GEN & DIST. CORPORATION	TITLE:- SWAS SCHEMES	DRG. NO. PE-DG-412-145-I110
	2 X 660 MW ENNORE SEZ STPP	SEPERATOR DRAIN WATER	SHEET 8 OF 24 REV 06



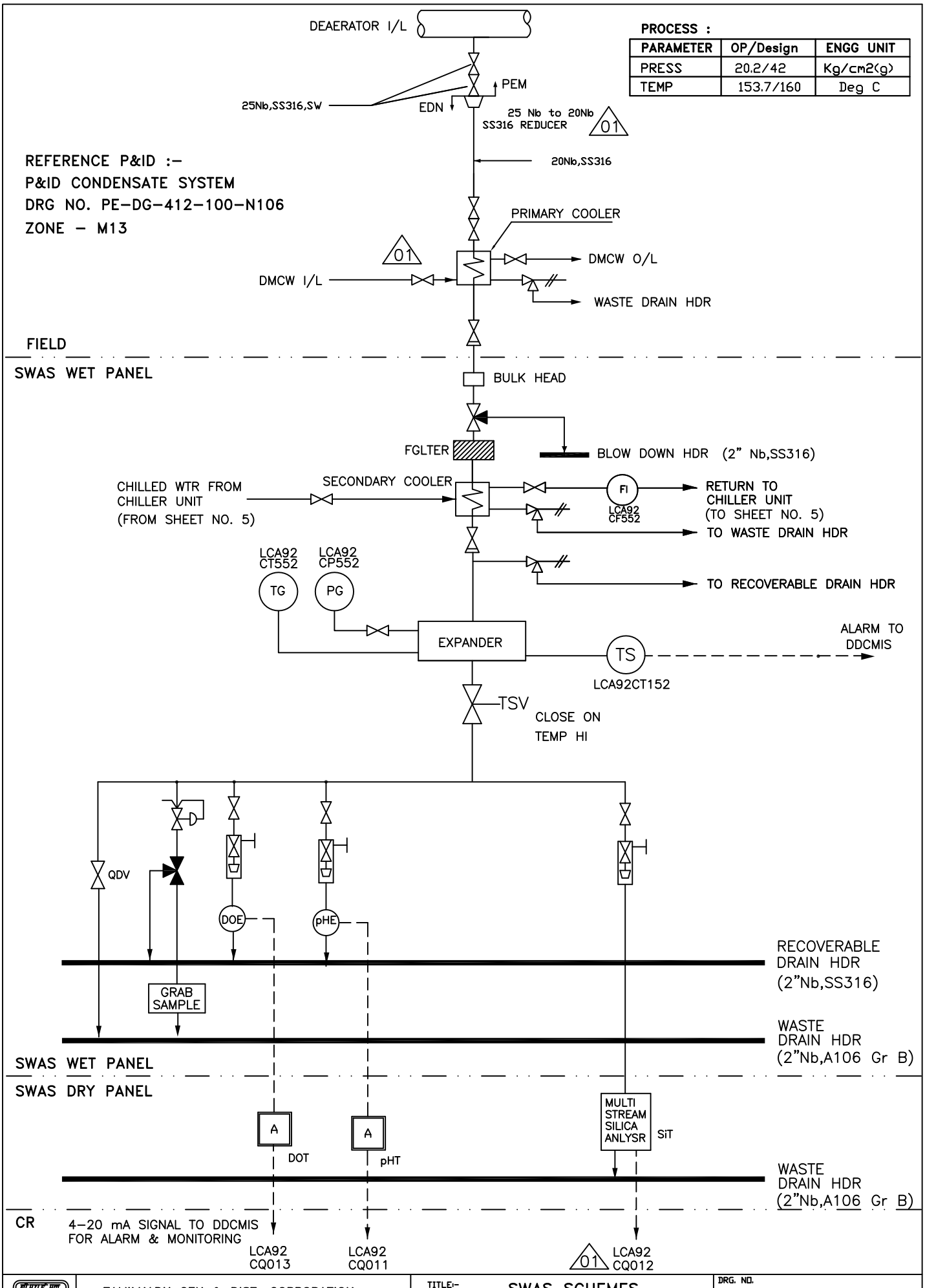
BHEL	TAMILNADU GEN & DIST. CORPORATION	TITLE:- SWAS SCHEMES	DRG. NO. PE-DG-412-145-I110
	2 X 660 MW ENNORE SEZ STPP	SEPARATOR O/L STM	SHEET 9 OF 24 REV 06

PROCESS :

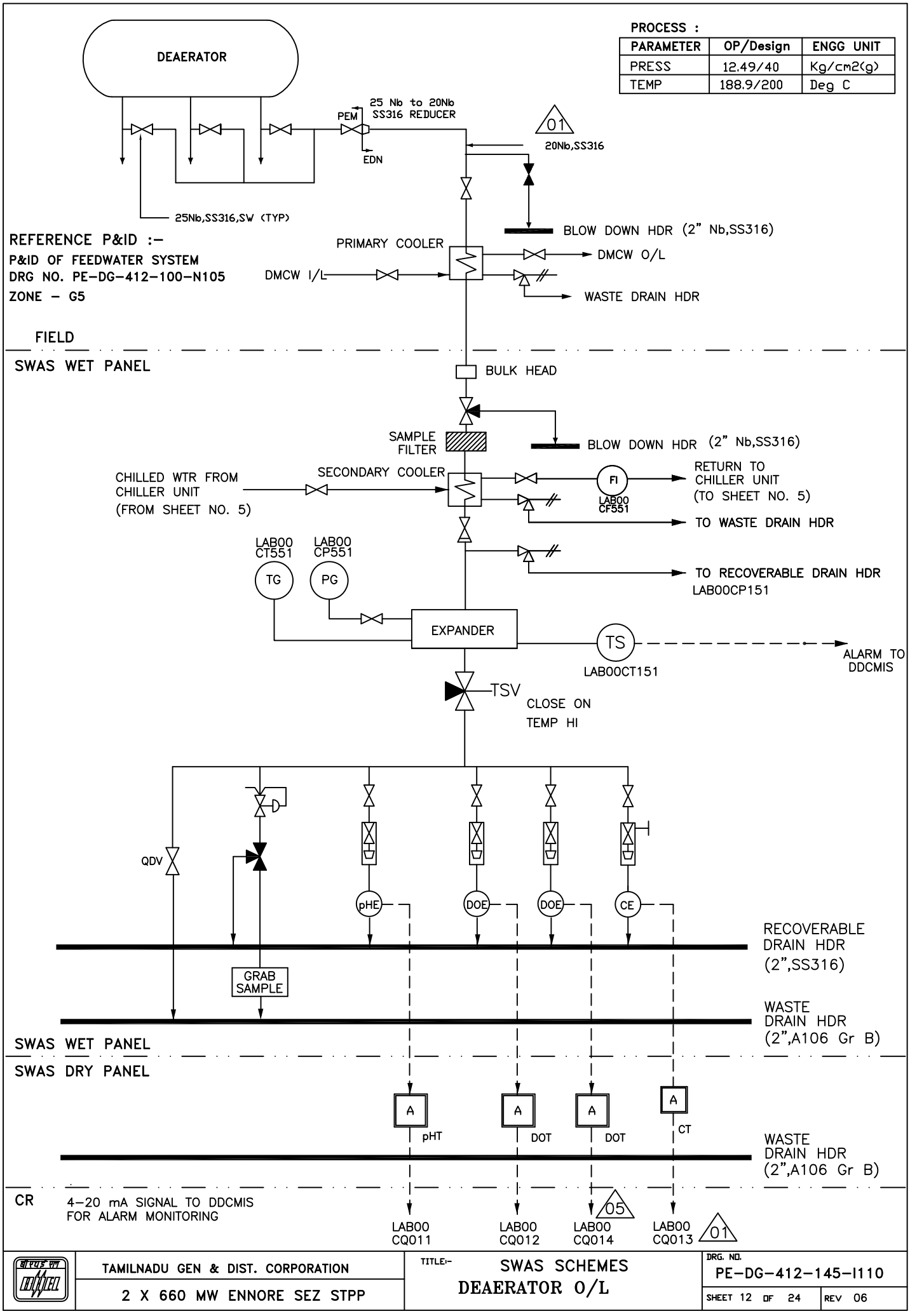
PARAMETER	OP/Design	ENGG UNIT
PRESS	53.53/71	Kg/cm2(g)
TEMP	596/601	Deg C



	TAMILNADU GEN & DIST. CORPORATION	TITLE:- SWAS SCHEMES	DRG. NO. PE-DG-412-145-I110
	2 X 660 MW ENNORE SEZ STPP	HRH STEAM	SHEET 10 OF 24 REV 06

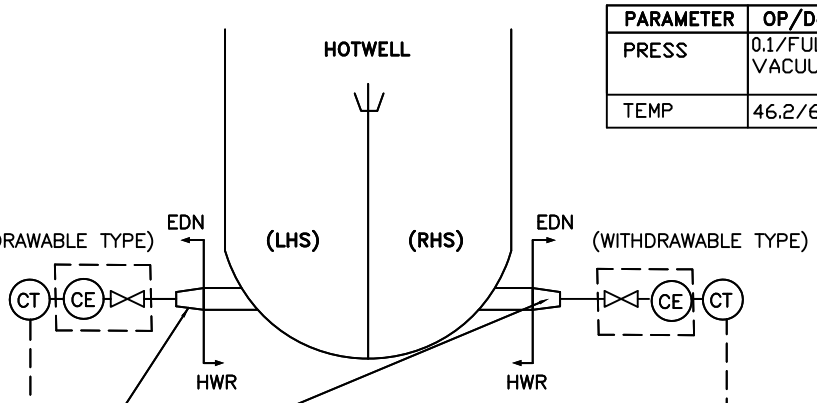


	TAMILNADU GEN & DIST. CORPORATION	TITLE:- SWAS SCHEMES DEAERATOR INLET	DRG. NO. PE-DG-412-145-I110
	2 X 660 MW ENNORE SEZ STPP		SHEET 11 OF 24 REV 06


PROCESS :
PARAMETER | OP/Design | ENGG UNIT
PRESS | 12.49/40 | Kg/cm2(g)
TEMP | 188.9/200 | Deg C
DEAERATOR
25 Nb to 20Nb SS316 REDUCER
PEM
EDN
01
20Nb,SS316
25Nb,SS316,SW (TYP)
BLOW DOWN HDR (2" Nb,SS316)
REFERENCE P&ID :-
P&ID OF FEEDWATER SYSTEM
DRG NO. PE-DG-412-100-N105
ZONE - G5
PRIMARY COOLER
DMCW I/L
DMCW O/L
WASTE DRAIN HDR
FIELD
SWAS WET PANEL
BULK HEAD
SAMPLE FILTER
BLOW DOWN HDR (2" Nb,SS316)
CHILLED WTR FROM CHILLER UNIT
(FROM SHEET NO. 5)
SECONDARY COOLER
FI
LAB00 CF551
RETURN TO CHILLER UNIT
(TO SHEET NO. 5)
TO WASTE DRAIN HDR
LAB00 CT551
LAB00 CP551
TG
PG
TO RECOVERABLE DRAIN HDR
LAB00CP151
EXPANDER
TS
LAB00CT151
ALARM TO DDCMIS
TSV
CLOSE ON TEMP HI
QDV
pHE
DOE
DOE
CE
RECOVERABLE DRAIN HDR (2",SS316)
GRAB SAMPLE
WASTE DRAIN HDR (2",A106 Gr B)
SWAS WET PANEL
SWAS DRY PANEL
A
pHT
A
DOT
A
DOT
A
CT
WASTE DRAIN HDR (2",A106 Gr B)
CR
4-20 mA SIGNAL TO DDCMIS FOR ALARM MONITORING
LAB00 CQ011
LAB00 CQ012
LAB00 CQ014
05
LAB00 CQ013
01
TAMILNADU GEN & DIST. CORPORATION
2 X 660 MW ENNORE SEZ STPP
TITLE:-
SWAS SCHEMES
DEAERATOR O/L
DRG. NO.
PE-DG-412-145-I110
SHEET 12 OF 24
REV 06

PROCESS :

PARAMETER	OP/Design	ENGG UNIT
PRESS	0.1/FULL VACUUM & 2	Kg/cm2(a) & Kg/cm2(g)
TEMP	46.2/60	Deg C



REFERENCE P&ID :-
P&ID OF CONDENSATE SYSTEM
DRG NO. PE-DG-412-100-N106
ZONE - J3

SUITABLE ADOPTER SHALL BE PROVIDED ALONG WITH PROBE FOR TAPPING POINT SIZE= 1-1/4" NPT
LENTGH OF PROBE SHALL BE DECIDED CONSIDERING HOTWELL WALL THK + STUB HEIGHT + LENTGH OF ADOPTER.

FIELD

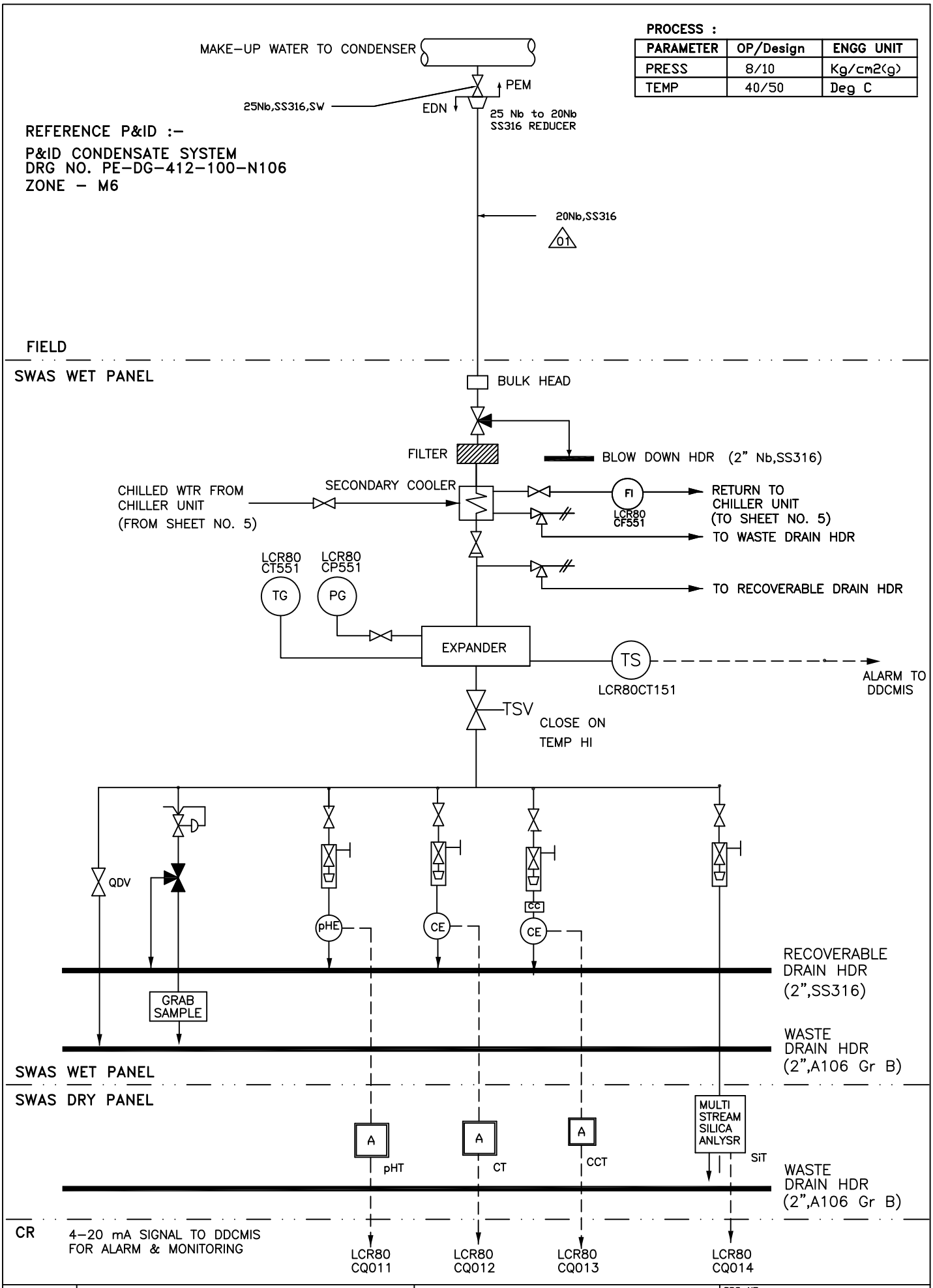
SWAS DRY PANEL

CR
4-20 mA SIGNAL
FOR ALARM &
MONITORING TO DDCMIS

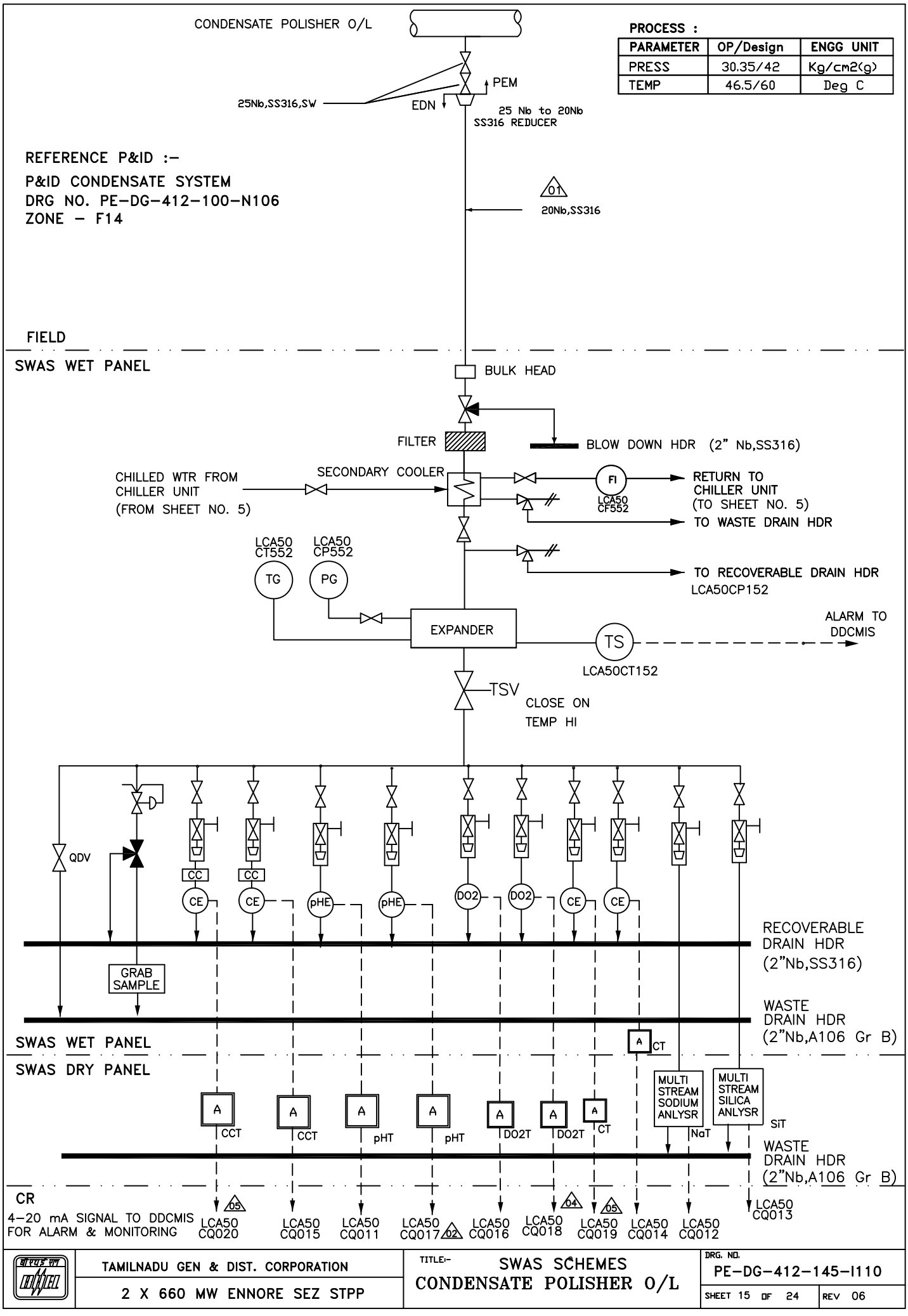
MAG10
CQ011

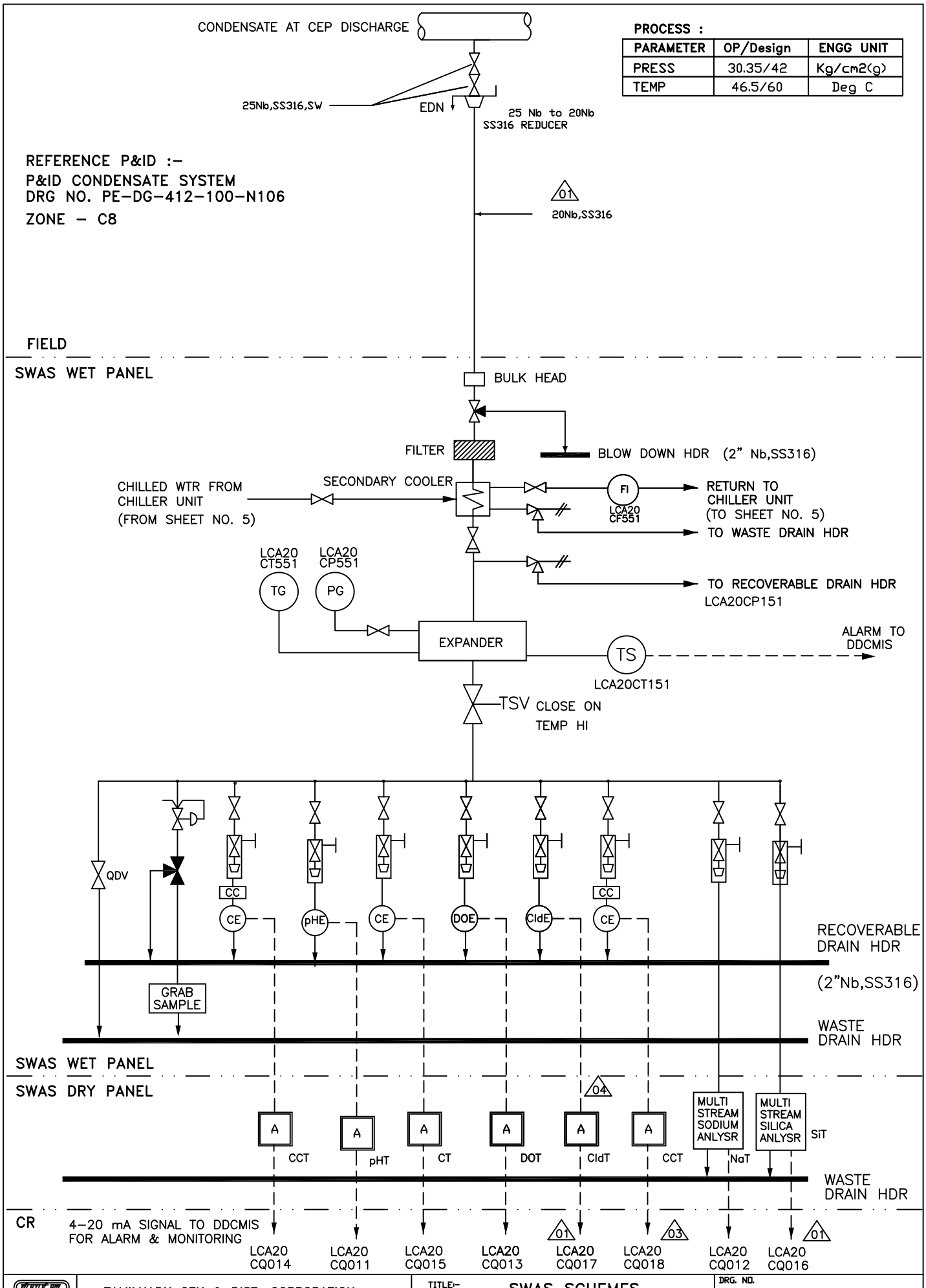
MAG10
CQ012

BHEL	TAMILNADU GEN & DIST. CORPORATION	TITLE:- SWAS SCHEMES	DRG. NO. PE-DG-412-145-I110
	2 X 660 MW ENNORE SEZ STPP	HOTWELL	SHEET 13 OF 24 REV 06



TAMILNADU GEN & DIST. CORPORATION	TITLE:- SWAS SCHEMES	DRG. NO. PE-DG-412-145-I110	
2 X 660 MW ENNORE SEZ STPP	MAKE-UP WTR TO CONDENSER	SHEET 14 OF 24	REV 06


CONDENSATE POLISHER O/L
PROCESS :
PARAMETER | OP/Design | ENGG UNIT
PRESS | 30.35/42 | Kg/cm2(g)
TEMP | 46.5/60 | Deg C
PEM
25Nb,SS316,SW
EDN
25 Nb to 20Nb SS316 REDUCER
REFERENCE P&ID :-
P&ID CONDENSATE SYSTEM
DRG NO. PE-DG-412-100-N106
ZONE - F14
01
20Nb,SS316
FIELD
SWAS WET PANEL
BULK HEAD
FILTER
BLOW DOWN HDR (2" Nb,SS316)
CHILLED WTR FROM CHILLER UNIT
(FROM SHEET NO. 5)
SECONDARY COOLER
FI
LCA50 CF552
RETURN TO CHILLER UNIT
(TO SHEET NO. 5)
TO WASTE DRAIN HDR
LCA50 CT552
LCA50 CP552
TG
PG
TO RECOVERABLE DRAIN HDR
LCA50CP152
EXPANDER
ALARM TO DDCMIS
TS
LCA50CT152
TSV
CLOSE ON TEMP HI
QDV
CC
CE
pHE
DO2
GRAB SAMPLE
RECOVERABLE DRAIN HDR (2"Nb,SS316)
WASTE DRAIN HDR (2"Nb,A106 Gr B)
SWAS WET PANEL
SWAS DRY PANEL
A
CT
CCT
pHT
DO2T
MULTI STREAM SODIUM ANLYSR
MULTI STREAM SILICA ANLYSR
NaT
SiT
WASTE DRAIN HDR (2"Nb,A106 Gr B)
CR
4-20 mA SIGNAL TO DDCMIS FOR ALARM & MONITORING
05
04
LCA50 CQ020
LCA50 CQ015
LCA50 CQ011
LCA50 CQ017
02
LCA50 CQ016
LCA50 CQ018
LCA50 CQ019
LCA50 CQ014
LCA50 CQ012
LCA50 CQ013
TAMILNADU GEN & DIST. CORPORATION
2 X 660 MW ENNORE SEZ STPP
TITLE:-
SWAS SCHEMES
CONDENSATE POLISHER O/L
DRG. NO.
PE-DG-412-145-I110
SHEET 15 OF 24
REV 06

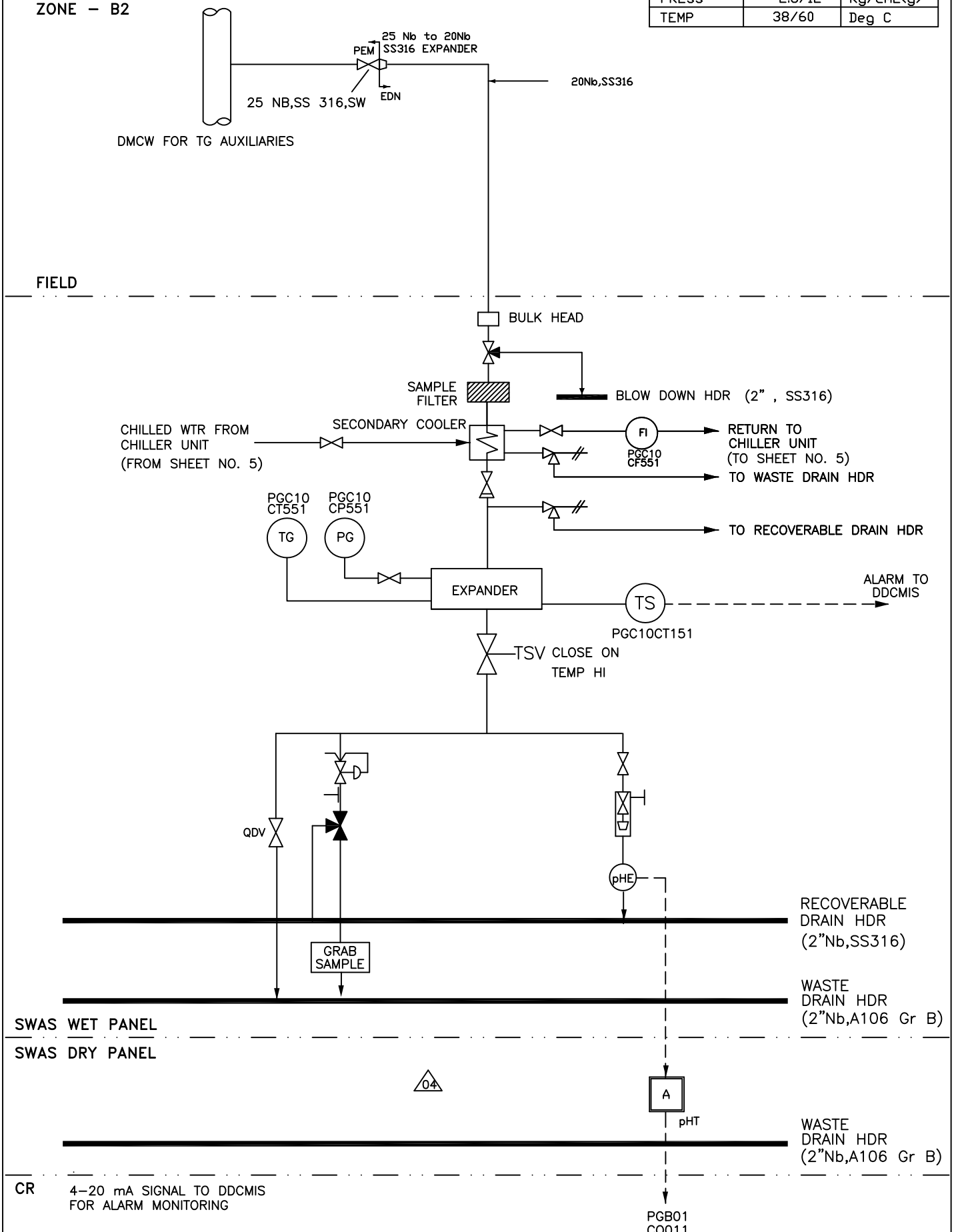


TAMILNADU GEN & DIST. CORPORATION	TITLE:- SWAS SCHEMES	DRG. NO.	PE-DG-412-145-I110
2 X 660 MW ENNORE SEZ STPP	CONDENSATE AT CEP DISCHARGE	SHEET 16 OF 24	REV 06

REFERENCE P&ID :-
P&ID DMCW SYSTEM
DRG NO. PE-DG-412-179-N001
ZONE - B2

PROCESS :

PARAMETER	OP/Design	ENGG UNIT
PRESS	2.6/12	Kg/cm2(g)
TEMP	38/60	Deg C

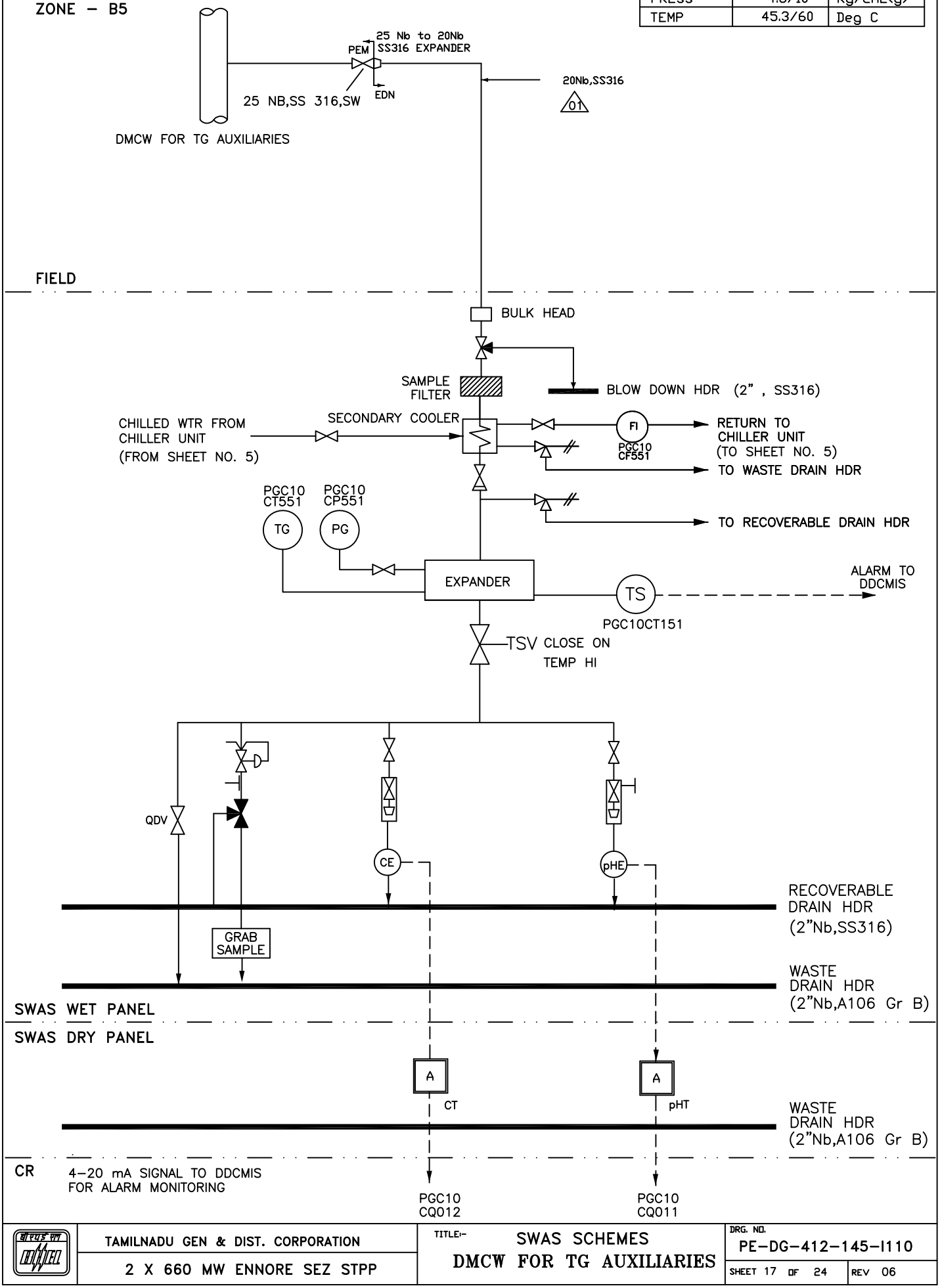


TAMILNADU GEN & DIST. CORPORATION	TITLE:- SWAS SCHEMES DMCW O/H TANK O/L	DRG. NO. PE-DG-412-145-I110	
2 X 660 MW ENNORE SEZ STPP		SHEET 16A OF 24	REV 06

REFERENCE P&ID :-
P&ID DMCW SYSTEM
DRG NO. PE-DG-412-179-N001
ZONE - B5

PROCESS :

PARAMETER	OP/Design	ENGG UNIT
PRESS	4.8/10	Kg/cm2(g)
TEMP	45.3/60	Deg C

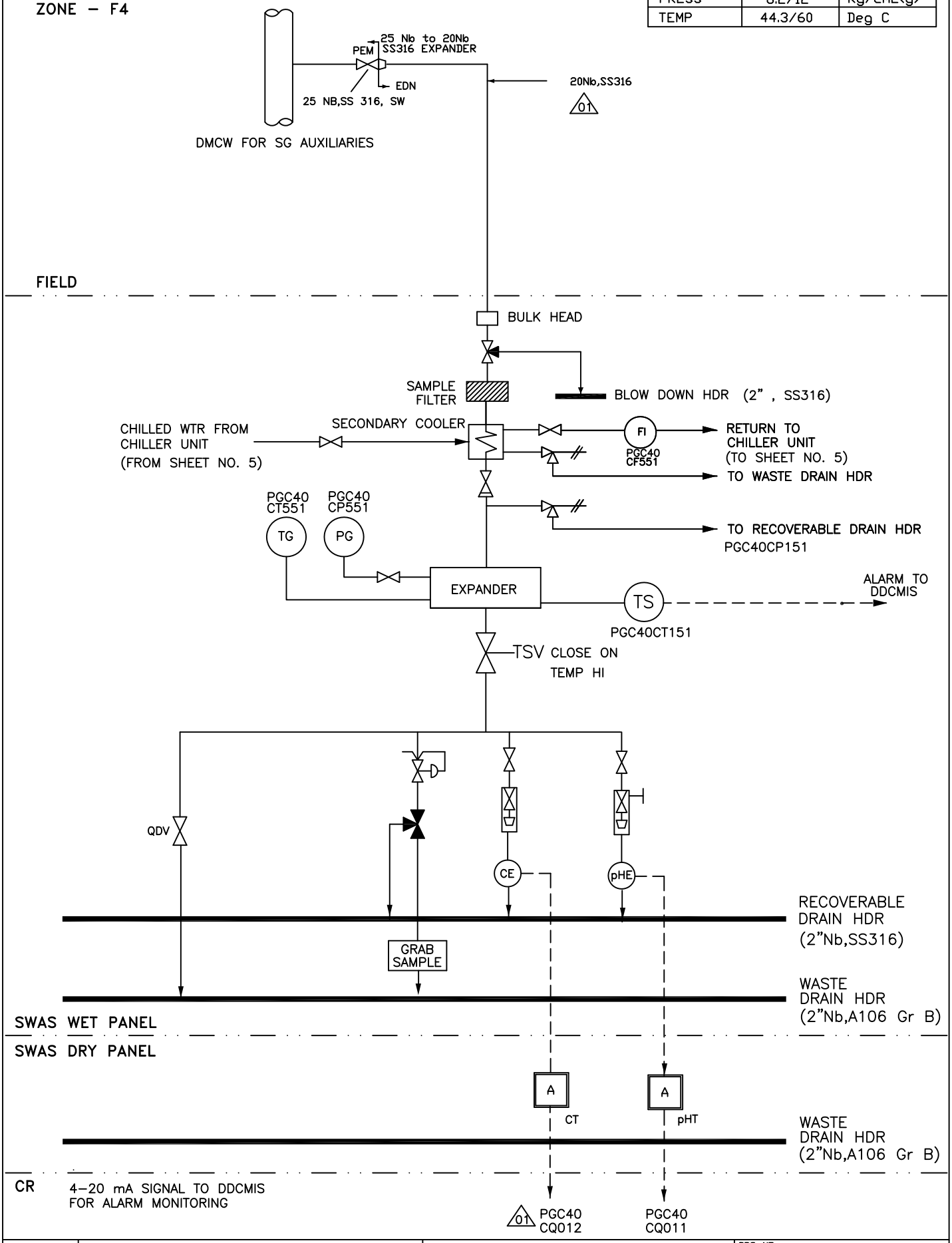


TAMILNADU GEN & DIST. CORPORATION	TITLE:- SWAS SCHEMES	DRG. NO.	PE-DG-412-145-I110
2 X 660 MW ENNORE SEZ STPP	DMCW FOR TG AUXILIARIES	SHEET 17 OF 24	REV 06

REFERENCE P&ID :-
DRG NO. PE-DG-412-179-N001
ZONE - F4

PROCESS :

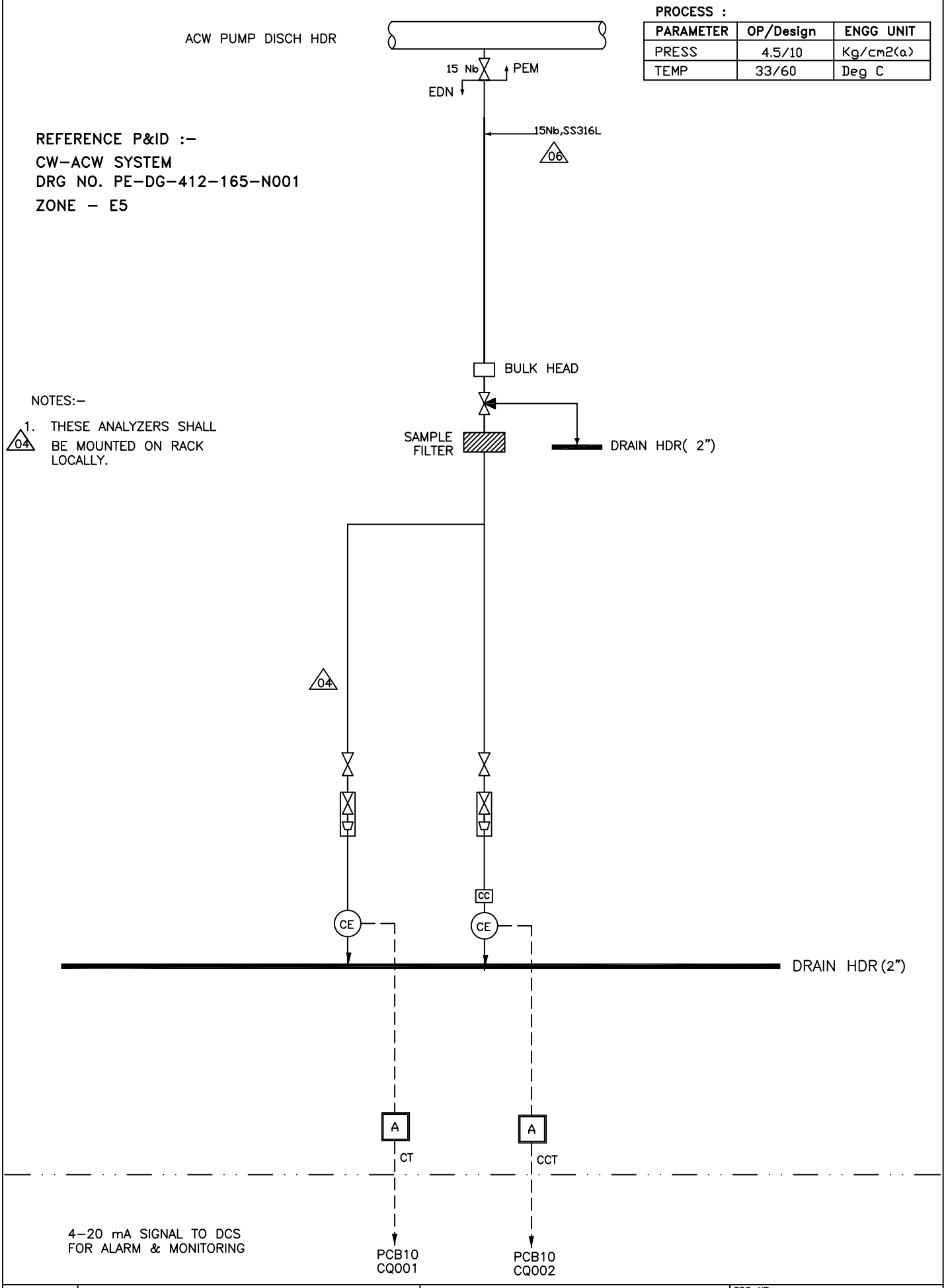
PARAMETER	OP/Design	ENGG UNIT
PRESS	6.2/12	Kg/cm2(g)
TEMP	44.3/60	Deg C



TAMILNADU GEN & DIST. CORPORATION	TITLE:- SWAS SCHEMES	DRG. NO. PE-DG-412-145-I110	
2 X 660 MW ENNORE SEZ STPP	DMCW FOR SG AUXILIARIES	SHEET 18 OF 24	REV 06

PROCESS :

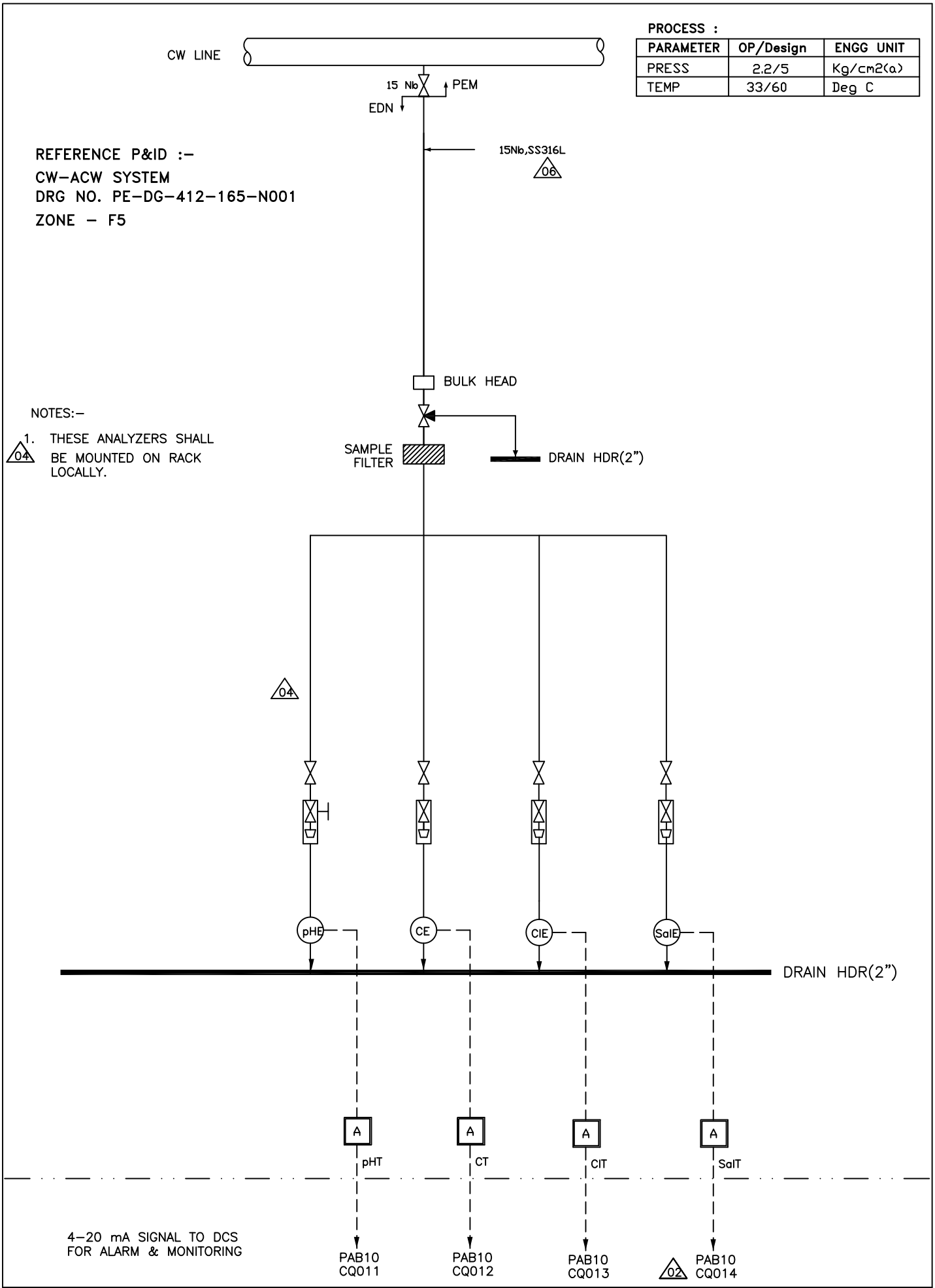
PARAMETER	OP/Design	ENGG UNIT
PRESS	4.5/10	Kg/cm2(a)
TEMP	33/60	Deg C



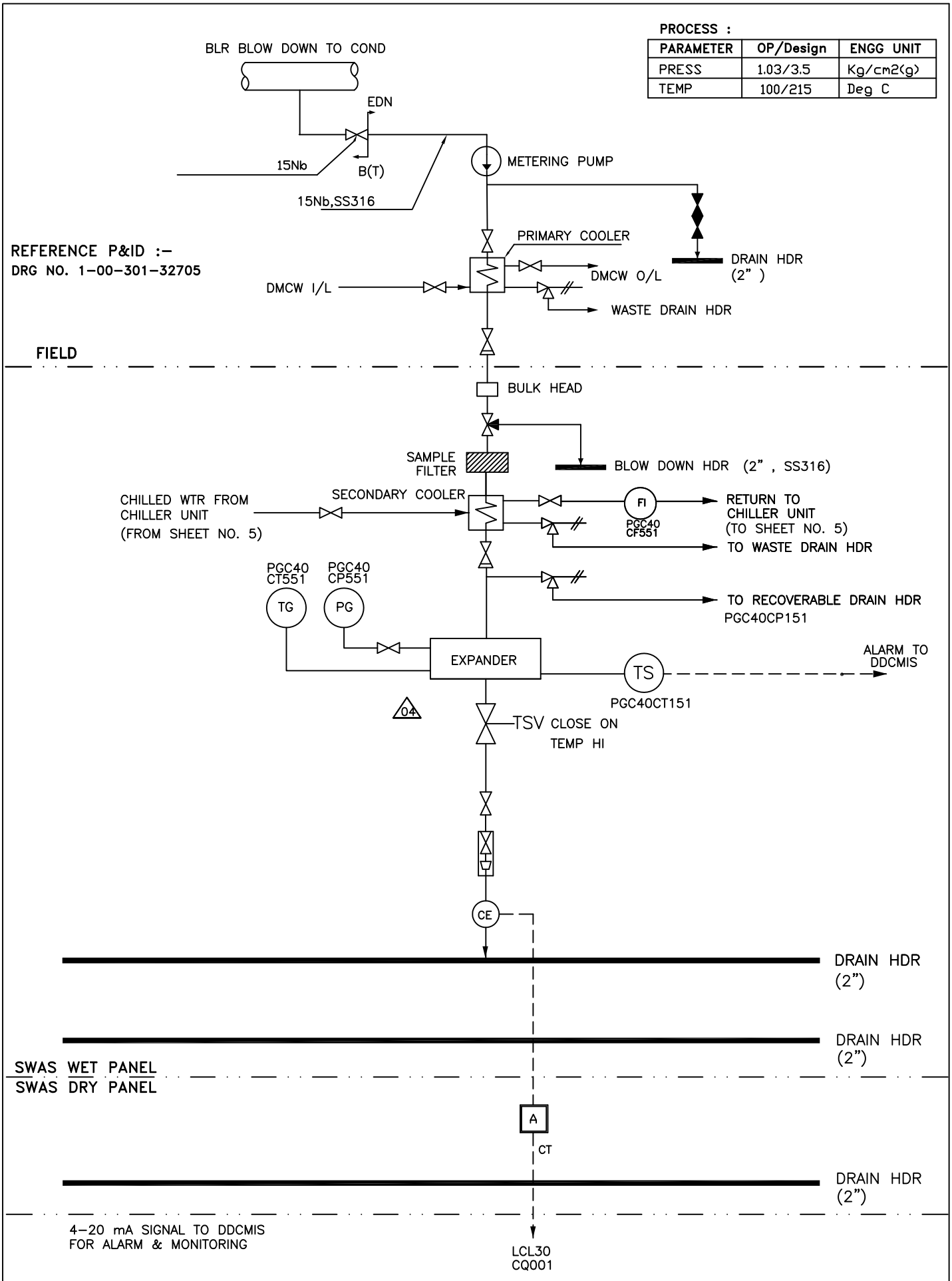
TAMILNADU GEN & DIST. CORPORATION	TITLE:- SWAS SCHEMES ACW PUMP DISCH	DRG. NO. PE-DG-412-145-I110	
2 X 660 MW ENNORE SEZ STPP		SHEET 19 OF 24	REV 06

PROCESS :

PARAMETER	OP/Design	ENGG UNIT
PRESS	2.2/5	Kg/cm2(a)
TEMP	33/60	Deg C



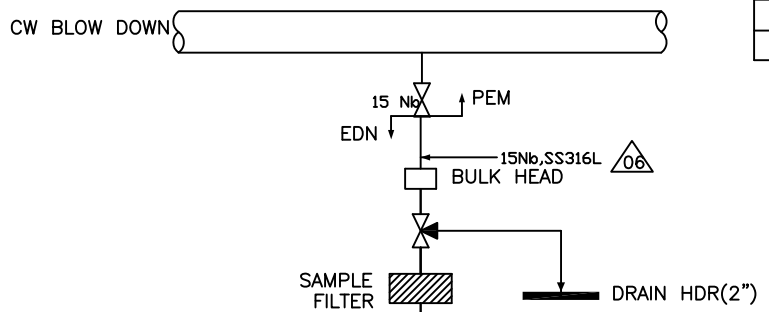
	TAMILNADU GEN & DIST. CORPORATION	TITLE:- SWAS SCHEMES CW PUMP DISCH	DRG. NO. PE-DG-412-145-I110
	2 X 660 MW ENNORE SEZ STPP		SHEET 20 OF 24 REV 06



TAMILNADU GEN & DIST. CORPORATION	TITLE:- SWAS SCHEMES	DRG. NO. PE-DG-412-145-I110	
2 X 660 MW ENNORE SEZ STPP	FTDT PUMP O/L	SHEET 21 OF 24	REV 06

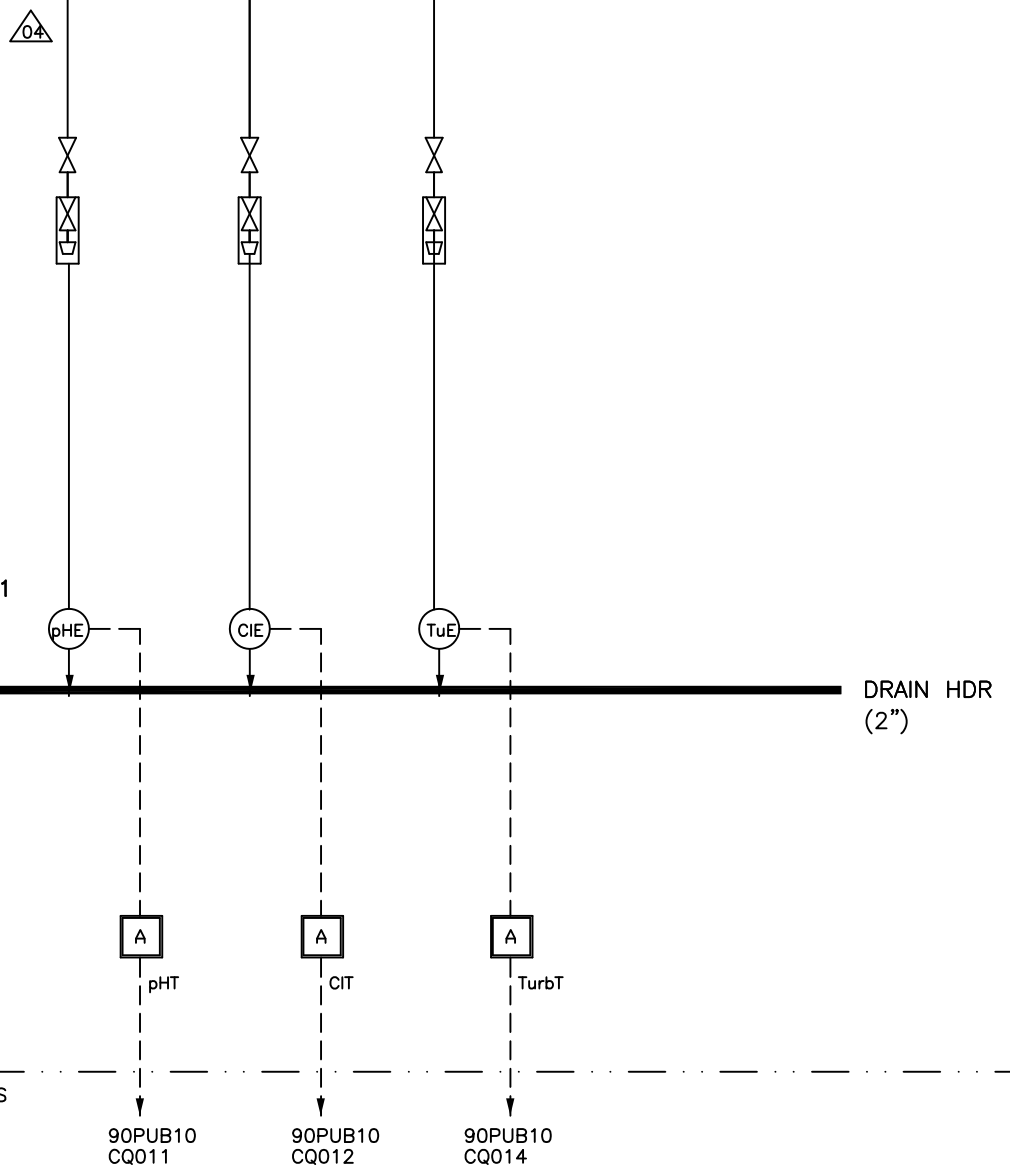
PROCESS :

PARAMETER	OP/Design	ENGG UNIT
PRESS	1.90/5.0	Kg/cm2(g)
TEMP	36/60	Deg C



NOTES:–

1. THESE ANALYZERS SHALL BE MOUNTED LOCALLY.

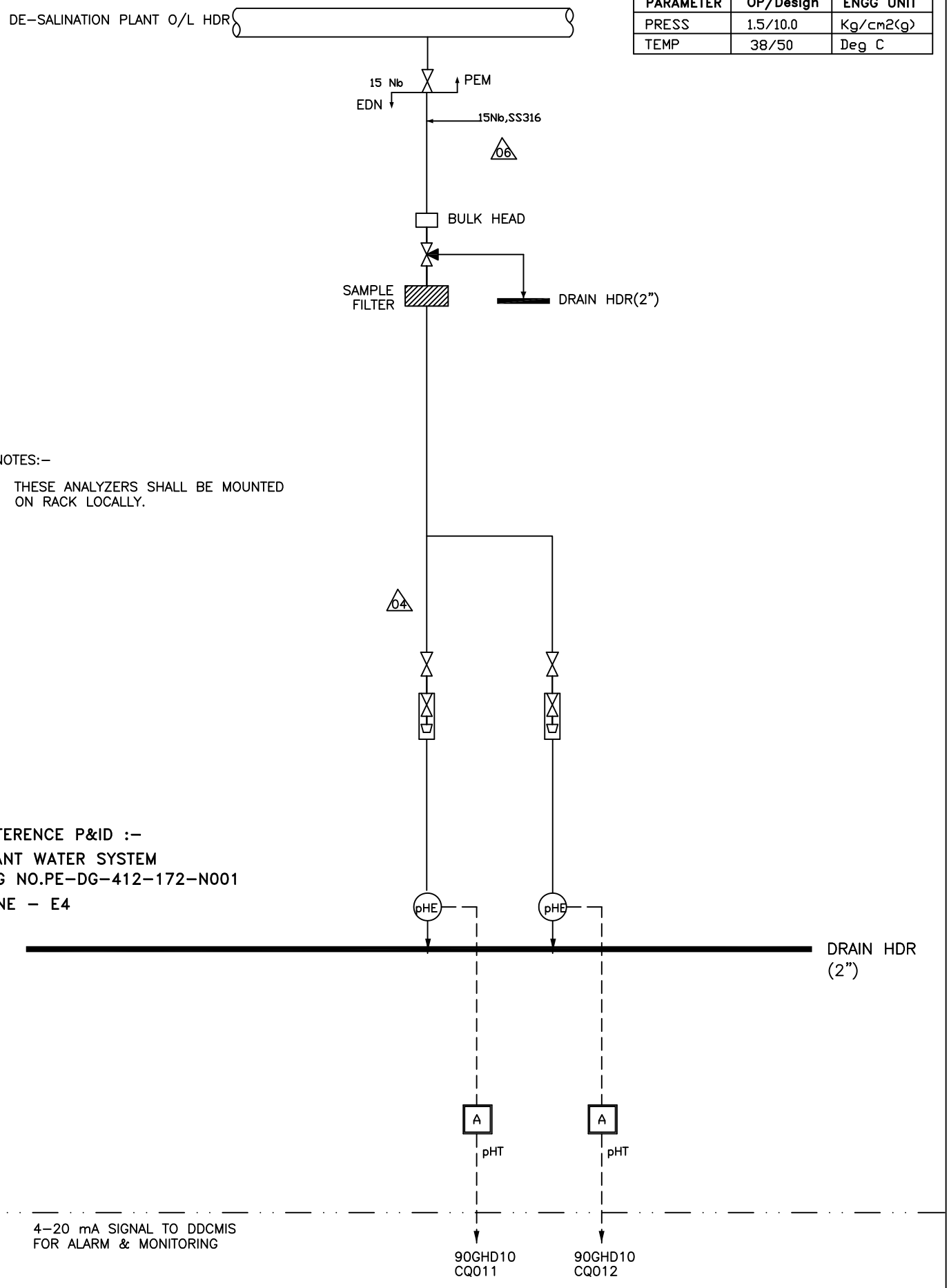


REFERENCE P&ID :–
CW–ACW SYSTEM
DRG NO.PE–DG–412–165–N001
ZONE – G5

	TAMILNADU GEN & DIST. CORPORATION	TITLE:– SWAS SCHEMES	DRG. NO. PE–DG–412–145–I110
	2 X 660 MW ENNORE SEZ STPP	CW BLOW DOWN	SHEET 22 OF 24 REV 06

PROCESS :

PARAMETER	OP/Design	ENGG UNIT
PRESS	1.5/10.0	Kg/cm2(g)
TEMP	38/50	Deg C



NOTES:-

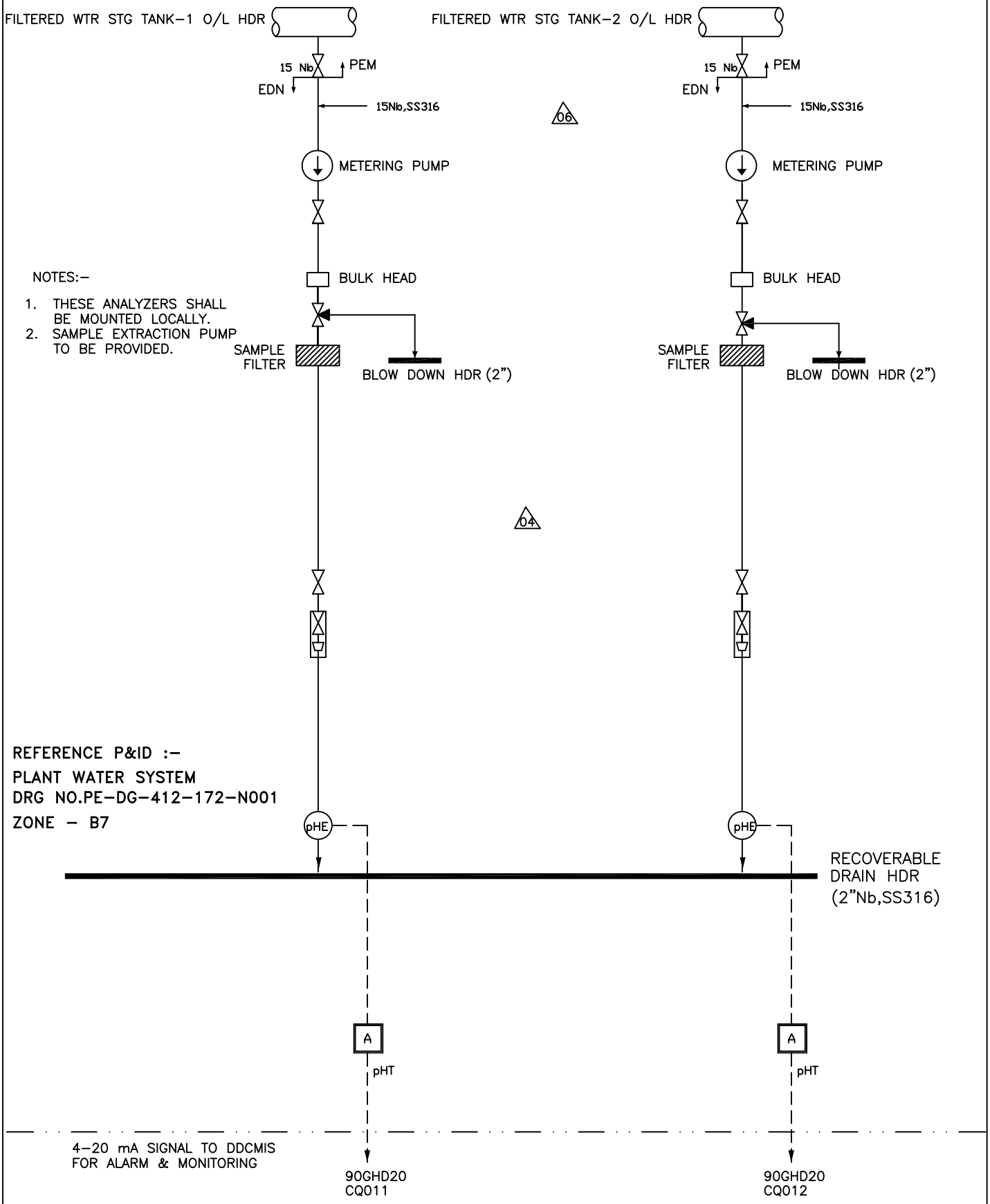
1. THESE ANALYZERS SHALL BE MOUNTED ON RACK LOCALLY.

REFERENCE P&ID :-
PLANT WATER SYSTEM
DRG NO.PE-DG-412-172-N001
ZONE - E4

TAMILNADU GEN & DIST. CORPORATION	TITLE:- SWAS SCHEMES	DRG. NO. PE-DG-412-145-I110	
2 X 660 MW ENNORE SEZ STPP	DE-SALINATION PLANT O/L HDR	SHEET 23 OF 24	REV 06

PROCESS :

PARAMETER	OP/Design	ENGG UNIT
PRESS	0.5/10.0	Kg/cm2(g)
TEMP	38/50	Deg C



BHEL	TAMILNADU GEN & DIST. CORPORATION	TITLE:- SWAS SCHEMES	DRG. NO. PE-DG-412-145-I110
	2 X 660 MW ENNORE SEZ STPP	FILTERED WATER STRG TANK O/L	SHEET 24 OF 24 REV 06

CHECK LIST FOR STAINLESS STEEL COMPRESSION FITTINGS
NUMBER :CE/416/SSF/CL REVISION : 00 DATE : 21-07-15
CONTRACTOR : M/s BHEL-EDN

SL NO.	TESTS/CHECKS	QUANTUM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS.	AGENCY**				REMARKS
				M	C	N	D*	
1	DIMENSIONS	REFER NOTE : 1		P	V	V		
2	MATERIAL	SAMPLE/	APPROVED SPECS./	P	V	V		
2.1	CHEMICAL	HEAT /	DATA SHEETS	P	V	V	✓	
2.2	PHYSICAL, HARDWARE	LOT						
3	PROOF PRESSURE TEST	5 RDM. SAMPLE		P	V	V	✓	
4	DISMANTLING RE-ASSEMBLY TEST	3 RDM. SAMPLE	MANUFACTURER'S STANDARD	P	V	V		
5	HYDRAULIC IMPULES & VIBRATION TEST	5 RDM. SAMPLE		P	V	V	✓	

LEGEND :
* RECORDS, IDENTIFIED WITH ' ' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.

** M: MANUFACTURER/SUB CONTRACTOR, C:CONTRACTOR/NOMINATED INSP.AGENCY
N: CUSTOMER "P" PERFORM "W" WITNESS "V" VERIFICATION

NOTE 1) QUANTUM OF CHECK SHALL BE AS BELOW :
100% - BY MANUFACTURER
NIL -BY M/s BHEL
NIL CUSTOMER

2) MANUFACTURER TO MAINTAIN CALIBRATED INSTRUMENT HAVING BETTER ACCURACY THAN THE ITEM UNDER TEST. INSPECTING ENGINEER SHALL CHECK THE SAME.

PREPARED BY
M/S BHEL

CHECK LIST FOR IMPULSE PIPES AND TUBES

NUMBER : CE/416/SP/CL REVISION : 00 DATE : 21-07-15

CONTRACTOR : M/S BHEL-EDN

SL NO.	TESTS/CHECKS	QUANTUM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS.	AGENCY**				REMARKS
				M	C	N	D*	
1	CHEEH FOR DIMENSION, GRADE, SURFACE-DEFECTS	SEE NOTE: BELOW	APPROVED DATA SHEET AND CORES SPONDING ASTM STDSFOR GRADE OF MATERIAL	P	V	V	√	
2	CHEMICAL PROPERTIES AND PHY. PROPERTIES AS PER RELEVANT ASTM. (GRADE SHALL BE AS PER APPROVED DATA SHEET)	FOR LOT		P	V	V	√	MANUFACTURER TO PROVIDE TEST CERT. AS PER RELEVANT ASTM STDS. MENTIONED IN SPECS.
3	FLATTENING TEST.		DO	P	V	V	√	
4	FLARING TEST	##		P	V	V	√	
5	BENDING TEST.	**		P	V	V	√	
6	HYDRAULIC TEST OR EDDY CURRENT TEST			P	V	V	√	
7	HARDNESS CHECK	##		P	V	V	√	

LEGEND :

* RECORDS, IDENTIFIED WITH ' √ ' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.

** M: MANUFACTURER/SUB CONTRACTOR, C:CONTRACTOR/NOMINATED INSP.AGENCY
N: CUSTOMER "P" PERFORM "W" WITNESS "V" VERIFICATION

NOTE : 1) QUANTUM OF CHECK SHALL BE AS BELOW :
100% - BY MANUFACTURER.
NIL -BY M/S BHEL
NIL - BY CUSTOMER

2) MANUFACTURER TO MAINTAIN CALIBRATED INSTRUMENT HAVING BETTER ACCURACY THAN THE ITEM UNDER TEST. INSPECTING ENGINEER SHALL CHECK THE SAME.
3) ## APPLICABLE FOR TUBES ONLY
4) ** APPLICABLE FOR CS PIPES ONLY.
5) WHEN MATERIAL CORRELATION IS NOT POSSIBLE , MATERIAL SAMPLES ARE TO BE TESTED AT THIRD PARTY LAB & TEST CERTIFICATES ARE TO BE SUBMITTED FOR NTPC REVIEW - CHP

PREPARED BY
M/S BHEL

CHECK LIST FOR FLOW SWITCH
NUMBER : CE/416/FS/CL REVISION : 00 DATE : 21-07-15
CONTRACTOR : M/s BHEL-EDN

SL NO.	TESTS/CHECKS	QUANTUM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS.	AGENCY**				REMARKS
				M	C	N	D*	
1.0	TYPE , MODEL , SL . NO . TAG NO. , RANGE.			P	V	V	✓	
2.0	SIZE , DIMENSIONS	REFER NOTE : 1 BELOW	AS PER APPROVED DATA SHEETS	P	V	V	✓	IN CASE OF IMPORTED ITEMS, CONTR. SHALL REVIEW TC's & NOT INSPECT.
3.0	REPEATABILITY			P	V	V	✓	
4.0	HV / IR	100%		P	V	V	✓	
5.0	CONTACT RATNG / NO. OF CONTACTS	RANDOM		P	V	V	✓	
6.0	MATL. T.C. FOR BODY, WET PARTS.	ONE/LOT		P	V	V	✓	
7.0	ACCESSORIES AS APPLICABLE	100%		P	V	V	✓	

LEGEND :
* RECORDS, IDENTIFIED WITH ✓ SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.

** M: MANUFACTURER/SUB CONTRACTOR, C:CONTRACTOR/NOMINATED INSP.AGENCY
N: CUSTOMER "P" PERFORM "W" WITNESS "V" VERIFICATION

NOTE : 1) QUANTUM OF CHECK SHALL BE AS BELOW :
100 % - BY MANUFACTURER.
NIL - BY CONTRACTOR.
NIL -BY M/S CUSTOMER.
2) MANUFACTURER TO MAINTAIN CALIBRATED INSTRUMENT HAVING BETTER ACCURACY THAN THE ITEM UNDER TEST.

PREPARED
M/S BHEL

CHECK LIST FOR TEMPERTURE SWITCH

NUMBER : CE/416/TS/CL REVISION : 00 DATE : 21-07-15

CONTRACTOR : M/s BHEL-EDN

SL NO.	TESTS/CHECKS	QUANTUM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS.	AGENCY**				REMARKS
				M	C	N	D*	
1.0	TYPE, MODEL, SL. NO., TAG NO., RANGE.			P	W	V	✓	
2.0	DIMENSIONS CHECK	REFER NOTE : 1 BELOW	APPROVED SPECS./ DATA SHEETS	P	W	V	✓	IN CASE OF IMPORTED ITEMS, CONTR.
3.0	REPEATABILITY			P	W	V	✓	SHALL REVIEW
4.0	SWITCHING DIFERENTIAL							TC's & NOT INSPECT.
5.0	CONTACT RATING / NO. OF CONTACTS	RANDOM		P	W	V	✓	
6.0	MATL. T.C. FOR BULB, CAPILLARY, ARMOUR	ONE/LOT		P	V	V	✓	
7.0	HV / IR	RANDOM		P	W	V	✓	
8.0	DEGREE OF PROTECTION	TYPE TEST		P	V	V	✓	
9.0	THERMOWELLS							
9.1	DIMENSIONS	100%		P	V	V	✓	
9.2	MATL. T.C. FOR THERMOWELL	ONE/LOT		P	V	V	✓	
9.3	HYD. TEST	100%		P	W	V	✓	
9.4	IBR CERT. IF APPLICABLE.			P	V	V	✓	

LEGEND :

* RECORDS, IDENTIFIED WITH ' ' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.

** M: MANUFACTUIRER/SUB CONTRACTOR, C:CONTRACTOR/NOMINATED INSP. AGENCY
N: CUSTOMER "P" PERFORM "W" WITNESS "V" VERIFICATION

NOTE : 1) QUANTUM OF CHECK SHALL BE AS BELOW :

100 % - BY MANUFACTURER.
NIL - BY CONTRACTOR.
NIL - BY M/s CUSTOMER.

2) MANUFACTURER TO MAINTAIN CALIBRATED INSTRUMENT HAVING BETTER ACCURACY THAN THE ITEM UNDER TEST. INSPECTING ENGINEER SHALL CHECK THE SAME.

PREPARED BY :
M/S BHEL

CHECK LIST FOR TEMPERATURE GAUGE / PAGE 1 OF 2

NUMBER : CE/416/TG/CL REVISION : 00 DATE : 21-07-15

CONTRACTOR : M/s B H E L - EDN

SL NO.	TESTS/CHECKS	QUANTUM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS.	AGENCY**				REMARKS
				M	C	N	D*	
1.0	CHECK FOR		APPROVED SPECS. /					
1.1	DIAL SIZE		APPROVED DATA	P	V	V	√	
1.2	MODEL NO/TAG NO		SHEETS	P	V	V	√	
1.3	RANGE/SCALE			P	V	V	√	
1.4	END CONNECTION	SEE		P	V	V	√	BY GO / NOGO
2.0	CALIBRATION	NOTE-1						GAUGE
2.1	ACCURACY	IN PAGE		P	V	V	√	
2.2	REPETABILITY	2 OF 2		P	V	V	√	
2.3	HYSTERISIS			P	V	V	√	MFR TO
3.0	OVER TEMEPRATURE TEST		DO	P	V	V	√	CARRY OUT ROUTINE
4.0	AMBIENT TEMP. COMPENSATION CHECK	1 OF TYPE		P	V	V	√	TEST ON 100 %
5.0	REVIEW OF T.C FOR MATERIALS OF-	FOR LOT						WHEN MAT'L CORELATION
5.1	SENSOR			V	V	V	√	ARE NOT
5.2	MOVEMENT			V	V	V	√	AVAILABLE
5.3	PROCESS CONNEC.			V	V	V	√	MFR'S
5.4	HOUSING			V	V	V	√	COMPLIANCE
6.0	REVIEW OF TC FOR DEGREE OF PROTEC.	TYPE TEST		V	V	V	√	TO BE PROVIDED
7.0	THERMOWELL							
7.1	HYD TEST ON THERMOWELL			P	V	V	√	IBR CERT. TO BE
7.2	MATERIAL T.C FOR THERMOWELL			V	V	V	√	PROVIDED IF CALLED IN
7.3	DIMENSIONAL CHECK		AS PER APPROVED DRAWING		V	V		SPECS.

LEGEND:

* RECORDS,IDENTIFIED WITH '√ ' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION

** M:MANUFACTURER/SUB CONTRACTOR,C:CONTRACTOR/NOMINATED INSP.AGENCY. N:CUSTOMER "P" PERFORM "W" WITNESS "V" VERIFICATION

CHECK LIST FOR TEMPERATURE GAUGE / PAGE 2 OF 2

NUMBER : CE/416/TG/CL REVISION : 00 DATE : 21-07-15

CONTRACTOR : M/s B H E L - EDN

NOTE : 1) QUANTUM OF CHECK SHALL BE AS BELOW :
100 % - BY MANUFACTURER.
NIL - BY M/s BHEL.
NIL - BY CUSTOMER

2) MANUFACTURER TO MAINTAIN CALIBRATED INSTRUMENT HAVING BETTER ACCURACY THAN THE ITEM UNDER TEST. INSPECTING ENGINEER SHALL CHECK THE SAME.

PREPARED BY :
M/S BHEL

CHECK LIST FOR PRESSURE & DIFFERENTIAL PRESSURE SWITCH

NUMBER : CE/416/PS/CL REVISION : 00 DATE : 21-07-15

CONTRACTOR : M/s B H E L - EDN

SL NO.	TESTS/CHECKS	QUANTUM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS.	AGENCY**				REMARKS
				M	C	N	D*	
1.0	CHECK FOR		APPROVED SPECS. /					
1.1	MODEL NO. TAG NO.		DATA SHEETS	P	V	V	√	
1.2	RANGE			P	V	V	√	
1.3	END CONNECTION			P	V	V	√	BY GO/ NO GO GAUGE
2.0	REPEATABILITY	SEE		P	V	V	√	
2.1	HYSTERISIS DIFFERENTIAL	NOTE-1 BELOW		P	V	V	√	
3.0	OVER PRESSURE AND LEAK TEST		DO	P	V	V	√	MFR. TO CARRY OUT
4.0	ELECTRICAL INSUL--ATION / H.V TEST							ROUTINE TEST ON
5.0	REVIEW OF T.C FOR MATERIALS OF-	FOR LOT		V	V	V	√	WHEN MAT'L CORELATION
5.1	SENSOR			V	V	V	√	ARE NOT
5.2	MOVEMENT			V	V	V	√	AVAILABLE
5.3	HOUSING			V	V	V	√	MFR'S
6.0	TC OF MICRO SWIT--CH			V	V	V	√	COMPLIANCE TO BE
7.0	REVIEW OF T.C FOR DEGREE OF PROTEC--TION.	TYPE TEST		V	V	V	√	PROVIDED.

LEGEND:

* RECORDS,IDENTIFIED WITH ' √ ' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION

** M:MANUFACTURER/SUB CONTRACTOR,C:CONTRACTOR/NOMINATED INSP.AGENCY. N:CUSTOMER "P" PERFORM "W" WITNESS "V" VERIFICATION

NOTE : 1) QUANTUM OF CHECK SHALL BE AS BELOW : 100 % - BY MANUFACTURER
NIL - BY CONTRACTOR.
NIL - BY M/s CUSTOMER

2) MANUFACTURER TO MAINTAIN CALIBRATED INSTRUMENT HAVING BETTER ACCURACY THAN THE ITEM UNDER TEST. INSPECTING ENGINEER SHALL CHECK THE SAME.

3) IN CASE OF IMPORTED PRESSURE SWITCHES DP SWITCHES BHEL SHALL REVIEW TC AND SHALL NOT INSPECT.

PREPARED BY :

M/S BHEL

CHECK LIST FOR PRESSURE GAUGE & DIFFERENTIAL PRESSURE GAUGE

NUMBER : CE/416/PG/CL REVISION : 00 DATE : 21-07-15

CONTRACTOR : M/S B H E L - EDN

SL NO.	TESTS/CHECKS	QUANTUM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS.	AGENCY**				REMARKS
				M	C	N	D*	
1.0	CHECK FOR		APPROVED SPECS. /					
1.1	DIAL SIZE		DATA SHEETS	P	V	V	√	
1.2	MODEL NO/TAG NO			P	V	V	√	
1.3	RANGE/SCALE			P	V	V	√	
1.4	END CONNECTION	SEE		P	V	V	√	
2.0	CALIBRATION	NOTE-1						
2.1	ACCURACY	BELOW		P	V	V	√	
2.2	REPETABILITY			P	V	V	√	
2.3	HYSTERISIS			P	V	V	√	MFR TO
3.0	OVER PRESSURE AND LEAK TEST		DO	P	V	V	√	CARRY OUT ROUTINE
4.0	OPERATION OF PR. RELIEF DEVICE.	# ONE		P	V	V	√	TEST ON 100 % .
5.0	REVIEW OF T.C FOR MATERIALS OF-	FOR LOT		V	V	V	√	WHEN MAT'L CORELATION
5.1	SENSOR			V	V	V	√	ARE NOT
5.2	MOVEMENT			V	V	V	√	AVAILABLE
5.3	PROCESS CONNEC.			V	V	V	√	MFR'S
5.4	HOUSING			V	V	V	√	COMPLIANCE
6.0	REVIEW OF TC FOR DEGREE OF PROTEC.	TYPE TEST		V	V	V	√	TO BE PROVIDED
7.0	ACCESSORIES, AS APPLICABLE	SEE NOTE-1		V	V	V	√	

LEGEND:

* RECORDS,IDENTIFIED WITH ' √ ' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION

** M:MANUFACTURER/SUB CONTRACTOR,C:CONTRACTOR/NOMINATED INSP.AGENCY. N:CUSTOMER "P" PERFORM "W" WITNESS "V" VERIFICATION

NOTE : 1) QUANTUM OF CHECK SHALL BE AS BELOW :
100 % - BY MANUFACTURER.
NIL - BY M/s BHEL.
NIL - BY M/s CUSTOMER
2) MANUFACTURER TO MAINTAIN CALIBRATED INSTRUMENT HAVING BETTER ACCURACY THAN THE ITEM UNDER TEST. INSPECTING ENGINEER SHALL CHECK THE SAME.
3) # ONE FOR PR. GAUGE AND ONE FOR DP GAUGE.

PREPARED BY :
M/S BHEL

PROJECT :- ENNORE 2X660 MW

CUSTOMER :- TANGEDCO

CONSULTANT :- DESEIN

SECTION G

APPROVED VENDOR LIST

C O P

REVISIONS :

APPROVED

(Punit P Singh)

PREPARED	ISSUED	DATE
PRK	416	23-01-2018

PRESSURE GAUGES:

A.N.INSTRUMENTS PVT LTD,CHENNAI
GOA THERMOSTATIC INSTRUMENTS,GOA
H.GURU INSTRUMENTS(SOUTH INDIA)PVT LTD,BANGALORE
MANOMETER (INDIA) PVT. LTD,MUMBAI
FORBES MARSHALL(HYD) LTD,HYDERABAD
PRECISION MASS PRODUCTS PVT. LTD,GANDHI NAGAR,GUJARAT.
WIKA INSTRUMENTS INDIA PVT. LTD,PUNE
GAUGES BOURDON (INDIA) PVT. LTD, MUMBAI.
BAUMER TECHNOLOGIES INDIA LTD,MUMBAI/VAPI

TEMPERATURE GAUGES:

A.N.INSTRUMENTS PVT LTD,CHENNAI
GAUGES BOURDON (INDIA) PVT. LTD,MUMBAI.
GOA THERMOSTATIC INSTRUMENTS,GOA
H.GURU INSTRUMENTS(SOUTH INDIA)PVT,BANGALORE
FORBES MARSHALL(HYD) LTD, HYDERABAD
PRECISION MASS PRODUCTS PVT. LTD,GANDHI NAGAR
WIKA INSTRUMENTS INDIA PVT. LTD,PUNE
GOA INSTRUMENTS INDUSTRIES PRIVATE LTD,GOA.
BAUMER TECHNOLOGIES INDIA LTD,MUMBAI/VAPI

PRESSURE SWITCH / TEMPERATURE SWITCH:

PRECISION MASS PRODUCTS PVT. LTD,GANDHI NAGAR,GUJARAT.
INDFOS INDUSTRIES LTD CHENNAI
SWITZER PROCESS INSTRUMENTS PVT. LTD,CHENNAI.
TRAFAG CONTROLS INDIA PVT. LTD,GURGOAN,HARYANA.
GAUGES BOURDON (INDIA) PVT. LTD,MUMBAI.
BAUMER TECHNOLOGIES INDIA LTD,MUMBAI/VAPI

TERMINAL: Wago Noida, Phoenix Noida,

Flow Indicators / Rotameters: Eureka, KROHNE MARSHALL,

Complete piping, tubing, fittings, valves, blow down valves, sample relief valves, shell relief valves, filters and other wetted parts in the sampling and analyzing system:

SWAGELOCK,USA
Dr Thiedig, Germany
PARKER HANNIFIN INDIA PVT. LTD.,CHENGAL PATTU,TAMILANADU

PRV, Back pressure regulator, thermal shutoff valve etc:

Sentry,USA
Dr Thiedig, Germany
Lowe UK

Primary and Secondary Sample coolers: with IBR, U Stamp, TUV/Lloyd certification.

Forbes Marshall, Pune
Steam Equipment (Panflow, USA)
Lowe UK
Sentry, USA
Dr Thiedig, Germany

Annunciator:- Procon, Hathway, Ronan

Furniture:- M/s. Pyrotech, M/s. Harmony, M/s. Godrej and M/s. Featherlite.

pH Analyser:

Teledyne LXT300 USA
SWAN Analytical Instruments Switzerland
Emerson process Management USA
Thermo Orion USA
Hach USA/Switzerland

Conductivity Analyser:

Hach USA/Switzerland
Teledyne LXT300 USA
Emerson process Management USA
Thermo Orion USA
SWAN Analytical Instruments Switzerland

Chloride Analyser:

Thermo Orion USA
ABB UK

Dissolved Oxygen Analyser:

Thermo Orion USA
Teledyne LXT300 USA

SWAN Analytical Instruments Switzerland
Hach USA/Switzerland (Polymetron Brand)

Hydrazine Analyser:

Hach USA/Switzerland (Polymetron Brand)
SWAN Analytical Instruments Switzerland
Thermo Orion USA

Phosphate, Silica, Sodium Analysers:

Hach USA/Switzerland (Polymetron Brand)
SWAN Analytical Instruments Switzerland
Thermo Orion USA

Turbidity Analyser:

Teledyne LXT300 USA
Emerson process Management USA
Hach USA
SWAN Analytical Instruments Switzerland

Residual Chlorine Analyser:

Teledyne LXT300 USA
Emerson process Management USA
SWAN Analytical Instruments Switzerland

Ammonia Analyser:

Hach USA
Thermo Orion USA
ABB UK

Salinity Analyser:

Hach USA
Thermo Orion USA

Note:-
1. Vendors to note that components of Sample Handling System and Analysers, above indicated vendors only will be acceptable.

SECTION - "H"

- Analysers & Spares shall be packed project wise in lockable Metal Container suitable for outside storage at project sites. Typical requirements are as below:-

  - Type: Standard Outdoor type MS container, fully closed.
  - Dimension: Vendor to decide based on Qty of Analysers & Spares.

General condition:

1) The container shall be suitable to store imported and sophisticated components in open environment at thermal power plants. It shall be leak proof.
2) Container shall be provided with proper glass wool thermal insulation at inside.
3) Wall thickness (all sides), reinforcement, supporting lugs, lifting lugs, etc., shall be suitable to store and transport the container with the permissible load as required.
4) Doors shall have suitable latches to lock the container with pad locks for safety purpose.
5) Interior and external surface shall be completely painted as per the standard practice and it shall be Suitable for sea-shore atmosphere.
6) Containers shall be provided with Tag Plates with Project Name.

Important Note: Mandatory Spares shall be sent in pre-decided lots in containers / secure boxes distinctly marked in Red colour with boldly written "S" mark on each face of the containers /secure boxes.

A4 - 15	**PLANT STANDARD**	ED 049 00 99 REV NO 10 PAGE 0 OF 28

REVISION HISTORY SHEET

REV NO.	DATE	NATURE OF CHANGE	REASONS	CHANGED BY	APPROVED BY
00	06/03/92	SUPERCEDS CN43000	-	VS MAS SHG	N.J
01	19/06/93	GENERAL	FEEDBACK FROM QUALITY	SHG	N.J
02	24/06/93	CL 3.4.10	FEEDBACK FROM QUALITY	SHG	N.J
03	01/07/93	SEMICONDUCTOR & PHTOVOLTAIC PANELS ADDED	FEEDBACK FROM DESPATCH	SHG	N.J
04	17/10/94	TOTALLY REVISED	FEEDBACK FROM QUALITY	SHG	N.J
05	08/06/95	ANNEXURE ADDED	FEEDBACK FROM QUALITY & ACCEPTANCE CRITERIA OF WOOD ADDED	SHG	N.J
06	17/11/95	CL 2.5.10 ALTERED	FEEDBACK FROM QUALITY & SHIPPING	SHG	N.J
07	05/03/97	UNDER CL 3.0 & 3.9.1 RPP ADDED ACCEPTANCE CRITERIA REMOVED	FEEDBACK FROM SHIPPING & QC	SHG	N.S
08	29/08/2001	CL 2.2.8 & 4.1 CHANGED	FEEDBACK FROM SHIPPING & QC	SHG	NS
09	15.12.2009	INCLUSION OF PINE WOOD AND SOME CLAUSES HAVE AMENDED	FEEDBACK FROM SHIPPING	PGD / KPN	MSS
10	21.06.2013	Inclusion of recommendations pertaining to spares in page-11&28	Recommendations from Corporate systems & IT	HRN	MSS

REV-10.

APPROVED: M. Sivaramaiah

PREPARED: HRN

ISSUED: STDS GROUP DATE: 21/06/13

PROCEDURE FOR PACKING OF CONTROL EQUIPMENTS PRODUCTS USING RUBBER WOOD, SILVER OAK WOOD, PINE WOOD AND CARTONS

1.0 SCOPE: This standard covers the guidelines for packing of Control Equipments, semiconductor devices and Photo voltaic panels/cells.

2.0 MATERIALS:

2.1 WOOD:

2.1.1 **INLAND:** The wood shall be Rubber wood (Havea Brasiliensis) for packing of cubicles, loose items, spares and photovoltaic items meant for customers in India.

2.1.2 **EXPORT:** Silver Oak (Grevillea Robusta) / Pine wood shall be used for packing of cubicles and loose items meant for export.

2.2 DIMENSIONS:

2.2.1 Thickness of planks for Front, rear, top and bottom sides and binding, jointing battens shall be 25 +2/-3 mm.

2.2.2 Width of all planks including the tongue shall be more than 125 mm after planing, except to adjust total height of item to be packed.

2.2.3 Minimum number of planks shall be used for a shook.

2.2.4 In any case, only one plank can be of width less than 125 mm, but greater than 100 mm.

2.2.5 Horizontal, vertical, diagonal planks shall be given for binding (number of such planks depend on the dimension of panel, as given in Figure-2).

2.2.6 External sides of front and rear planks to be planed to facilitate writing of address and other markings.

2.2.7 Width of binding planks shall be minimum 100 mm.

2.2.8 Distance between any 2 binding planks shall be less than 750 mm. As shown in Fig-3, diagonal planks shall be used in between vertical binding planks when distance between inner to inner of vertical planks is more than 750 mm

2.2.9 Distance of the outer edges of these planks from the edge of case shall be less than 250 mm.

2.2.10 Diagonal planks are not required for top planks and width side also, if the width of pallet is less than 750 mm.

2.2.11 **Jointing of planks:** Single length planks shall be used for cubicles whose overall length is less than 2400 mm. For cubicles of length more than 2400 mm, jointing is permitted. The jointing shall be done with one single or maximum of 2 planks of wood same as other planks of width 250 mm (minimum) with two rows of nails on either side of the joint in zigzag manner. From the joint along height side it shall be of lap joint with over lap of at least the width of plank.

2.2.12 **Tongue and Groove joints:** Two Consecutive planks shall be joined by tongue and groove joint. Depth of tongue shall be 12$\pm$1 mm, thickness of tongue shall be 8 $\pm$1 mm. The groove dimensions shall be such that the tongue fits tightly into the groove to make a good joint.

2.3 **PERMISSIBLE DEFECTS: -** Wood shall be free from knots, bows, visible sign of infection and any kind of decay caused by insects, fungus, etc.

End splits: Longest end splits at each end shall be measured and lengths added together. The added length shall not exceed 60 mm per meter run of shook's. Wood pins shall be used to prevent further development of split.

Surface cracks: Surface cracks with a maximum depth of 3 mm are permissible. A continuous crack of any depth all along the length is not allowed.

2.4 .0 CHEMICAL TREATMENTS FOR PRESERVATION OF WOOD:-

2.4.1 This treatment provides protection to the packing wood against deterioration due to fungi and attack by termites, borers and marine organism and any kind of infections.

2.4.2 The wooden planks, after making tongues / grooves shall be treated with chemicals. For pine wood, treatment with ASCU/ CCA solution need not be done.

2.4.3 The chemical used shall be ready mix ASCU paste. This consists of Arsenic pent oxide, copper sulphate sodium dichromate. This Paste shall be mixed at the rate of 1 kg of paste per 10 liters of water to the extent of water used. Alternate this CCA paste as mentioned at Para 2.4.5 can also be used.

2.4.4 The chemical treatment shall be done at the premises of the contractor. A cement concrete tank of capacity to hold a minimum of 2000 liters of solution shall be constructed. The solution

shall be prepared in the presence of BHEL- EDN's Representative by contractor. The wooden planks shall be soaked in the solution for a minimum of 12 hours. The solution shall be replenished after treating a maximum of 12 cubic meters of wood. A log book shall be maintained by the contractor to give the details of date of preparation of solution, quantity of solution prepared, quantity of chemicals used, Quantity of wood treated and the details of replenishment. Samples of solutions before mixing will be got tested at the laboratories designated by BHEL. The testing fees to be paid to the laboratories will have to be borne by the contractor. The paste shall be tested as and when required.

2.4.5 Specifications for water soluble type wood preservatives: Copper – Chromium – Arsenic [CCA]:

Copper – Chromium – Arsenic preservative formulation shall be as per IS : 10013 Part – II – 1981 shall consist of following active ingredients in nominal proportions by weight as shown below:

Arsenic Pent oxide	$AS_2O_52H_2O$	12.5
Copper Sulphate	$CuSO_45H_2O$	37.5
Sodium Dichromate	$Na2Cr_2O_75H_2O$	50.0
Or		
Potassium Dichromate	$K2Cr_2O_7$	

2.5 **OTHER MATERIALS**:

2.5.1 NAILS: The dia. of the nails shall be 3.15 mm. The length of the nails shall be 65 mm wherever two planks of 25 mm thickness are joined and 75 mm wherever a 25 mm planks is joined to a 50 mm plank.

2.5.2 BLUE NAILS: These are used for nailing bituminized Kraft paper/hessian cloth to the planks. The length of the nails shall be 16 mm.

2.5.3 HOOP IRON STRIPS: These are used for strapping the boxes. The width of the strips shall be 19$\pm$1 mm and thickness 0.6 $\pm$0.01 mm. The material shall be free from rust.

2.5.4 CLIPS: These shall be used for strapping the hoop iron strips on the boxes.

2.5.5 BRACKETS: These brackets are used for nailing to the corners of cubicle boxes. The brackets shall be of mild steel of thickness 2 $\pm$1 mm and width 25$\pm$1 mm. The brackets shall be of "L" shape, the length of each side being 100$\pm$2 mm. Two holes shall be provided towards the end of each side for screwing /nailing.

2.5.6 FASTENERS: Bolts, double nuts, spring washers will have to be used for packing of some special items like transformers, reactors, breakers, etc., to hold the job to the bottom plank of the box. The bolts, nuts, washers will be provided by BHEL. However, drilling of holes will have to be done using contractor's tools.

2.5.7 POLYETHYLENE SHEET: The polyethylene sheets are used to make covers to the jobs individually. The material shall have a thickness of 0.175 mm (175 microns). The polyethylene sheet shall be clear and transparent.

2.5.8 BITUMINISED WATER PROOF KRAFT PAPER: This is used for lining the inside of shoots of cubicles.

2.5.9 BITUMEN COATED HESSIAN POLYETHYLENE KRAFT PAPER: This is used for lining the inside of top planks of cubicles and for lining of all inner sides of boxes.

2.5.10 RUBBERISED COIR: The rubberized coir is used as cushioning material .For the packing of loose items, items are to be arrested by using rubberized coir. For the packing of cubicles rubberized coir of thickness 25mm and width 75mm shall be used.

2.5.11 FOAM RUBBER / 'U' FOAM: This is used for covering the delicate items. This material is normally provided by BHEL.

2.5.12 THERMOCOL (EXPANDED POLYSTYERENE) SHEETS): This is used for covering delicate items. This material is normally provided by BHEL.

2.5.13 MARKING PLATE: This shall be of anodized aluminum sheet. Details and specifications are given in Fig-5.

2.5.14 PACKING SLIP HOLDER: This shall be of galvanized iron /tinned

2.5.15 SILICA GEL: This shall be of indicating type.

2.5.16 COTTON BAGS: These are used for holding silica gel. The bags shall have the following matter indicated them:

BHEL-EDN, BANGALORE - 5 60 026
SILICA GEL INDICATING TYPE
BLUE : ACTIVE
ROSE : REDUCED ACTIVITY
WHITE : NO ACTIVITY. TO BE REPLACED WITH FRESH SILICA GEL

2.5.17 COTTON/ PLASTIC TAPE: This is used for tying small items .And also to prevent vibrations of moving parts within the cubicles.

2.5.18 MARKING INK: The ink used normally is black in color. In some special cases other color also will have to be used. The ink shall be non-fading/indelible and non-washable by water.

2.5.19 POLYETHYLENE BAGS: These are to be used for keeping the, Packing slips. The bag shall be of size 70 mm X 100 mm (minimum).

2.5.20 Hessian cloth, twine thread, paint will have to be used in packing certain items.

2.5.21 Mechanical Lat ching clam ps: For CLW Ra ilway pan els an d similar Panels self locki ng clamps can also b e used on need basis in conjunction with or apart from regular bolt and nut fixing arrangement. [Refer Draw ing Fig-7]. For reusable boxes, t hese cl amps pro vide easy locking and unlocking arrangement. These clamps will be made available from BHEL in some cases.

3. 0 *PACKING* SPECIFICATIONS: Different types of packing are used as follows:

1) Packing of cubicles with rubber wood.
2) Packing of cubicles with Silver Oak wood / Pine wood
3) Packing of empty cubicles with rubber wood.
4) Packing of loose items/spares with rubber wood.
5) Packing of loose items /spares with Silver Oak wood.
6) Packing of Photo-voltaic items with rubber wood.
7) Packing using bitumen coated hessian polyethylene Kraft papers.
8) Supply of rubber wood pallets for empty cubicles.
9) Packing of semiconductor panels.
10) Packing of material covered under category of RPP (Registered Postal Parcel)
11] Packing of materials using PVC [sunspace] / corrugated Kraft paper cartons.
12] Packing of materials using heavy duty cartons

3.1 PACKING OF CUBICLES WITH RUBBER WOOD:

3.1.1 The packing is to be done as per clause 2.O in all respects.

3.1.2 The cubi cles are al ready fi xed on wo oden pall ets. Hence t he c ontractor need n ot arrange the bottom pallets normally.

3.1.3 The cubi cles wil l be of di fferent sizes bo th wi dthwise and l engthwise. Th e cubi cles m ay b e made up o f sin gle sui te, 2 Suite, 3 Suite, 4 Suite, etc., The w idth of the cubicles generally varies from 400 mm to 1650mm.The length o f the cubicle, generally varies from 1500 mm to 4800 mm. The height is normally 2430 mm. In some cases the height may be less/more.

3.1.4 BITUMINISED WATER PROOF KRAFT PAPER: The inner surface of 4 sides of shook's shall be nailed with Bituminized water proof Kraft paper (as per 2.5.8) using blue nails (as per 2.5.2)wherever 2 pieces of Kraft paper are used, the joint shall have an overlap of minimum 20 mm.

3.1.5 BITUMEN COATED HESSIAN POLYETHYLENE KRAFT PAPER: The inner surface of top cover shall be nailed with Bitumen coated Hessian polyethylene Kraft paper (as in 2.5.9). This sheet shall project outside on 4 sides by at least 100 mm and shall be nailed properly on sides. Joining of sheets should have overlap of minimum 20 mm.

3.1.6 POLYETHYLENE SHEET COVERING: The cubicles shall be covered with a polyethylene petticoat (Polyethylene sheet as per 2.5.7). This shall be 'tailor made' to fit the cubicle. The sealing shall be such as not to allow any moisture to enter the cubicle.

3.1.7 SILICA GEL: Silica gel (as per 2.5.15) packed in cotton bags shall be kept at different places inside the cubicle as per EDN directions. Each suit of cubicle shall be provided with 1 kg of Silica gel (for a 4 suit cubicle 4 kgs of Silica Gel to be used. The bag containing silica gel to be as per 2.5.16).

3.1.8 LOOSE PARTS: Any loose parts in the cubicles shall be tied using cotton/ plastic tape. Wooden battens shall be provided wherever necessary.

3.1.9 WOODEN BATTENS: In case of cubicle which are not rectangular in shape like control desks, sufficient number of wooden rafters/battens of proper size shall be provided to give strength to the package.

3.1.10 RUBBERISED COIR: Gap between the cubicle and the case shall be filled with rubberized coir (as per 2.5.10) with distance between consecutive layers less than 500 mm.

3.1.11 CLAMPING: Packing shall be bound at edges by nailing M.S.clamps / Brackets (as per 2.5.5). Each vertical edge shall have minimum 3 clamps. Top horizontal edges will have one clamp for every meter length of package. However, minimum 4 clamps shall be nailed at the top for any cubicle.

3.1.12 PACKING SLIP: Packing slip kept in the polyethylene bag (As per 2.5.19) shall be placed in the box at appropriate place. In addition, one more packing slip covered in polyethylene cover and packing slip holder (as per 2.5.14) shall be nailed to front / rear of case.

3.1.13 MARKING PLATE: One no. (As per 2.5.13) shall be nailed to the front side of the case.

3.1.14 CASE MOUNTING: After complete packing, stencil marking of various details and marking of symbols shall be done as per BHEL instructions using indelible / non washable marking ink.

3.2 PACKING OF CUBICLES WITH SILVER OAK / PINE WOOD: Packing of cubicles for export shall be done exactly in same manner as described at 3.1 except for the following changes: -

Wood shall be Silver oak/ Pine wood instead of rubber wood.
- Double polyethylene petticoat instead of one.
- Fumigation may have to be done if required (BHEL Scope).

3.3 Different types of Cubicles with sizes for Packing

SL	TYPE OF CUBICLE	VARIANT DIMENSIONS [Internal sizes]
01	Single suite cubicle	- 900 x 950 x2500
02	Two suite cubicle	- 1650 x 950 x 2500
03.	Three suite cubicle	- 2400 x 950 x2500
04.	Four suite cubicle	- 3150 x 950 x 2500
05.	Regulation cub	- 1300 x 1350 x 2500
06.	Thy cub	- 2870 x 1350 x 2500
07.	VFD Cub	- 3800 x 1550 x 2500

3.4 PACKING OF LOOSE ITEMS/SPARES USING RUBBER WOOD:

3.4.1 Shape of cases shall be square, rectangular with single gabled roof or with double gabled roof depending on the nature of the job to be packed. Construction shall be as per drawings enclosed. Only gable will be additional as required.

3.4.2 Wood shall be rubber wood with Tongue and Groove joint as per clause 2.2.12.

3.4.3 Chemical treatment as per clause 2.4 to be done.

3.4.4 Width of planks shall be at least 100 mm. Width of binding planks (battens) shall be at least 75mm.

3.4.5 External surface of planks on front and rear shall planed 100% (except bottom plank).

3.4.6 Inner surfaces of all 6 sides shall be lined with bitumen coated hessian polyethylene Kraft paper (as per clause 2.5.9) using blue nails.

3.4.7 Rubberized coir of minimum 25mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of box.

3.4.8 Internal packing: Items that go into the box shall be packed using polyethylene sheet/ U foam/ thermocol sheets/ air bubbled sheets/ paper cartoons and cotton tape. Any space left. Between the job and the sides and the top of the box shall be filled with rubberized coir to get proper cushioning effect.

3.4.9 Certain items like transformers, reactors, breakers, etc., shall be bolted to the bottom of the box using bolts, nuts and washers.

3.4.10 Silica gel as per clause 2.5.15 held in cotton bags as per clause 2.5.16 shall be kept at proper places in the box.

SL NO	BOX INNER DIMENSIONS (mm)	VOLUME (liters)	QUANTITY OF SILICA GEL (grams)
1	300X300X300	27	100
2	400X400X400	64	100
3	500X500X400	100	100
4	600X600X400	144	100
5	700X700X400	196	100
6	770X770X500	297	100

3.4.11. Packing slip kept in polyethylene bag (clause 2.5.19) shall be placed in the box.

3.4.12. Marking plate as per clause 2.5.13 shall be nailed to side of the box.

3.4.13. Two numbers of hoop iron strips as per clause 2.5.3 shall be strapped tightly on the case using clips.

3.4.14. Stencil marking of various details and marking of various symbols shall be done as per BHEL instructions using indelible/non-washable marking ink.

3.4.15 Loose items to be kept inside the cubicle

- The components which are removed from cubicle for shipping purpose only, such as meters shall be kept inside the cubicle individually kept in wooden box and tied firmly in bottom of Cubicle.

- Other items which are given loose in addition to cubicle shall be packed in separate boxes (like cables).

- For transformer cubicles loose items shall be packed in separate boxes and these boxes may be tied firmly in bottom of cubicles.

- Items which are bigger in size such as impulse tubes may be kept in top of cubicles firmly bunched and tied.

3.5. PACKING OF LOOSE ITEMS USING SILVER OAK / PINE WOOD: Packing of loose items for export shall be done in same manner as at clause.3.4 . except for the following changes:

-Wood shall be Silver oak/ Pine wood instead of rubber wood.
-Fumigation may have to be done.
-2 polyethylene covers to be provided.

3.6 PACKING OF PHOTO VOLTAIC PANELS, ETC.USING RUBBER WOOD:
Same as 3.4 above except for the following changes:

- Wood need not be treated with chemical solution.

- Tongue and groove jointing is not required. But planks shall be so joined as to not leave any gap at the joint. Bituminized Kraft paper and Bituminized Kraft sheet need not be used.

- Silica gel need not be used.

3.7 PACKING USING BITUMEN COATED HESSIAN POLYETHYLENE KRAFT PAPER:

3.7.1. This method is adopted for packing of poles, frames, Empty boxes, etc.

3.7.2. Job shall be covered and stitched tightly with bitumen coated hessian polyethylene Kraft paper.

3.7.3. Marking has to be done as mentioned in CL 3.4.14.

3.8 SUPPLY OF RUBBER WOOD PALLETS FOR EMPTY CUBICLES:

3.8.1. The wood shall be rubber wood.

3.8.2. Thickness of planks shall be 25 $\pm$2 mm. The size of the supporting battens at bottom shall be 75 $\pm$2 mm (width) and 100$\pm$2 mm (height).

3.8.3. If the width of the pallet is 1000 mm or less, only 2 supporting battens at the edges may be provided. In case of pallets having width of more than 1000 mm, one extra supporting batten shall be provided in the middle.

3.8.4. Jointing of top planks is not permitted for pallets of width less than 1000mm. For pallets of width more than 1000 mm, jointing of top plank is permitted. However, joint shall be at the center of the supporting batten.

3.8.5 The consecutive top planks shall be so nailed as to leave no gap. Tongue and groove joint is not required.

3.9 PACKING OF SEMICONDUCTOR DEVICES

Semiconductor devices shall be received in prepackaged condition as per the device type and packed in plywood boxes as per the following procedure,

- Provide thrmocole sheets/rubberized coir.
- Stack the preplaced devices inside the case.
- Fill up gaps with thermocol sheets/rubberized coir.
- Close the top cover and nail.
- Provide suitable marking of the package details.

3.9.1 Packing of material for Registered Post Parcel (RPP) RPP packing boxes to be made in-house with 12mm (for sides) and 6mm thick (for top and bottom) commercial quality ply wood sheet. The size of the box should be decided on the material to be dispatched. Between material 10mm and 15mm thick thermocole sheets or rubberized coir/foam should be provided as cushion.

3.9.2. Packing of materials using sunpac cartons and corrugated Kraft paper cartons: Individual items can be packed using sunpac or polyprophelene [PVC]/ corrugated Kraft paper cartons of suitable sizes and gramage depending upon the items to be packed. Heavy duty cartons can also be used for packing of loose items, manuals, repaired items and others.

3.9.3. Packing of materials using Heavy duty cartons: Panels can also be packed using Heavy duty carton with other required packing materials having 2000gsm corrugated board of 7 ply 15 thick. Loose items and spares can be packed using 5ply 2000gsm corrugated heavy board with other packing materials. Different sizes of cartons are required depending upon the sizes of the items being packed. Details are separately given.

4.0 ADDITIONAL POINTS TO BE FOLLOWED FOR EXPORT ORDER SEAWORTHY PACKING:

4.1 Packing to be done as per Fig - 6.
Thickness of G.I.sheet 0.3 mm. plus or minus 0.05 [0.3-0.05]

Additional points to be taken care for :

Easy spares [Initial and O&M] Traceability and Identification at units and as well as at sites:

(Recommendations from Corporate Systems & IT)

Sl	Activity
1	All Initial and O&M spares preferably supplied in one lot to site and progressive inventory till all spares are accumulated could be kept at units.
2	Spares (Initial and O&M) should be supplied in separate Boxes / Containers and not mixed in main supply boxes.
3	**i)** Initial spares Box / Container to be labeled as "INITIAL SPARES " in RED. Ref fig: 14 (Page-26). **ii)** O & M spares Box /Container to be labeled as" O&M SPARES " in GREEN. Ref fig: 14 (Page-26).
4	**iii)** Initial Spares Box to have red Color strip as per diagram. Ref fig: 14 (Page-26). **iv)** Majority of spares (initial and O&M) are for indoor storage at site. **v)** O&M spares box to have green Color strip as per diagram. Ref fig: 14 (Page-26).
5	**vi)** Spares (Initial and O&M) Packing list kept inside the boxes and affixed securely outside the box to contain **vii)** Custom name **viii)** Project / Power station Name **ix)** Customer PO No and date **x)** Sl no of customer PO. **xi)** Quantity total & dispatched. **xii)** Unit work order number **xiii)** All above to be developed from Unit IT System
6	**xiv)** All spares (Initial and O&M) items to have tags (wono, item customer order no, customer item.description)
7	**xv)** Supply of spares by Vendor should also be instructed for following point 2,3,4,5,6 mentioned above.

Action By : Sites on arrival of spares (Initial and O&M)Receipt .

	Activity
1	Material utilized if any from Initial and O&M spares , should have prior written approval of concerned MUs. Such MUs shall also confirm replacement dates which should be entered in the system for creation of repository.

5.0 DETAILS OF DRAWINGS/FIGURES ENCLOSED

FIG-1: Details Of Cubicle Packing Box
FIG-2: Binding Of Panel
FIG-3: Lifting Of Packed Case
NOTE: 1) Spreaders are to be used only for lifting the case.
2) Spreaders are wooden items & not nailed to the case.
3) Height between crane hook & spreaders to be kept Minimum to void rotation of case while lifting.
FIG-4: Lifting And Moving Un Packed Case
FIG-5: Marking Plate
FIG-6: Closed Packing Case With G.I. Sheet Showing Layers Of Packing Materials.
FIG-7: Mechanical Latching Clamp
FIG-8 to 15 : Sample Packing drawing of single/ double / triple & four suit pane.l

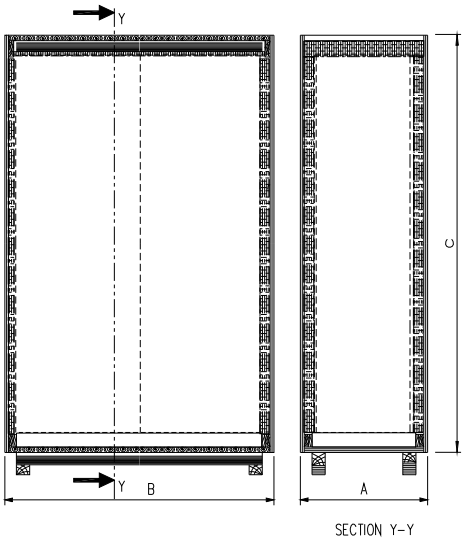


FIG-1 : DETAILS OF CUBICLE PACKING BOX.

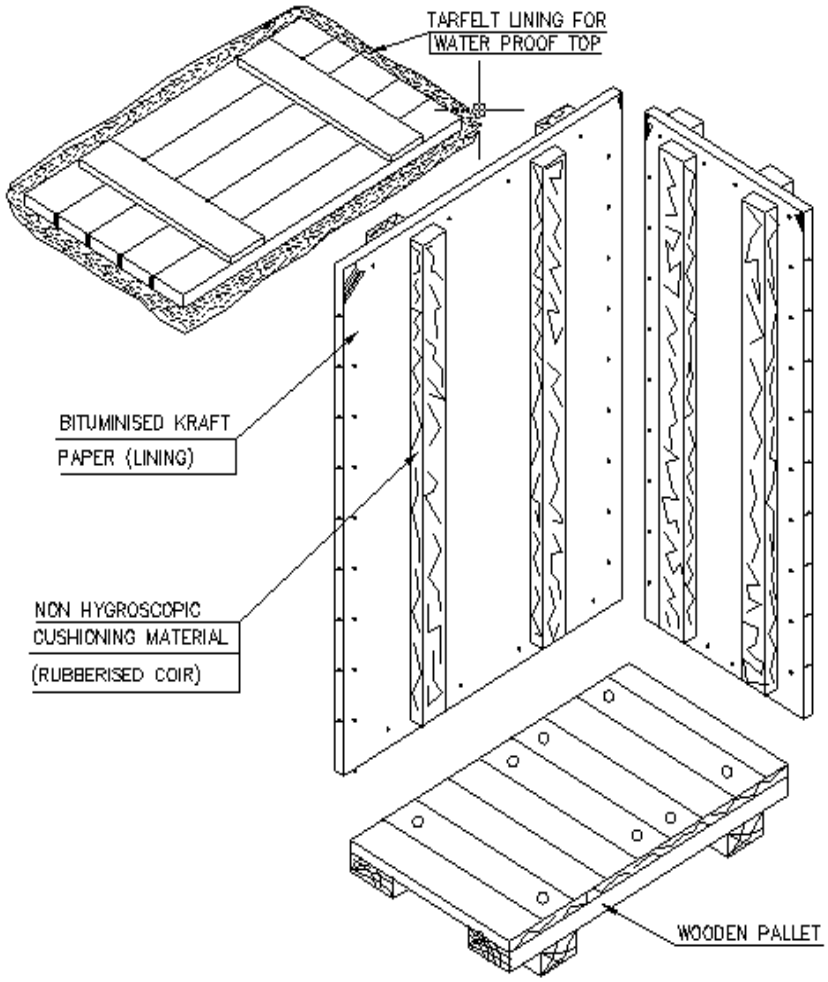
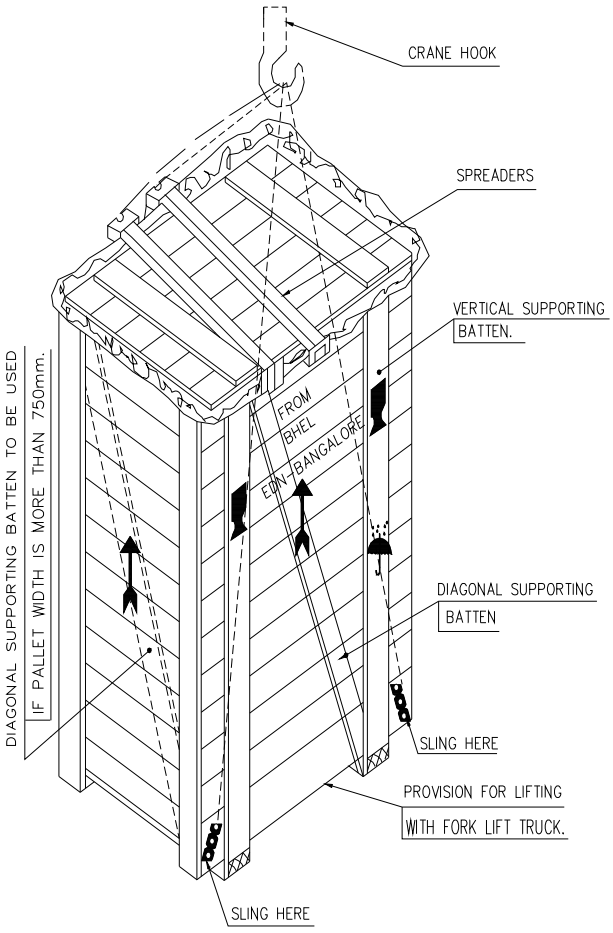


Fig. 2 : Binding of Panel



FIG–3 : LIFTING OF PACKED CASE.

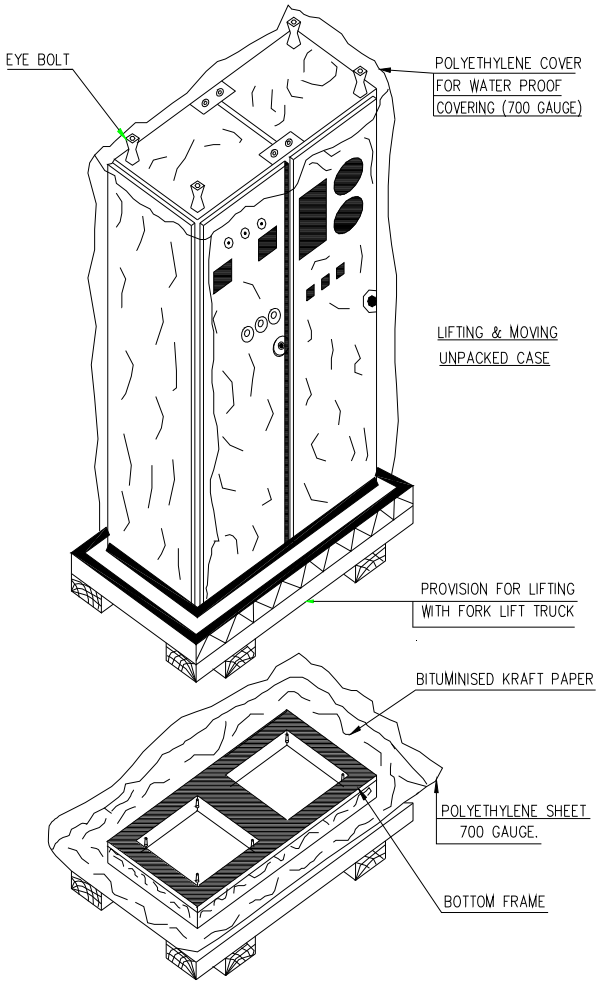


FIGURE-4

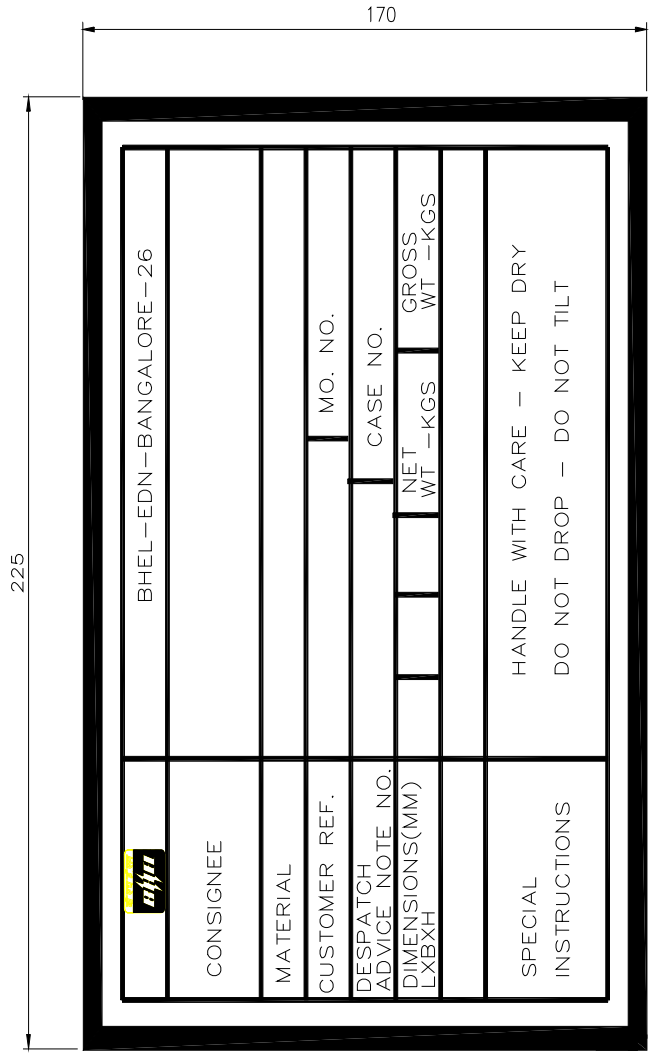
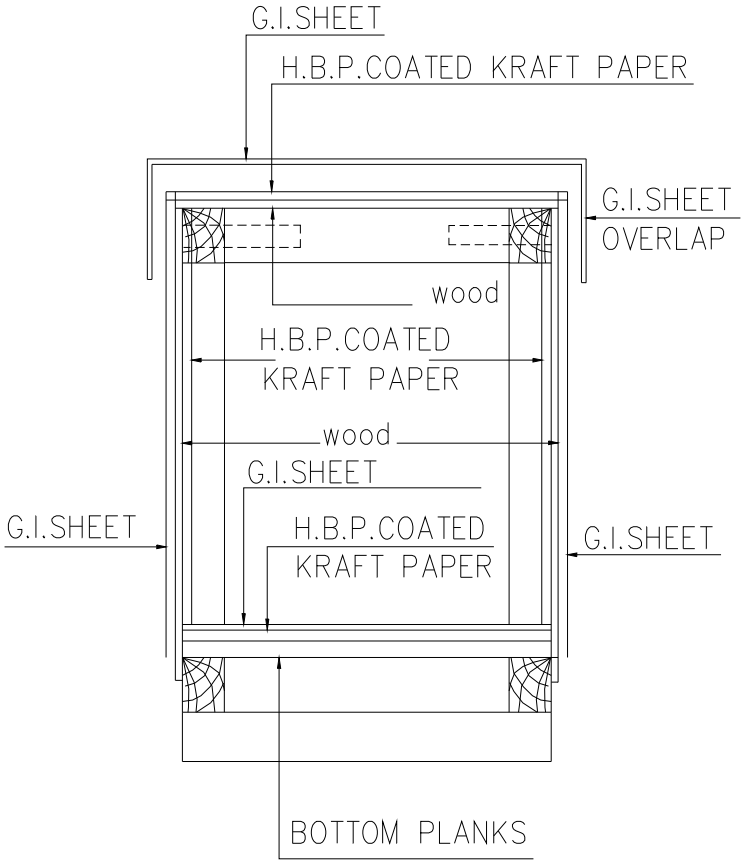
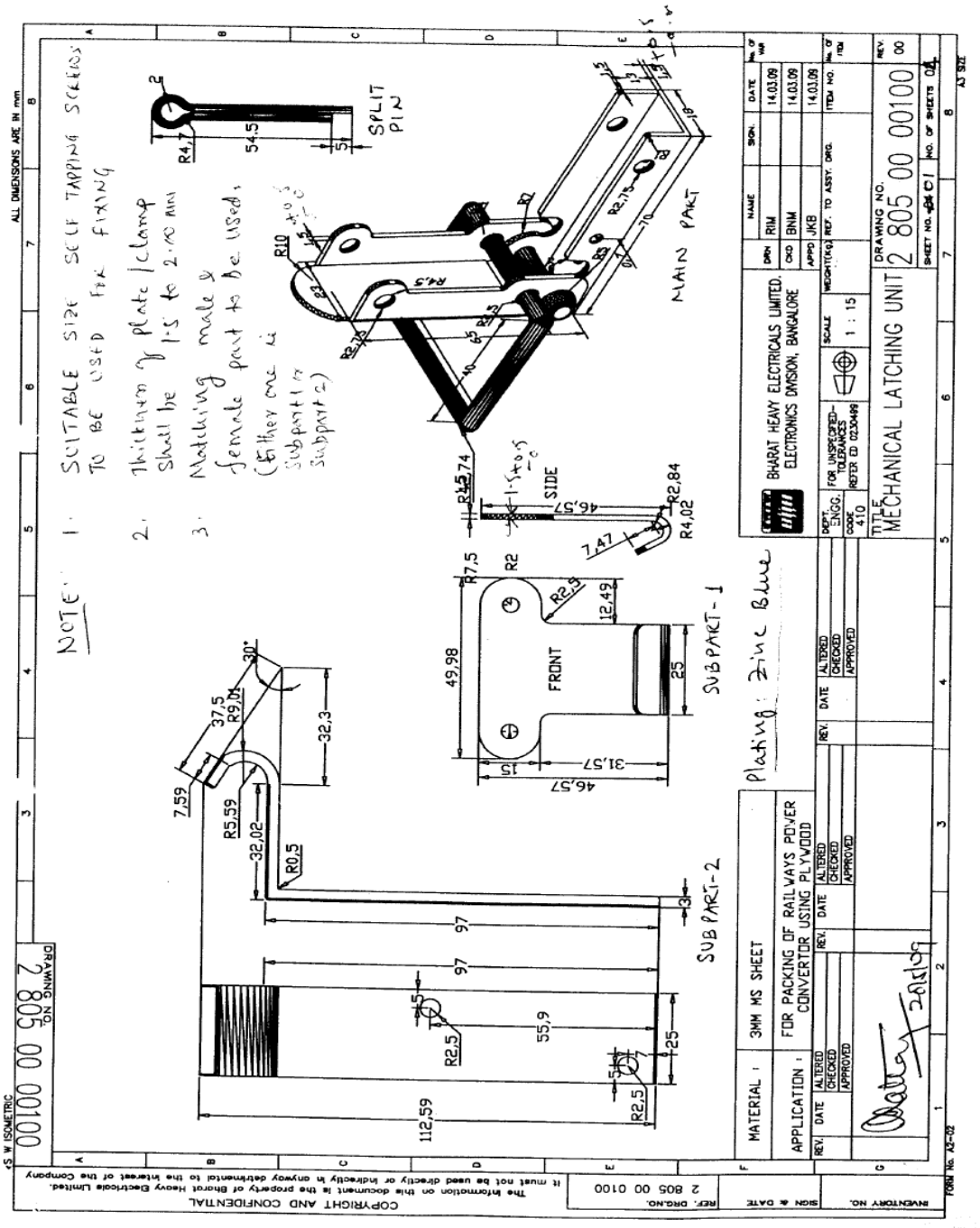


FIG-5 : MARKING PLATE.



FIG–6 : CLOSED PACKING CASE WITH G.I.SHEET
SHOWING LAYERS OF PACKING MATERIALS.



A4 - 14

Fig – 7 : Mechanical Latching Clamp

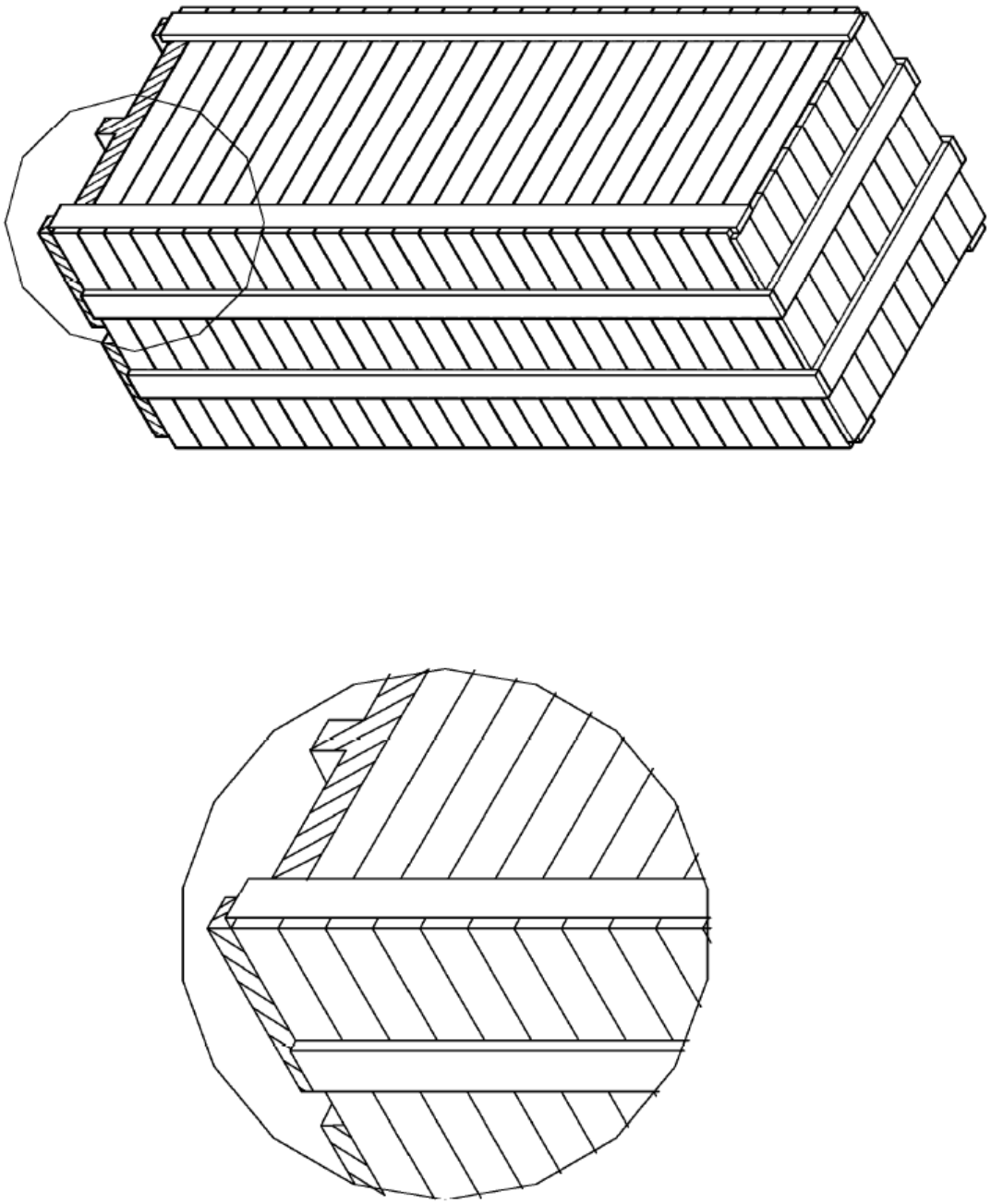


Fig – 8 : Single Suit Cubicle Packing View

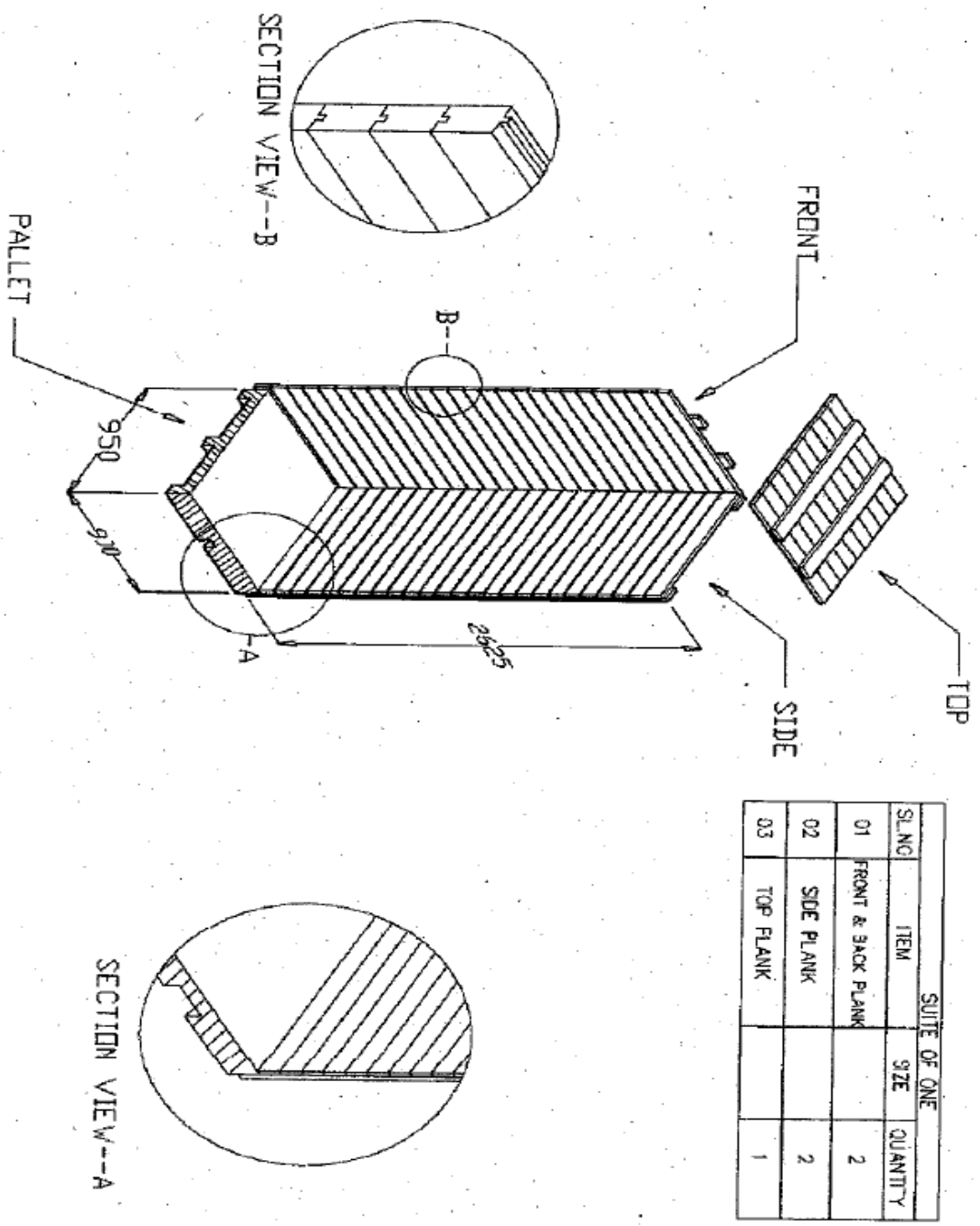


Fig – 9 : Single Suit Packing Assembly Drawing

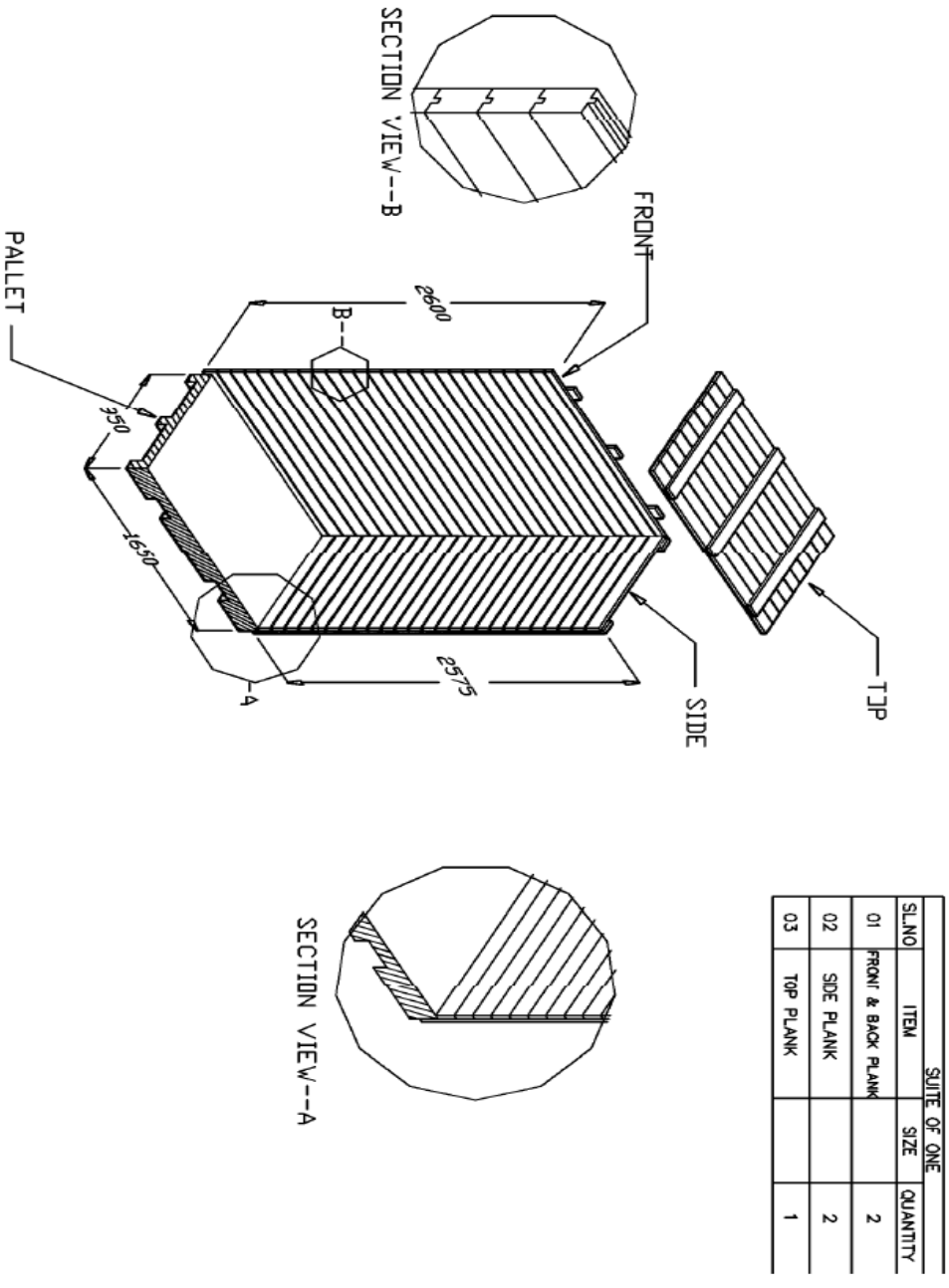


Fig – 10 : Two Suit Packing Assembly Details

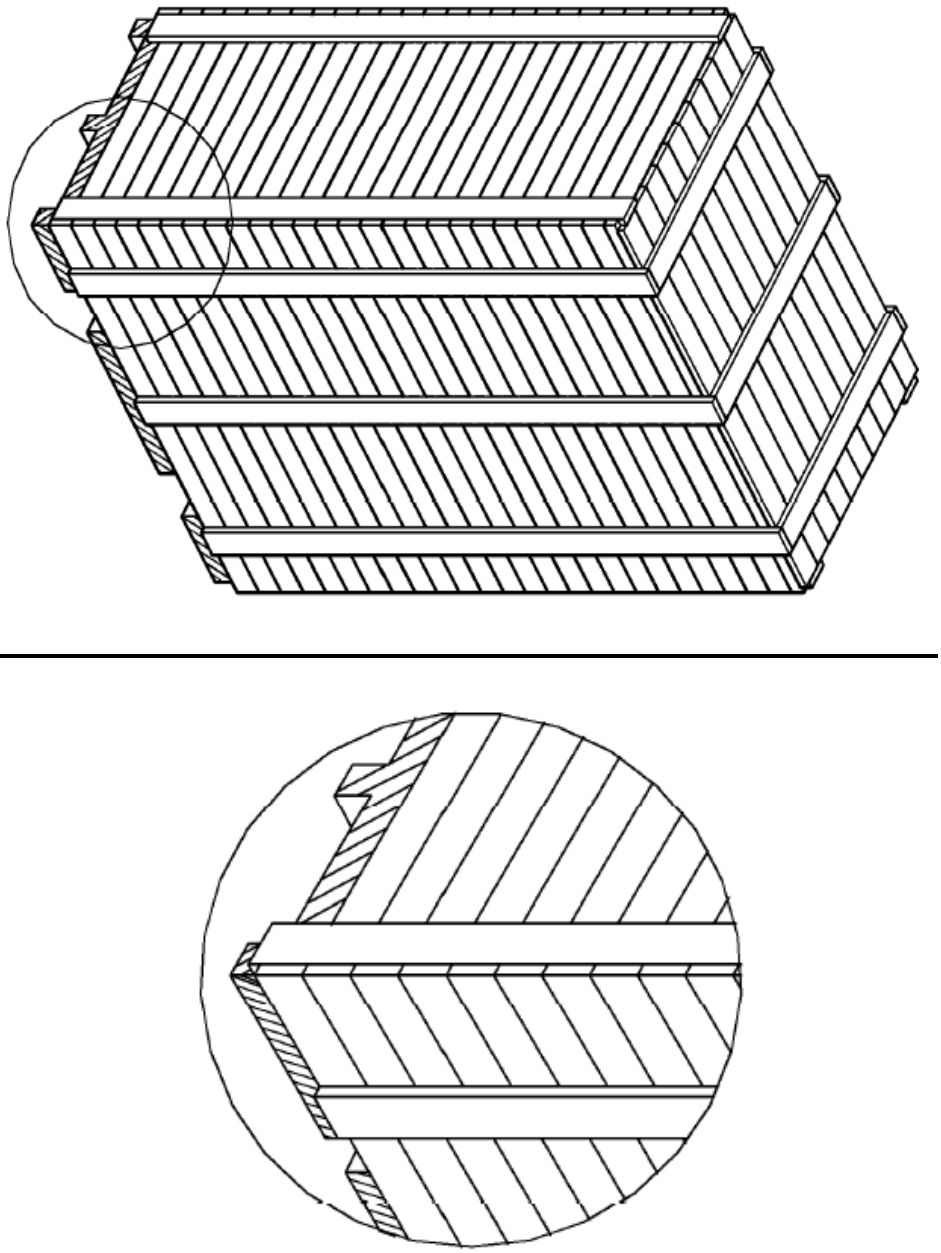
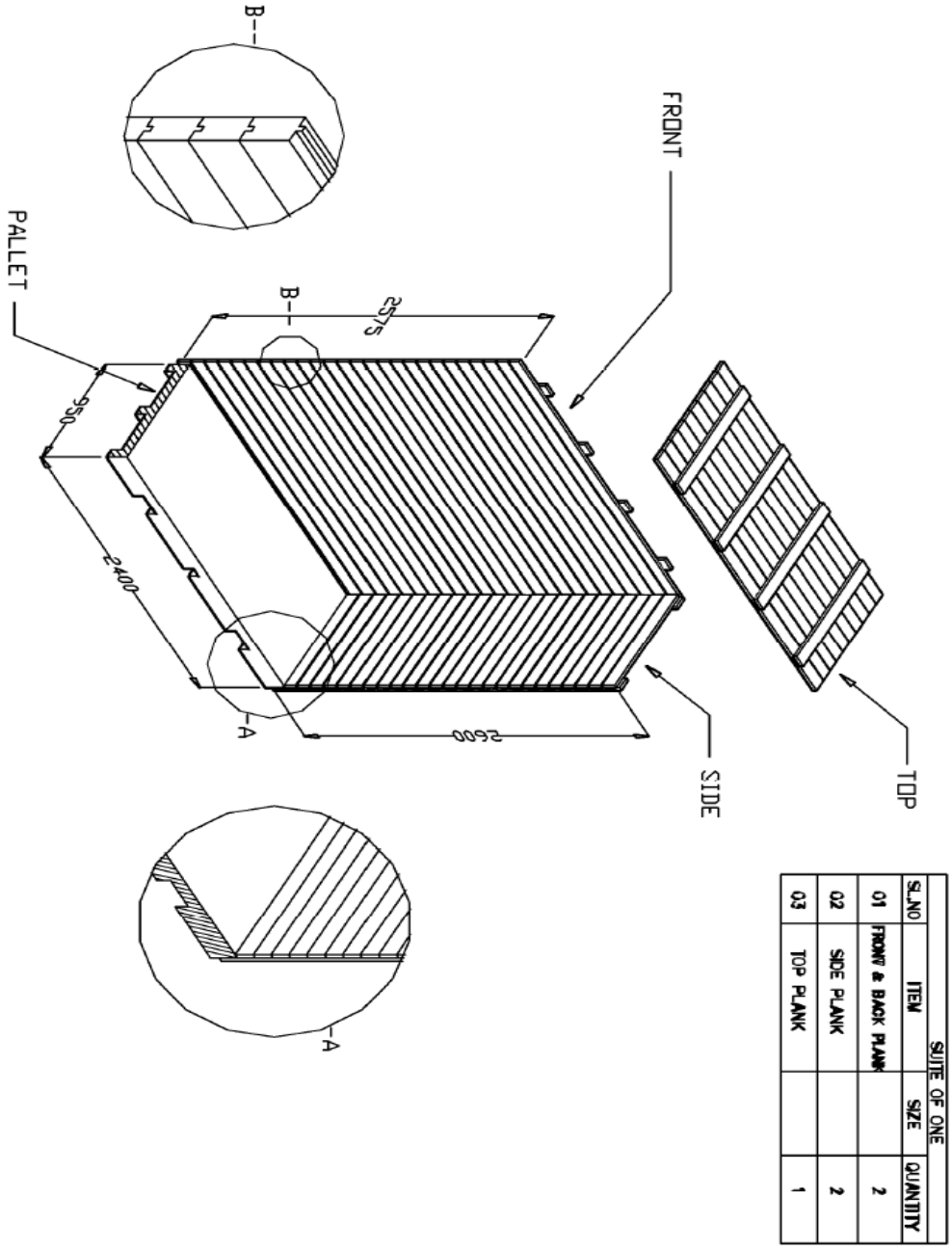


Fig – 11 : Two Suit Panel Packed view



SUITE OF ONE			
SL.NO	ITEM	SIZE	QUANTITY
01	FRONT & BACK PLANK		2
02	SIDE PLANK		2
03	TOP PLANK		1

Fig – 12 : Three Suit Panel Packing Assembly View

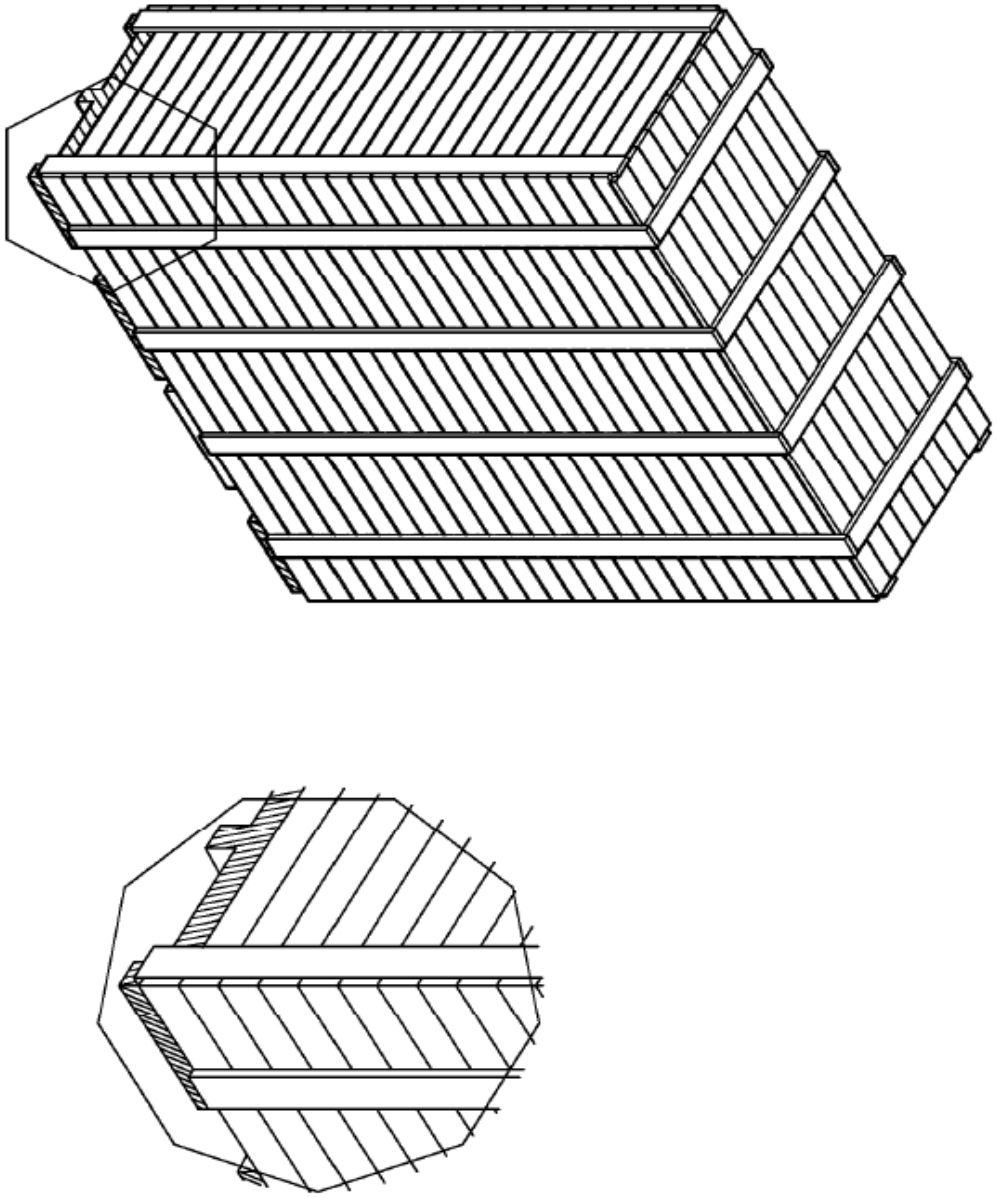
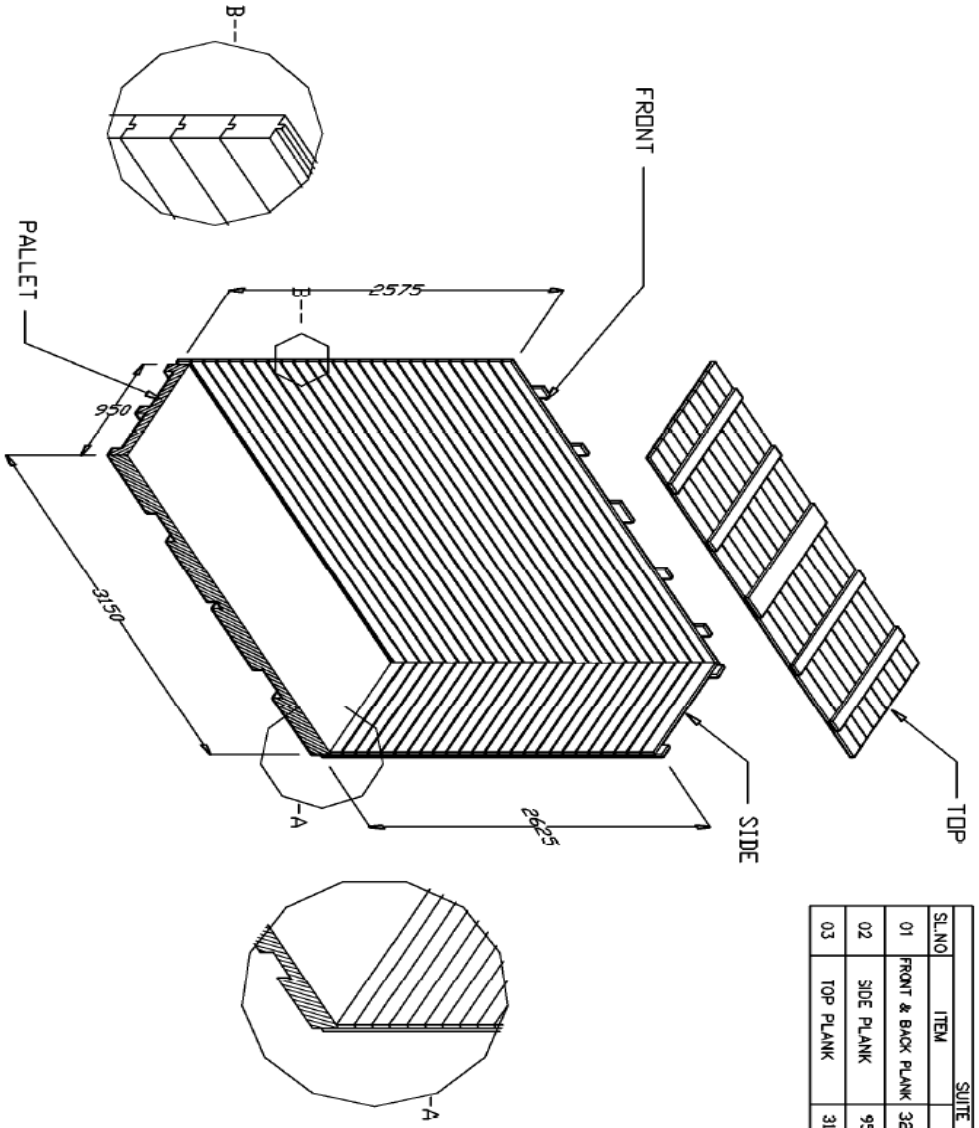


Fig -13 : Three Suit Panel Packed View



SUITE OF ONE			
SL.NO	ITEM	SIZE	QUANTITY
01	FRONT & BACK PLANK	3200X2575	2
02	SIDE PLANK	950X2500	2
03	TOP PLANK	3150X1000	1

Fig – 14 : Four Suit Panel Packing assembly Detail

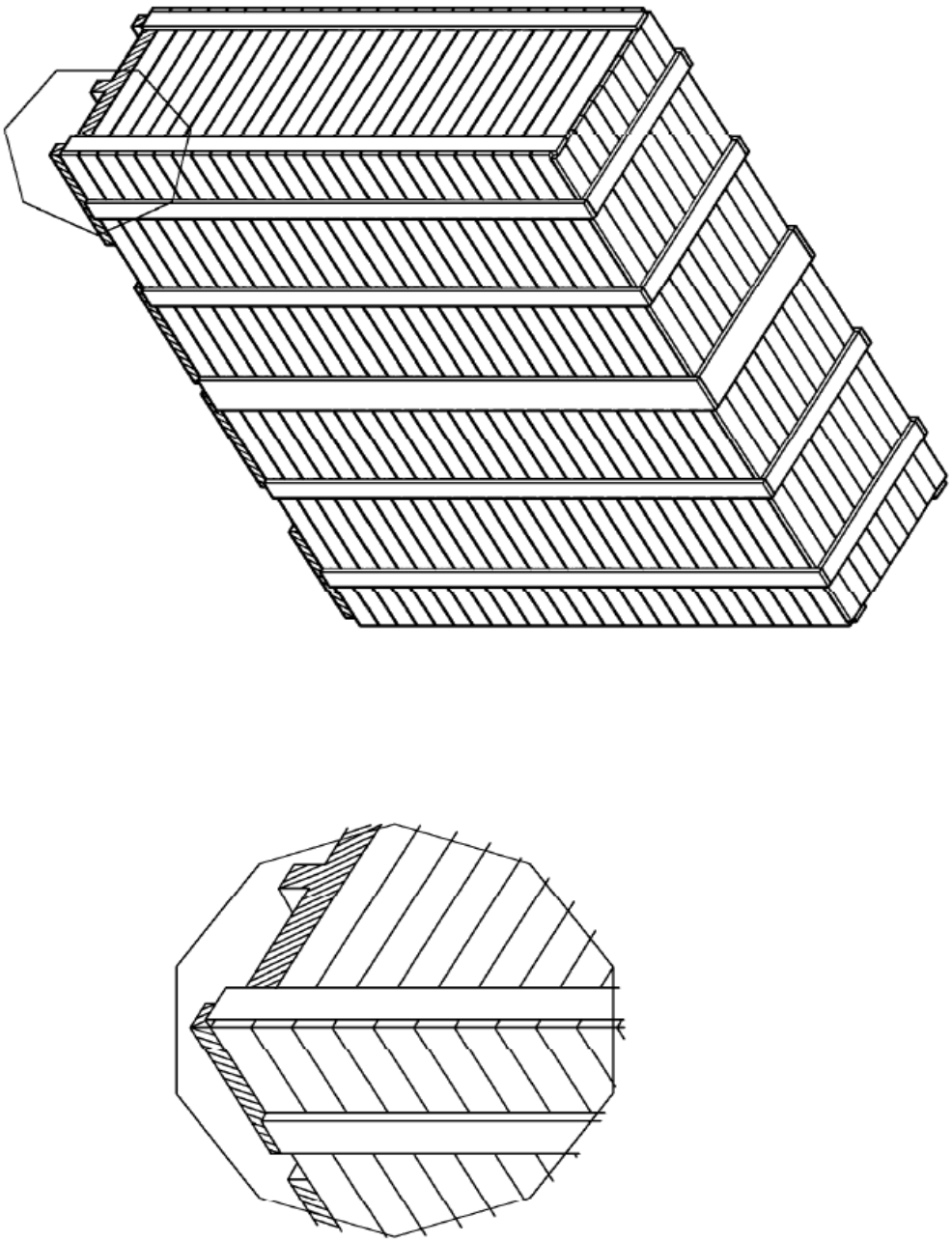
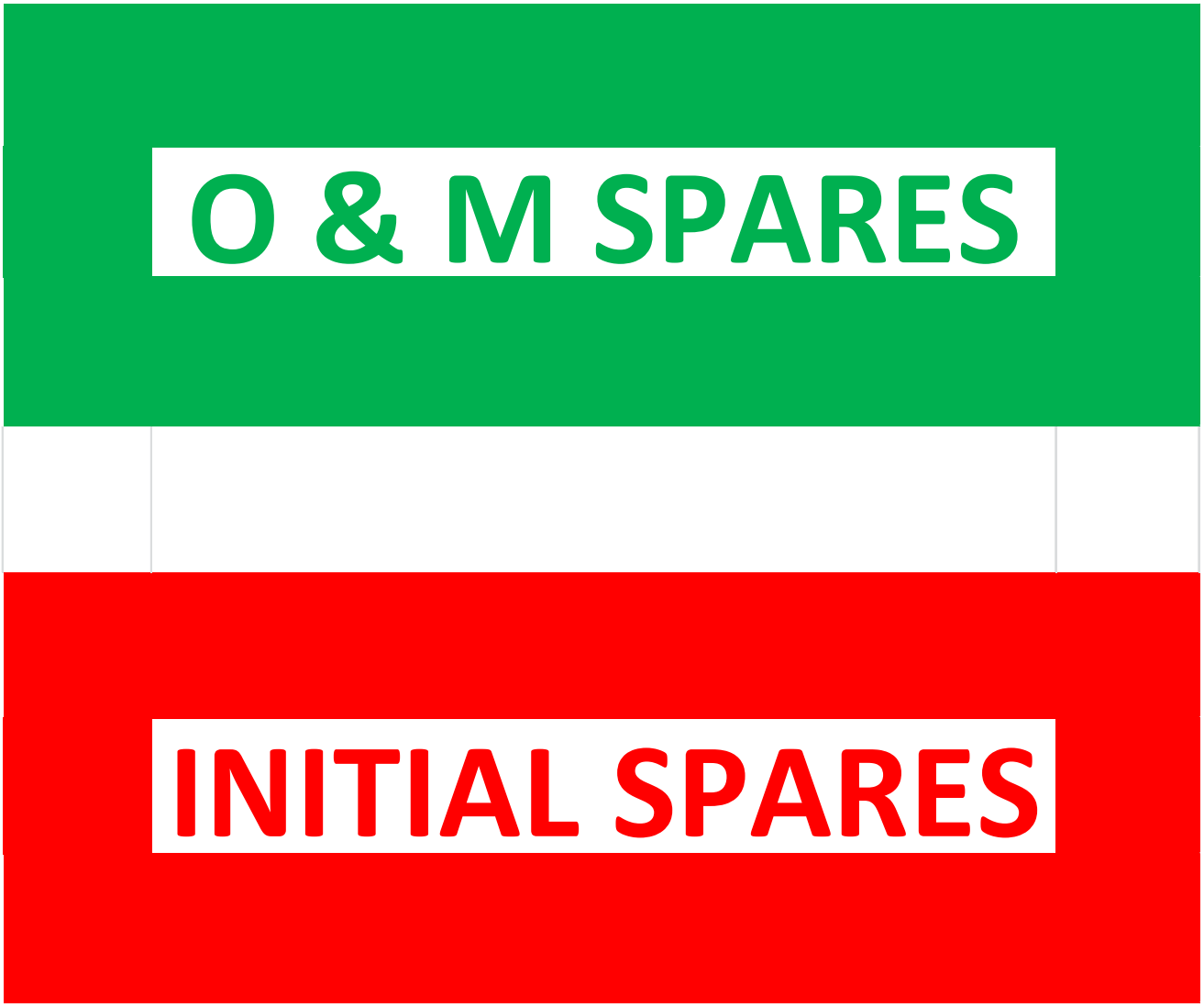


Fig -15 : Four Suit Panel Packing View

Easy spares [Initial and O&M] Traceability and Identification at units and as well as at sites:

Fig: 14



	ANNEXURE - D	
	ANALYSER SPECIFICATIONS	
SPEC NO.	**REQUIREMENT**	
5.11.00	**Technical Specifications of Conductivity Analyser/Salinity Analyser**	
a)	Applicable standard	ASME PTC 19.11-1970 except as modified in this specification.
b)	Type:	
	i) Cell	Flow through type/ removable type (with drawable with sealing valve)
	ii) Monitors	Electronic(Microprocessor based) indicating type with multi range facility
c)	Material :	
	i) Cell	Epoxy resin/ SS316
	ii) Electrode	Platinised / PEEK body
	iii) Monitors body	Carbon steel / Polycarbonate
d)	Monitor output:	
	i) 4-20 mA D.C.	
	ii) 4-20mA DC for DDCMIS Output load : 500Ω	
e)	Power supply	240V, AC, 50 Hz / 85 - 265 VAC
f)	Accuracy	+ 1% of full scale span/ Linearity: ±0.6% of reading /+/- 0.1% FS / ±1 % of measured value
g)	Stability	+ 1% of full scale per month non-cumulative / 0.5% FS/Month.
h)	Repeatability	+0.3% of span / 0.1% of range
i)	Annunciation contacts for monitors	
	i) Number	2SPDT / 3 SPDT
	ii) Type	Snap action micro switch / 4 wire micro processor based
	iii) Rating	5 amp, 240 V, 0.2 Amp, 220V DC / 1C, 250VAC, 3 Amp
	vi) Cell	On line/pipe mounted (ON LINE in sample table)
	v) Monitors	flush panel mounting
j)	Connection:	
	i) Cell	On line/pipe mounted (ON LINE in sample table) 1/4 (Quarter) inch NPT (F) SCRD for on-line type and Three quarter (3/4) inch NPT (M) SCRD for pipe mounted.
	ii) Process	1/4 (Quarter) inch NPT(F) SCRD for on-line type Three quarter (3/4) inch NPT (M) SCRD for pipe mounted / 3/4"NPT(M) with SS316 gland fitting with Teflon Ferrule
k)	Electrical	Half (1/2) inch NPT (F) SCRD
l)	Accessories (As part of Sample Handling system as	i) Automatic temperature compensation in the range 0- 100°C

	applicable)	
		ii) Ammonia (NH3) removal equipment.
		iii) Sample coolers
		iv) Flow and pressure regulators
		v) SS impulse tubing and fittings
		vi) Isolation & drain valves as required
		vii)Other accessories as required
		viii)Adequate length of cables for connecting coils to monitors
		ix) Sample rate set valves
		x) Alarm settings and Alarm indications on monitor.
m)	Range	As per sample stream detail table
n)	Other particulars	Cell shall be suitable for maximum pressure of 7 kg/cm2 and maximum temp. of 100°C
o)	cation Resin column	color changing resine
p)	Response Time	< 3 seconds / < 5 Sec
5.12.00	**Technical Specification of pH Cell and Transmitters**	
a)	Applicable Standard	pH electrodes shall conform to IS:6804-1972 except as modified in this specification
	i) Cell	Measuring and Reference Electrode Combination with Flow through type SS316/ Polypropylene flow chambers) for power plant's steam & water application. Sensor shall not be affected by f low variation. Sensor shall be designed for power plant applications.
	ii) Monitors	Electronic (microprocessor based) indicating type with adjustable range facility.
c)	Material:	
	i) Measuring & reference	Toughened sensitive / Teflon® / Silver Chloride
	ii) Electrode	pH glass
	iii) Monitor body	Carbon steel/ Aluminum Polycarbonate / Polycarbonate / Beige Polycarbonate / Noryl® resin
d)	d) Monitor output	i)4-20 mAmp D.C.
		ii)4-20mA DC for DDCMIS Output load : 500Ω
e)	Power supply	240V AC, 50 Hz / 85 - 265 VAC
f)	Accuracy/repeatability	+ 0.03 pH/+0.02PH / 0.02 pH / 0.01 pH /
g)	Resolution	+ 0.01 pH or 1 mV. 1C

h)	Stability	0.02 pH per week / ±0.001 PH/Week / 0.01 pH
i)	Annunciation contacts for monitors:	
		i) Number 2 SPDT 'Hi' and 'Lo' / 3 SPDT
		ii) Type Snap action micro switch
		iii) Rating 5 amp, 240V AC, 0.2 Amp, 220V DC or 5.0 A 230 Vac,5.0 A115 Vac or Contact Rating 1C, 250VAC, 3 Amp
j)	Connection:	
	i) Process	One-quarter (1/4)inch NPT(F) SCRD ON-LINE or Front facing: 3/4″ and 1″ MNPT Rear facing: 1″ MNPT
	ii) Electrical	Half (1/2) inch NPT(F) SCRD / Conduit openings: 1/2 in. or PG 13.5 conduit fittings
k)	Mounting:	
	i) Cell	Pipe Mounted / in Flow chamber
	ii) Monitors	Flush panel mounting
	l) Accessories (As part of Sample Handling system as applicable)	i) Automatic temperature compensation with fast response integral temperature sensors in the range 0-100°C
		ii) Co-axial cable as required
		iii) Sample coolers
		iv) Flow and pressure regulators
		v) Standard pH solutions
		vi) SS impulse tubing and fittings
		vii) Isolation & drain valves as required
		viii) Electrode holders
		ix) Other accessories as required
		x) Sample rate set valves
		xi) Alarm settings and indications on monitor.
		xii) RFI/EMI shielded, weather and corrosion proof casing
m)	Ranges	As per sample stream detail table.
5.13.00	**Technical Specification of Dissolved Oxygen Analyser**	
a)	Applicable Standards	ASTM PTC 19.11-1970 except as modified in this specification
b)	Type	Microprocessor based Electro-chemical / amperometric type
c)	Material	Die-cast aluminum /SS/Polycarbonate / Noryl® resin
d)	Output	i) 4-20 mAmp DC spare output
		ii) 4-20 m Amp, DC Isolated output for DCS.
e)	Supply	240V AC, 50 Hz / 85 - 265 VCA

f)	Accuracy	.+ 5 % of reading / 0.1% FS or 0.3%, if cal temp. = measurement temp 1.5%, at +/- 10°C deviation to cal temp
g)	Response:	
	i) Sensitivity	+ two (2) per cent overall / 0.1 ppb
	ii) Time (sensor)	Less than 30 seconds for 90% step change. Or <20 sec to 90% of final reading at 77 °F (25 °C)
h)	Connection:	
	i) Process	One quarter (1/4) inch NPT(F)SCRD
	ii) Electrical	Half (1/2) inch NPT (F) SCRD / Conduit openings: 1/2 in. or PG 13.5 conduit fittings
i)	Accessories (As part of Sample Handling system as applicable)	i)Sample cooler assembly with shut off valve at cooling water inlet, with thermometer and reducing valve at sample outlet.
		ii) Flow stabilizer
		iii) Automatic temperature compensation
		iv) Other accessories as required including chillier.
		v) Calibration device.
j)	Ranges	As per sample stream detail table
k)	Mounting	Flush
l)	Annunciation contacts:	
	i) Number	2 SPDT / 3 SPDT
	ii) Type	Snap action micro switch
	iii) Rating	5 Amp 240V AC, 0.2 amp 220V DC or 5.0 A 230 Vac,5.0 A115 Vac
5.14.00	**Technical Specification of Silica Analyzer (SI OX)**	
a)	Applicable standard	ASME PTC 19.11-197 except as modified in this specification
b)	Type	Multi Channel (max of each Three channel) Colorimetric Analyzer (with auto reagent shut off feature in case of sample loss or power loss) built in phosphate inhibition feature. Micro processor based.
c)	Material:	
	i) Case	Die cast aluminium / POLYCARBONATE
d)	Cycle Time	Less than 15 minutes per analysis
e)	Analyser output	i) 4 to 20 m Amp DC for spare output
		ii) 4 to 20 m Amp DC Isolated output for DCS
f)	Power supply	240V AC, 50 Hz
g)	Accuracy	+ 1% of span Or Less than 5% of reading or ±0.5ppb, whichever is greater, from 0 to300ppb. Less than 10% of reading from 300 to 5000ppb. Or ±1% or ±1 µg/L of reading upto 500µg/L Or 1 ppb or 5%, whichever is greater

h)	Repeatability	+ 2% of full scale Or Less than ±2% of reading or ±0.5ppb, whichever is greater from 0 to300 ppb. Less than ±5% of reading from 300 to 5000ppb. Or ± 0.5 µg/L or ± 1 % of reading, whichever is greater Or 1 ppb or 5%, whichever is greater
i)	Sensitivity	0.2 micrograms/litre Or Resolution 0.5ppb in all ranges Or 0.5 µg/L Or 1 ppb
j)	Connection:	
	i) Process	Quarter (1/4) inch NPT(F) SCRD / 1/4 in. O.D. flexible tubing,
	ii) Electrical	Half (1/2) inch NPT (F) SCRD
k)	Ranges	As per sample stream detail table
l)	Mounting	Flush / WALL MOUNTING
m)	Annunciation contacts:	
	i) Number	2 SPDT / Four SPDT, 5A at 240V Programmable
	ii) Type	Snap action micro switch
	iii) Rating	5 amp 240V AC 0.2 Amp 220V DC
n)	Accessories (As part of Sample Handling system as applicable)	
		ii) Automatic temperature compensation between 5 to 50°C / Not applicable for Colorimetric Analzyer
		iii) Automatic zeroing provision
		iv) SS tubing & vessels
		v) All chemical reagents for 12 months operation of the analyzer
		vi) Sample rate set values
		vii) Comprehensive diagnostic and alarm features.
		viii) Auto sampling facility with necessary valves & solenoids in the sample lines shall be provided.
	Note:	Silica analyzers shall be 2 no.s each of 3- channel. Silica analyser shall have inbuilt sequencer & separate analog output for each channel. Cycle time shall not be dependent on sample temperature.
5.15.00	**Technical Specification of Hydrazine Analyzer**	
i)	Type	Microprocessor based Electrochemical

ii)	Case material	Die-cast aluminum/SS/Polycarbonate
iii)	Analyzer output	i) 4-20 mA DC for spare output
		ii) 4-20 mA DC isolated output for DDCMIS
iv)	Power supply	240V AC, 50 Hz
v)	Accuracy	+2% of full scale Or 2 % or 1 ppb whichever is greater
vi)	Sensitivity	1.0 microgram/litre / 2ppb / 1 ppb / 0.1 ppb
vii)	Annunciation contacts:	
	Number	2 SPDT / 3 Relay Outputs; Relay Load: 250VAC; 30VDC; 5A / Four electromechanical SPDT(Form C) contacts, 1200 W,5A
	Type	Snap action microswitch
	Rating	5A 240V AC, 0.2 A, 220V DC Or Relay Load: 250VAC; 30VDC; 5A
	Mounting	Flush Mounting / WALL MOUNT
viii)	Accessories (As part of Sample Handling system as applicable)	i) Flow regulator
		ii) Flow gauges
		iii) Other accessories as required
		iv) Sample rate set valves
		v) Chemical reagents as applicable for 12 months consumption
5.16.00	**Technical Specification of Sodium Ion Analyzer**	
i)	Type	Microprocessor based Continuous flow through sample type with sodium responsive electrode and reference electrode having pH adjustment facility (Max 3 streams)
ii)	Case material	Die-cast aluminum/SS/Polycarbonate / ABS WITH SS FRAME ENCLOSURE
iii)	Analyzer power supply	240V AC, 50 Hz
iv)	Analyzer output	i) 4-20 mA DC for spare output
		ii) 4-20 mA DC isolated output for DDCMIS
v)	Accuracy	Better than +5% of full scale / ±5% or 0.01ppb – whichever is greater / Less than 0.02 ppb or 1.5% reading
vi)	Response Time	6 minutes. Max / 95% within 2 minutes
vii)	Sensitivity	0.1 ppb / 0.01 ppb
viii)	Annunciation contacts:	
	Number	2 SPDT / 3 Relay Outputs; Relay Load: 250VAC; 30VDC; 5A / 4 X Relay (Connection)
	Type	Snap action micro switch
	Rating	5A 240V AC, 0.2 A, 220V DC

		Or Relay Load: 250VAC; 30VDC; 5A
	Mounting	Flush Mounting / WALL MOUNT
viii)	Terminal points	All components piped & wired to terminal points
ix)	Accessories (As part of Sample Handling system as applicable)	i) Flow regulator
		ii) Flow gauges
		iii) Sample rate set valves
		iv) Other accessories as required to make the system complete
		v) Chemical reagents as applicable for 12 months consumption
5.18.00	**Technical Specification of Chloride analyser**	
i)	Type	Microprocessor based Continuous flow through sample type. Or The chloride monitor shall measure chloride concentrations using ion selective, solid state sensing electrodes. Or Microprocessor based ION Selective Method.
iii)	Analyzer power supply	240V AC, 50 Hz
iv)	Analyzer output	i) 4-20 mA DC for spare output
		ii) 4-20 mA DC isolated output for DDCMIS
v)	Accuracy	Better than 5 micro gram / litre. Or 10% of reading or ± 5 ppb, whichever is greater, within ± 5°C of calibration temperature, whichever is greater
vi)	Sensitivity	Better than +4% of full scale Or 0.1 ppb from 5 to 999.9 ppb range
	Range	As per Requirements
vii)	Annunciation contacts:	
	Number	2 SPDT
	Type	Snap action microswitch
	Rating	5A 240V AC, 0.2 A, 220V DC / Or Relay Load: 250VAC; 30VDC; Or 5A / 5A @ 220V AC/0.2 A @ 220VDC
	Mounting	Flush Mounting / WALL MOUNT
viii)	Terminal points	All components piped & wired to terminal points
ix)	Accessories (As part of Sample Handling system as applicable)	i) Flow regulator
		ii) Flow gauges
		iii) Sample rate set valves
		iv) Other accessories as required to make the system complete
5.20.00	**Technical Specification of Residual chlorine analyser**	
	Sensor	

	Method	Amperometric
	Electrodes	Gold Cathode/Silver Anode
	Cell Material	PVC
	Electrolyte	Potassium Bromide / Potassium iodide
	Transmitter	
	Type	Microprocessor Based with self diagnostic features
	Transmitter Output	4 – 20 mA
	Enclosure Protection	IP65 / NEMA 4X IP66
	Enclosure Material	Polyester coated Al./ Beige Polycarbonate
	Electrical Connection	½" NPT (F)
	Mounting	FIELD
	Display Type	LCD
	Display Details	digit backlit LCD matrix
	Diagnostics	Required
	Meter Range	0-1 mg/l Or 0 to 10 ppm (mg/L) as CL2.
	Resolution	0.01 ppm Or 0.001 ppm or 0.01 ppm – selectable Or 0.00 to 5.00 mg/l
	Sensitivity	0.01 ppm Or +/- 0.01 ppm
	Area Classification	safe
	Electromagnetic Compatibility	BUILT – IN
	Temp. Compensator	AUTO – BUILT – IN
	Temp. Compensating element	PT 100
5.21.00	**Turbidity Analyser**	
	Sensor	Reference Type
	Operating Principle	Alternating light source Or near infrared LED
	Cleaning	Self cleaning
	Electrode holder-type	Flow through
	Body material	CPVC
	Process connection	½" NPT (F)
	Preamplifier	Built-in

	Transmitter	
	Type	Microprocessor Based with self diagnostic
	Enclosure Protection	IP65 Or NEMA 4X IP66
	Enclosure Material	Polycarbonate / Beige Polycarbonate
	electrical connection	½" NPT (F)
	load indicator	Provided (LCD Display)
	accuracy	0.2 NTU or ± 2% of reading Or Accuracy after calibration at 20.0 NTU:0 1 NTU: Or .± 2% of reading Or ± 0.001 FNU/NTU or 1% of reading
	Repeatability	±0.1 of span Or 0.1% of range Or ± 0.001 FNU/NTU or 1% of reading
	Stability	
	RESPONSE TIME	
	Linearity	
	Temperature compensator	Built – in
	Cable between transmitter & Sensor	To be provided
	Technical Specification of Ammonia Analyzer	
	SOFTWARE FEATURES	Software Features Self-test & diagnostics: YES Real time clock: YES Meter serial number: YES Programmable alarms: High, low, error, calibration/ Offline Password protection: YES Reset function: YES Or Self-test & diagnostics, Real time clock, Meter serial number, Password protection, Programmable alarms: High, low, error, calibration/ offline, Reset function.
	ENCLOSURE PROTECTION CLASS	Weatherproof enclosure: IP66 & NEMA 4X
	INSTRUMENT RANGE MEASUREMENTS RANGE	Instrument Rang:- 0 to 10 ppm Measurement Range:-0 to 10 ppm
	AMBIENT TEMPERATURE	Ambient operating temperature: 5 to 45 ˚C
	ACCURACY	Accuracy (with DKA cal): ± 5% or 0.03 ppm, whichever is greater, at 20 °C and 35 °C Or ± 5% or 0.03 ppm
	RESPONSE TIME	Initial response within 15 seconds, reach 90% of reading within 1 minute of injecting a standard solution
	UNITS DISPLAYED	ppb, ppm (auto ranging), mV, temperature
	TEMPERATURE MEASUREMENT RANGE	Range: - 10 to 120 ˚C
	FLOW RATE	Flow rate: 40 mL/min nominal set by pressure

		regulator
	RELATIVE HUMIDITY	Relative humidity: 5 to 95% non-condensing
	STORAGE TEMEPRATURE	Storage temperature: - 20 to 60 ˚C
	POWER SUPPLY	Input: 85-132 or 170-264 VAC Or 170-264 VAC Or 85 to 132VAC
	OUTPUT SELECTION	Analog output: Galvanically isolated Number of analog outputs: 2, one dedicated to ammonia, one to temperature; shared ground Or 4-20 MA AND RS485
	Resolution	Resolution: 2, 3 or 4 digits mV Measurement Range: ± 1999.9 mV Resolution: 0.1 mV

ENGINEERING CHECKLIST
PROJECT: ENNORE 2X660 MW
Important Note: Bidders to Mandatorily fill the below checklist (with Company seal and Signature) otherwise offers shall be rejected.

Sl. No.	DESCRIPTION	NOT CONFIRMED (If applicable Please Tick Mark 'v')	CONFIRMED (If applicable Please Tick Mark 'v')
1	"The bidder should have executed / completed work of "Design, supply, erection & commissioning of SWAS (Including Sample Handling System and Analysers) in a Coal Fired Thermal Power Plant minimum of 500 MW rating for at least 2 units and working satisfactorily for at least two (02) years as on date 28.06.2013".		
2	Compliance to Each point in PQR		
3	All Analysers shall have 2 x 4-20 mA, galvanically isolated outputs and relay contacts for alarms shall be provided as per Specs.		
4	All offered analyser shall be suitable for 240 V supply & shall be 4 wire analysers.		
5	Mandatory spares shall be offered against each line item of the specs. If any item is not available meeting the description of the specs, then functionally equivalent item shall be offered against that line item.		
6	Pl. furnish the cell constants for each Tag No. and confirm that in the event of any change in cell constant required during approval stage, same shall be done without any commercial implication.		
7	Anlysers are with digital communication facility like RS485 / HART / Modbus / Profibus (One of the communication method will be chosen during detailed Engg. with price implication.). Pl. confirm.		
8	All sample wetted parts & Sampling tubes/coil of Primary & Secondary coolers shall be SS316 material. Also cooling water lines from headers to Coolers shall be SS 316		
9	Primary Coolers shall be IBR/U Stamp/TUV/Lloyd certified with Inconel 625 cooler coils.		
10	Pl. confirm that offer includes high pressure reducing valve in the primary rack for all High Pr. Samples (>100 Kg/cm2)		
11	Chiller for the project shall have required capacity for the system (Minimum 5 TR) & shall be with SS 316 Tank		
12	1 time Gas filing shall be considered for Chiller at site during commissioning/handing over. This is in addition to gas filling done for functional checking during inspection at vendor works.		
13	Packing shall be as per corporate standard indicated in Specs.		
14	Pl. confirm that all analyzers shall be provided with all consumables & reagents required for 12 months operation after commissioning of system.		
15	All items with limited shelf life shall be supplied during commissioning only. If any items require replacement due to expiry of shelf life, same shall be replaced without any commercial implication to BHEL-EDN (Such as Tygon tube, pH Cells, DO sensors, Reagents).		
16	All headers in Primary racks & Wet Panel shall be supplied with suitable sized counter and mating flanges. In addition to this, 1 set of mating & counter flanges shall be provided for all the cooling water headers for connecting to tapping point in field.		
17	Pl. confirm that that IBR certified Isolation valve, Blowdown valves in primary rack shall be offered, and for primary coolers IBR certified coil/U-stamped cooler shall be offered.		
18	Pl. confirm that all components/accessories required to meet the intent of the specification shall be offered. If it is found, at any stage of procurement /commissioning, that some components/accessories have not been offered/supplied, same shall be supplied without any cost/time implication to BHEL to meet the system / product requirement		
19	Pl. confirm that for tubing between wet and dry panel suitable DFDC connectors shall be provided		
20	Pl. confirm that Insulation of Pipe between Chiller and wet panel shall be done at site.		
21	Pl. confirm that stream selector shall be with pulse based selection.		
22	Mandatory Spares shall be sent in pre-decided lots in containers /secure boxes distinctly marked in Red colour with boldly written "S" mark on each face of the containers /secure boxes.		
23	Pl. confirm that There is no deviation w.r.t Annexure 'C' and Annexure 'D'.		
24	Items used for SWAS system shall be from Approved vendors indicated in Specs. For items not covered in the list bidders approved vendors will be acceptable.		
25	Site work for both Analysers & Sample Handling system shall be as per Scope of Supply		
26	If offered Models of Analysers are not accepted during document approval, same shall be replaced by Analyser models of customer approved vendors without any commercial impact.		
27	All sample wetted parts & Sampling tubes/coil of Primary & Secondary coolers shall be SS 316. Also cooling water lines from headers to Coolers shall be SS 316		
28	Individual Flow indicators are provided in return cooling water lines of each primary & secondary coolers.		
29	Bulkhead in Primary racks & Wet Panel shall be suitable for pipe sizes indicated in Enquiry specs		
30	Primary & Secondary cooler shell drain shall be valved and piped to waste drain header as per Specs.		
31	After Secondary Cooler both Thermal Shut off Valve and Temperature Switch has been offered as per specs requirements.		
32	Silica Analyser and Sodium Analyser shall be suitable for 3 channel measurement as per specs.		
33	Loose supply item such as cabling and tubing shall be calculated by considering the Total Qty of Analyser for both the units (2 Units) and 30 Meter per run.		
34	Complete piping, tubing, fittings, valves, blow down valves, sample relief valves, shell relief valves, filters and other wetted parts in the sampling and analyzing system shall be of Swagelok, Dr Thiedig or Parker make only.		
35	All critical components like PRV, Back pressure regulator, thermal shutoff valve etc shall be of Sentry, Lowe or Dr Thiedig make only.		
36	Primary and Secondary Sample coolers shall be of Forbes Marshall, Steam Equipment (Panflow, USA), Sentry, Lowe or Dr Thiedig make only with Third Party Certification like Third party (TUV/ Lloyd) design Validation for ASME Design and IBR Form IIIC certification for material & design tractability.		
37	Inconel – 625 coil primary coolers will be supplied for all high pressure and temperature sampling lines.		
38	Laser cutting will be carried out at only those fabricators, which is having laser cutting machine for stainless steel sheet metal for more than 1.5 mm thickness.		
39	Vendor shall use Swagelok / Parker De-burring tool to remove burrs on tubing.		
40	At later stage if it is found that vendor offer is not in line with tender specification then vendor to supply material in line with tender specification without any price impact to BHEL.		

(Company seal and Signature)