BHARAT HEAVY ELECTRICALS LIMITED

TIRUCHIRAPPALLI-620 014

Fuel Systems/PE(FB)

Technical Purchase Specification for

ASH SWEEPER SYSTEM

Specification No.: **TSR:006** Revision No.: 01

01	*30.07.21*	*-*	*General Revision*	VSN	GSK
Rev. No.	***Rev. Date***	***Clause***	***Description***	***Checked***	***Approved.***

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2 Technical Specification

2.1 Scope

This specification defines the minimum requirements for the design, manufacture, testing, preparation for shipment and delivery of materials and engineering documentation and start-up service (support for erection and commissioning) for this equipment. Supplier is solely responsible for correct design, engineering, and supply of their scope of supply.

The offering, based on recommendations from the Supplier, shall employ Ash Sweepers located as mutually established so as to avoid major stiffeners and structure but so as to effectively clean the entire cross section area and volume of each catalyst level so equipped.

In the event of conflicts between codes, standards, and this specification, customer specification of this document, the more stringent requirements shall apply and the conflict between these specifications shall be submitted to BHEL in writing and should obtain BHEL's prior approval.

2.2 Equipment, Materials and Services by Supplier

The Supplier's scope of supply includes, but is not necessarily limited to:

a. Ash Sweeper system utilizing plant compressed air to clean the top of each catalyst layer for each SCR reactor; The required quantity of ash sweepers for each reactor shall be determined by the Supplier.
b. Equipment and ancillaries as defined in datasheets of Ash Sweeper Selection, P&ID's, and General Arrangement Drawings of this document.
c. Supplier shall include mounting plates/rings or tubes (as required, one for each Ash Sweeper), pre-drilled and tapped and/or weld-prepped, with all required fasteners and hardware. No welding to the ash sweepers is permitted. Blanking plates for ash sweepers of future layers.
d. An ASME pressure vessel, relief valve, piston valve assembly, high temperature nozzle preferably fan jet nozzle, aircraft grade safety cable, Solenoid valve, mounting plates/ rings tubes pre-drilled and tapped, fasteners and two flexible hoses for each ash sweeper, blanking plates for ash sweepers of future layers.
e. Drawings and documents showing loads, forces, centres of gravity (pick points), required structural bracing, and other technical details necessary for a safe, robust installation

f. Operating procedure explaining ash sweeper operational practice and suggested sequence manuals and instructions for storage, installation, commissioning, operating and maintenance
g. Equipment datasheets, completely filled by the Supplier, in order to inform BHEL as to the specifics of the equipment being supplied
h. Special tools required; For example, if a special lifting device is required during shop fabrication or handling, the device must be available on the construction site for installing that piece of equipment.
i. Schedule for specific deliverables and required dates
j. De dusting system Erection drawings with BOM
k. Ash sweeper system design shall include compressed air supply piping and DCS controls for all ash sweeper including future layer ash sweepers with the initial design itself to facilitate future tie-in for the spare catalyst layer. Receiver tank, fasteners, valves and other accessories required for the future layer shall be designed and supplied for this specification. Supplier to design and supply equipment in full where in only future layer ash sweepers will be ordered to make the system complete.

2.3 Equipment, Materials and Services by Others

The scope of supply by others shall be:

- Unloading and storage at site
- Installation Testing, field performance monitoring, and inspections (Supplier to witness and assist as necessary)
- Utility systems piping up to terminal point
- Monorails and hoists
- Compressed air interconnecting piping to the Supplier's supplied equipment up to terminal point
- Structural support steel
- Insulation
- Electrical wiring, conduits, trays, push buttons and starters external to Supplier supplied equipment.
- DCS controls and remote alarms
- Instruments PG/PI, PIT/PT's and PDT/PDIT's are in BHEL scope as marked by terminal points and shown in P&ID for sonic horn system in reference drawings.
- Ash sweepers in Future layer

2.4 Performance Guarantees

The equipment provided by the Supplier shall operate in accordance with the performance data in the datasheet(s) included herewith.

The equipment shall meet all applicable codes and standards requirements.

BHEL and/or Owner may conduct field tests during start up and after commercial operation of the installation for a period determined by the terms and conditions of purchase.

Total air consumption rate (including that of sonic horn) shall not exceed the instantaneous and averaged hourly rates as specified by the supplier as per guarantee clause No.05.

The Supplier shall fully cooperate with BHEL and Owner in defining a system test procedure.
This test procedure shall consider individual ash sweeper performance, grouped or otherwise, both in the cold SCR and hot flue gas conditions. Monitoring of SCR system pressure drop criteria shall be determined in advance. Catalyst surface cleanliness criteria shall be determined based on SCR operating procedures and observations of dust accumulation accounting for operating time and fuels being fired. The Supplier's test procedure shall be mutually agreed upon by the concerned parties including, but not limited to, Supplier, BHEL and Owner, and Owner's Engineer.

The System must ensure operational cleanliness and performance of the SCR catalyst without any damage or deterioration of the catalyst and its ancillary equipment.

2.5 Detailed Requirements of Equipment

2.5.1 General

The SCR reactor is designed and operated with flue gas having high dust concentrations.

The flue gas conditions and fuel data for the resultant ash/dust, etc. are as defined in the specifications included in Sections 5 clause 5.2 of TSR:007.

Air discharge shall be by piston valves controlled by solenoid valves. A spring return shall aid in piston closure and sealing after discharge.

The design shall prevent the ash sweeper from accidently operating as a result of an abnormal drop in supply air pressure.

Each ash sweeper shall include an isolation slide gate installed in the blow pipe and an aircraft grade safety cable to prevent the pressure vessel from falling further than 1.5 meters should it become detached from the nozzle or blow pipe.

Supplier shall include mounting plates/rings or tubes (as required, one for each Ash Sweeper), pre-drilled and tapped and/or weld-prepped, with all required fasteners and

hardware. No welding to the ash sweepers is permitted. Blanking plates for ash sweepers of future layers.

Supplier must provide Material Safety Data Sheets (MSDS) for all coatings, paints, lubricants, preservatives, or chemicals that will be brought onto site by the Supplier for whatever reason. The MSDS must be submitted before equipment is delivered on the site.

Piping material shall be stainless steel as per ASTM A312 Gr304.

Supplier shall provide a detailed description of any special lifting and/or installation requirements.

2.5.2 System Air Supply

In order for the Ash Sweeper System to operate properly and safely under normal and expected conditions, the Supplier shall provide BHEL with complete data for the requirements of the Air Supply (see also datasheets in Section 5, to be completed by Supplier):

- Required air pressure (Kg/cm2(g))
- Required air flow rate during normal operation of the Ash Sweeper System (Nm3/hr)
- Acceptable moisture limit in the air supply. Vendor shall note the quality of service air requirement as per annexure and has to supply required equipment to handle the said service air quantity.
- Acceptable range of oil and particulate material
- Measures needed to avoid freezing, damage, or failure of the System

2.5.3 Instrumentation and Controls

Supplier shall provide necessary details & write up for integration of controls into the BHEL/ Owner's DCS. Ash Sweeper operation shall be synchronized with that of the sonic horn system. Instruments and controls must be sourced from suppliers on the Owner's Approved Suppliers List.

2.6 Industry Reference Documents (Codes and Standards)

At a minimum, all work performed and materials provided by the Supplier must be in accordance with all applicable Centre, State and local laws, ordinances, and regulations. The equipment will comply with the applicable portions of the following Codes and Standards.

The applicable revision of each of these Codes and Standards will be the current edition with addenda or the edition adopted by the controlling jurisdiction at the time of the purchase order.

In the event of a conflict between these documents and the specification, the Supplier shall submit a written request for an interpretation by BHEL. In general, the most stringent requirement shall govern.

Following are few standards.

American National Standard Institute (ANSI)
American Society of Testing and Materials (ASTM)
American Society of Mechanical Engineers (ASME)
American Petroleum Institute (API)
Air Moving & Control Association (AMCA)
Environmental Protection Agency (EPA)
Institute of Electrical and Electronic Engineers (IEEE)
Insulated Power Cable Engineers Association (IPCEA)
International Organization for Standardization (ISO)
Steel Structures Painting Council (SSPC)
National Electrical Code (NEC)
National Electrical Safety Codes (NESC)
National Electrical Manufacturer's Association (NEMA)
National Fire Protection Agency (NFPA)
American Welding Society (AWS)
American Institute of Steel Construction (AISC)
Occupational Safety and Health Administration (OSHA)
Joint Industrial Conference (JIC)
Instrument Society of America (ISA)
Bureau of Indian Standards (IS)

2.7 Operating procedure / duration

A operating procedure shall be provided by the Supplier to define the operating parameters of the system including the function of each piece of equipment, sounding intervals/durations, control devices, and instrumentation. This narrative shall form a basis to instruct and train plant personnel.

Precise P&ID's, and complete equipment/system operating and maintenance instructions/manuals provided in accordance with this specification shall complement this narrative.

2.8 Surface Preparation and Painting

As Per Manufacturer's Standard for outdoor installation and painting as applicable to project.

2.9 Tagging Requirements

Mechanical equipment, motors, electrical equipment, control panels, valves, and instruments shall be tagged.

2.10 Field Service

At the request of BHEL, Supplier shall furnish a Field Engineer to provide technical assistance during construction/installation and commissioning.
BHEL will give Supplier sufficient notice prior to the site requirement for field service.
Supplier stipulations that require a field service engineer or technician, such as inspection prior to equipment start up, shall be indicated in writing.

2.11 Spare Parts

Supplier shall include Start-up spare parts in the base pricing.
Supplier shall provide an option price for 5-year operating spare parts.
Supplier must supply a Start-up Spare Parts List and a 5-year Operating Spare Parts list in Excel format.

2.12 Documents to be submitted along with the offer

a) Filled in data sheets
b) Point wise compliance to the specification
c) Deviations to the specification (if any) shall be clearly spelt out in detail.
d) Overall dimensional assembly drawing for the selected variant along catalogues, drawings and O&M manuals.
e) Cross sectional drawing with parts and materials identified with ash sweeper assembly details.
f) Full designation with description of the designation codes for the selected variant.
g) Relief valve dimensional drawing, data sheet and selection criteria.

2.13 Documents to be submitted after placement of order

Following documents shall be submitted along with the supplies.

a) Functional write up
b) Equipment training manual
c) O&M instruction in soft version
d) Dimensional drawing
e) Cross section drawing with material identification and ash sweeper assembly details and Data sheets
f) Erection drawings along with BOM clearing all the interferences in boiler and SCR for BHEL review. BHEL will provide necessary General arrangement and floor plan drawings for preparation of erection drawings.

2.14 Packing

a) All opening shall be firmly capped against ingress of water or dust.

b) Shall be seaworthy packed in wooden boxes with water proof under cover for export jobs and road worthy packing for inland jobs.

c) Liberal packing material & struts shall be used to arrest rolling & to protect from transit damages.

2.15 Marking

Stainless steel name plates with following boldly engraved shall be firmly fixed to the body with Maker's name & production serial number, tag number and Ash sweeper designation.

2.16 Guarantee

Vendor shall guarantee for design & manufacturing defects for a period of 12 months from the date of commissioning or 18 months from the date of supply whichever is earlier.

Vendor shall guarantee the performance of the de dusting system as per Clause 2.4 of this specification and annexure De-dusting system/performance guarantee.

3 Attachments and Reference Documents

3.1 Datasheets

Document No.	Description
Refer 5.0	Ash Sweeper selection
	Flue Gas Conditions (attached along with TSR:007)

3.2 Reference Drawings

Refer enclosures

4 Customer Specifications, Attachments, and Reference Documents

4.1 Customer Specifications & data sheets

Nil

4.2 Reference Drawings

Nil

5 Ash Sweeper selection and Datasheet

		ASH SWEEPER SELECTION		
		Owner / Client:	MAHAGENCO	Customer Number: 1727
		Plant:	BHUSWAL TPS	**Datasheet**
Confidential	Data Revision Date	Unit No:	#6	
See NOTICE below	…	Location:	MAHARASHTRA	

NOTICE: This document and the information, design, and material contained and/or illustrated herein (hereinafter "proprietary material"), is the property of COMPANY and is submitted, lent, and furnished to recipient in strict confidence with the express understanding that the recipient shall not reproduce, copy, loan, dispose of, or disclose to anyone outside recipient's organization, directly or indirectly, or use said proprietary material for any purpose other than that for which it is furnished and submitted by COMPANY. Recipient by receiving said proprietary material agrees to these terms, not to use the proprietary material in any way injurious to the interests of COMPANY, and to return the same upon request by COMPANY.

5.1	**GENERAL INFORMATION**	
5.1.1	Equipment Name:	Ash Sweeper System
5.1.2	Quantity:	64 (Present) + 32 (Future)#
5.1.3	Tag Number(s):	AS#1 to AS# 64 $
5.1.4	Indoor/Outdoor:	Outdoor
	REFERENCE DOCUMENTS	
5.1.5	0-SR-056-00049	P&ID Key Diagram
5.1.6	0-SR-500-00006	P&ID for ash sweeper system
5.1.7	0-SC-288-90002	P&ID of SCR reactor system
5.1.8	1-SR-000-00005	SCR reactor arrangement for de dusting system
5.1.9	0-SR-500-00005	P&ID for sonic horn system
5.1.10	Valve list	SR/DD/1727/valve/001

Provision for future is required including valves, pipes and necessary accessories making the system complete except ash sweepers.

$ - Vendor to Confirm

5.2	**PERFORMANCE DATA**	**Units**	**Value / unit**
	Number of Units	**No.**	**1**
5.2.1	Number of reactors per unit	No.	2
5.2.2	Reactor designations per unit	-	A,B
5.2.3	Number of levels of ash sweepers per reactor	No.	3 (2 Present +1 Future)
5.2.4	Number of ash sweepers per level per reactor	No.	16$
5.2.5	Total number of ash sweepers per reactor	No.	Present : 32$ + Future :16$
5.2.6	Total of ash sweepers per unit	No.	Present : 64$ + Future :32$

5.2.7	Reactor size (inside casing dimensions) (D_RXW_R)	mm x mm	12682x 16772
5.2.8	Configuration (sweeper placement per level: front wall / rear wall / side walls)	--	Front wall, Rear wall
5.2.9	Flue Gas Dust Loading	g/Nm^3 (Max)	80.1
5.2.10	Low Dust or High Dust SCR	--	High Dust SCR
5.2.11	Fuel / Type of Coal	--	Worst Coal with 25% Excess Air
5.2.12	Verification System Required	Yes / No	No
5.2.13	Pining material		*

$ - Vendor to confirm

*- Vendor to fill

5.3	REQUIREMENTS FROM BHEL TO ASH SWEEPER SUPPLIER TO MEET PEROFRMANCE GUARANTEES					
5.3.1	**Requirement**		**Units**	**Value**	**Coverage (% Of Surface)**	**Deviation**
5.3.2	Gas velocity distribution at catalyst inlet		%	±10	80	Deviation from Mean
5.3.3	Gas velocity distribution at catalyst inlet		%	±20	100	Deviation from Mean
5.3.4	No substantial accumulation of popcorn ash is deposited on catalyst surface					
NOTE	All ash sweepers are supplied and installed at the start of the project except Future layer ash sweepers.					

5.4	DESIGN CRITERIA	Units	Value
5.4.1	Required air pressure	Kg/cm2 (Gauge)	*
5.4.2	Required air flow rate when operating	Nm^3/h	*
5.4.3	Required Air Quality Class as per ISO 8573-1	solids.water.oil	*
5.4.4	Interval between sweeper blasts	minutes	*
5.4.5	Area of coverage per sweeper	depth/width	*
5.4.6	Reaction thrust when a sweeper is fired	kg	*

5.5	CONSTRUCTION	Units	Value
5.5.1	ASME Pressure Vessel Size	L	*
5.5.2	ASME Pressure Vessel Material	material	*
5.5.3	Safety Cable Length	m	*
5.5.4	Safety Cable Material	material	*
5.5.5	Ash Sweeper Valve Type	-	*

5.5.6	Mounting components & blanking plates to allow future mounting in spare /future catalyst layer	Number	Required~~/Not required~~
5.6	Solenoid Valve Details	Units	Value
5.6.1	Solenoid Valve rating	V	24V DC
5.6.2	Solenoid valve Make & Model	-	*
5.6.3	End Connections	Inch	*
5.6.4	Body material	-	*
5.6.5	Single/Dual	single	*
5.6.6	Insulation class	Class H	*
5.6.7	Enclosure	IP65	*
5.7	Relief Valve Details	Units	Value
5.7.1	Relief valve Set pressure	Kg/cm^2	*
5.7.2	Make & Model	-	*
5.7.3	End connection details	-	*
5.7.4	Relief valve GA Drawing	-	*
5.7.5	Nozzle type	-	*

*- Vendor to fill

5.8	**Hoses**	**Units**	**Value**
5.8.1	Number of Hoses per Ash sweeper assembly	No	*
5.8.2	Hose End connections	-	*
5.8.3	Hose Make and Model	-	*
5.8.4	Hose GA drawing	-	*

6 ANNEXURE- A

BHEL APPROVED VENDOR LIST FOR SCR DE-DUSTING SYSTEM

Sl.no	Component/ equipment		Vendor
1	Sonic horns	a)	Integrated Global Services
		b)	Clyde Bergemann
		c)	Martin Engineering Company India Private
2	Ash Sweepers (Air Cannons)	a)	Integrated Global Services
		b)	Martin Engineering
NOTE 1 : Vendor list to be submitted for BHEL review along with credentials.			
NOTE 2 : All applicable components, electrical equipment and accessories which are part of the skid shall have PESO/CCOE certification and the same to be provided to BHEL.			
NOTE 3: Any other alternate vendor shall be subjected to BHEL approval on submission of credentials to the fullest satisfaction of BHEL.			

BHARAT HEAVY ELECTRICALS LIMITED

TIRUCHIRAPPALLI-620 014

Fuel Systems/PE(FB)

Technical Purchase Specification for

SONIC HORNS SYSTEM

Specification No.: **TSR:007** Revision No.: 01

01	*30.07.21*	*-*	*General Revision*	VSN	GSK
Rev. No.	***Rev. Date***	***Clause***	***Description***	***Chd.***	***Appd.***

	Name	***Signature***	***Date***
Prepared	***Preetam kumar***	***-Sd-***	***04-09-2019***
Checked	***V Shankar Naik***	***-Sd-***	***05-09-2019***
Approved	***G. Saravanakumar***	***-Sd-***	***06-09-2019***

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2 TECHNICAL SPECIFICATION

2.1 Scope

This specification defines the minimum requirements for the design, manufacture, testing, preparation for shipment and delivery of materials and engineering documentation, for this equipment. The supplier is solely responsible for correct design, engineering and supply of their scope of supply including support for erection and commissioning.

The offer shall be based on supplier recommendations, employ sonic horns at appropriate location, as mutually established so as to avoid major stiffeners and structure but so as to effectively clean the entire cross section area and volume of each catalyst level. In the event of conflicts between codes, standards, and this specification, customer specification the more stringent requirements should apply and the conflict between these specifications shall be submitted to BHEL in writing.
In the event of conflicts between specification, datasheets & contract specific requirements the following order is to be considered for the system design.

1. Contract specific requirement.
2. Datasheets.
3. Technical purchase specification.

2.2 Equipment, Materials and Services by Supplier

The Supplier's scope of supply includes, but is not necessarily limited to:

- Equipment and ancillaries are as defined in datasheet Sonic Horn Selection, P&ID, and General Arrangement Drawings located in Section 5 of this document.
- 75 Hz Acoustic Horns - Straight Design.
- 75 Hz Acoustic Horns - Curved Design
- Air receiver tank
- De dusting system Erection drawings with BOM
- Mounting Rings or Tubes and Blank-off Plates (including fasteners) for future installation of additional acoustic horns, if applicable.
- All solenoid air valves, with associated bleed and block hand valves, pressure regulators, flexible hoses, air filters, Air receiver tank, and all other ancillary sub-equipment.
- System P&ID defining scope of supply, terminating points, piping, equipment, and instrumentation.
- Narrative explaining horn operational practice and suggested sequence.
- Manuals and instructions for storage, installation, commissioning, operating and maintenance.
- Equipment data sheets are to be completed by the Supplier in order to inform BHEL about the equipment being supplied.

- Special tools required. For example, if a special tool is required during shop fabrication or handling, the device must be available on the construction site for installing that piece of equipment.
- Sonic horn system design shall include compressed air supply piping and DCS controls for all sonic horns including future layer sonic horns with the initial design itself to facilitate future tie-in for the spare catalyst layer. Receiver tank, fasteners, valves and other accessories required for the future layer shall be designed and supplied for this specification. Supplier to design and supply equipment in full where in only future layer sonic horns will be ordered to make the system complete

2.3 Equipment, Materials and Services by Others

- The scope of supply by others shall be:
- Unloading and storage at site
- Installation
- Testing, field performance monitoring, and inspections (Supplier to witness/assist)
- Utility systems piping up to terminal point
- Monorails and hoists
- Compressed air interconnecting piping to the Supplier's supplied equipment up to terminal point.
- Structural support steel
- Insulation
- Electrical wiring, conduits, trays, push buttons and starters external to Supplier supplied equipment
- DCS controls and remote alarms
- Instruments PG/PI, PIT/PT's and PDT/PDIT's are in BHEL scope as marked by terminal points and shown in P&ID for ash sweeper & sonic horn system in reference drawings.
- Ash sweepers in Future layer

2.4 Performance Guarantees

The equipment provided by the Supplier shall operate in accordance with the performance data in the datasheet(s) included herewith.

The equipment shall meet all applicable code requirements so that all required inspections are passed and permits obtained.

BHEL and/or Owner may conduct field tests during start-up and after commercial operation of the installation for a period determined by the terms and conditions of purchase. With the boiler unit operating as mentioned in SCR/DD/PG/001 and the SCR in operation, the Supplier's sonic horn equipment shall be guaranteed to maintain the total pressure loss across each installed catalyst layer at a value no greater than as specified in SCR/DD/PG/001. The increase in pressure

loss must be measured over a twenty-four (24) hour period of continuous operation of the SCR system. Supplier may expect that no significant accumulation of LPA (Large Particle Ash) is deposited on catalyst surfaces.

Total air consumption rate shall not exceed the instantaneous and averaged hourly rates as specified by the supplier on the data sheet in section 5 clause 5.4.04. Also the total air consumption of ash sweepers and sonic horns put together shall be below the values mentioned in the De-dusting system/ performance guarantee SCR/DD/PG/001.

The catalyst surface shall be free of accumulations of dust/ash that would harm or cause loss of catalyst performance.

The operating horn performance and operating sequence chosen by Supplier shall not be less than 125dB at any point in the reactor.

The Supplier shall fully cooperate with BHEL and Owner in defining a system test procedure. This test procedure shall consider individual horn performance, grouped or otherwise, both in the cold SCR and hot flue gas conditions. Monitoring of SCR system pressure drop criteria shall be determined in advance. Catalyst surface cleanliness criteria shall be determined based on SCR operating procedures and observations of dust accumulation accounting for operating time and fuels being fired. The Supplier's test procedure shall be mutually agreed upon by the concerned parties including, but not limited to, Supplier, BHEL and Owner.

The System must ensure operational cleanliness and performance of the SCR catalyst without any damage or deterioration of the catalyst and its ancillary equipment.

2.5 Detailed Requirements of Equipment

2.5.1 General

The SCR facility is designed and operated with flue gas having high dust concentrations. The flue gas conditions and fuel data for the resultant ash/dust, etc. are as defined in Section 5.

The Supplier shall include mounting plates/rings or tubes (as required, one for each sonic horn), pre-drilled and tapped and/or weld-prepped, with all required fasteners and hardware. No welding to the horn sections is permitted.

The Supplier shall provide mounting components and blanking plates to allow future mounting of additional sonic horns on the spare layers of the SCR if specified in datasheets.

The horn driver diaphragm shall be proven and is to be made of Supplier's standard material for the service and be replaceable with the reactor in service.

The Supplier shall ensure that the Supplier's standard horn materials are suitable for the service. Generally, the outboard section(s) of the horn will be of Supplier selected cast iron and the inner section(s) of stainless steel. All sections shall be securely bolted to form an integral unit. If a longitudinal weld is required in the fabricated stainless steel section of the horn the weld shall have no re-entrant angles, and be of a regular profile both longitudinally and laterally with no undercut or concavity.

An insulated enclosure will be fabricated by BHEL to attenuate noise and to prevent corrosion due to a combination of condensation and ash plugging in the horn.

The Supplier must provide Material Safety Data Sheets (MSDS) for all coatings, paints, lubricants, preservatives, or chemicals that will be brought onto the site by the Supplier for whatever reason. The MSDS must be submitted before equipment is delivered on the site.

The Supplier shall provide a detailed description of any special lifting and/or installation requirements.

Vendor shall provide mounting details required for the Air receiver tank. The required fasteners shall be in the scope of supplier.

2.5.2 System Air Supply

In order for the Sonic Horn System to operate properly and safely under normal and expected conditions, the Supplier shall provide BHEL with complete data for the requirements of the Air Supply (see also datasheets Sonic Horn Selection in Section 5, to be completed by Supplier):

- Required air pressure ($Kg/cm^2(g)$).
- Required air flow rate when operating (Nm^3/hr).
- Acceptable moisture limit in order to avoid freezing.
- Acceptable range of oil and particulate content.
- Measures needed to avoid freezing, damage or failure of the System.

The air receiver tank shall be included in the Supplier's scope of supply and it must have an ASME stamp and be sized correctly for all the acoustic horns on each reactor (one receiver per reactor). Each receiver shall include inlet and outlet nozzles, pressure relief valve, pressure gauge connection/stub as applicable, and manual drain valve.

2.5.3 Terminal Points

The Supplier shall furnish all equipment and services necessary to connect the equipment to the BHEL's system. Connections will include, but are not limited to the following as required by this specification:

- Refer attached P&ID for terminal points.
- Line mounted instruments shall be under the scope of supply of BHEL / Vendor as marked by terminal point.

- Supplier shall identify detail terminal points and applicable services in their proposal.

2.5.4 Instrumentation, equipment and valves

Supplier shall provide the valves as per BHEL valve schedule and specification. However, supplier shall provide the list and supply instruments, equipment and valves to make the system complete.
Also vendor to provide the complete P&ID equipment, valves, instruments in line with BHEL P&ID's in excel and drawing formats in the offer stage itself.

2.5.5 Pipe, Valves, and Fittings

The Supplier shall provide all equipment as per terminal point scope. The piping class shall be 300.
Flexible pipe connections to the sonic horns shall be stainless steel flex hose having threaded connections.
Piping material shall be stainless steel as per ASTM A312 Gr304.

2.6 Industry Reference Documents (Codes and Standards)

At a minimum, all work performed and materials provided by the Supplier must be in accordance with all applicable Centre, State and local laws, ordinances, and regulations.

The equipment will comply with the applicable portions of the following Codes and Standards. The applicable revision of each of these Codes and Standards will be the current edition with addenda or the edition adopted by the controlling jurisdiction at the time of the purchase order. In the event of a conflict between these documents and the specification, the Supplier shall submit a written request for an interpretation by BHEL. In general, the most stringent requirement shall govern.

- American National Standard Institute (ANSI)
- American Society of Testing and Materials (ASTM)
- American Society of Mechanical Engineers (ASME)
- American Petroleum Institute (API)
- Air Moving & Control Association (AMCA)
- American Gear Manufacturers Association (AGMA)
- Anti-Friction Bearing Manufacturers Association (AFBMA)
- Bureau of Indian Standards (IS)
- Environmental Protection Agency (EPA)
- Institute of Electrical and Electronic Engineers (IEEE)
- Insulated Power Cable Engineers Association (IPCEA)
- International Organization for Standardization (ISO)
- Steel Structures Painting Council (SSPC)
- Hydraulic Institute (HI)
- National Electrical Code (NEC)

- National Electrical Safety Codes (NESC)
- National Electrical Manufacturer's Association (NEMA)
- National Fire Protection Agency (NFPA)
- American Welding Society (AWS)
- American Institute of Steel Construction (AISC)
- Occupational Safety and Health Administration (OSHA)
- Joint Industrial Conference (JIC)
- Instrument Society of America (ISA)

2.7 Operating Sequences/Duration

An operating procedure shall be provided by the Supplier to define the operating parameters of the system including the function of each piece of equipment, sounding intervals/durations, control devices, and instrumentation. This operating procedure shall form a basis to instruct and train plant personnel.
Precise P&ID's, and complete equipment/system operating and maintenance instructions/manuals provided in accordance with this specification shall complement this narrative.

2.8 Surface Preparation and Painting

Project specific painting or Manufacturer's Standard whichever is applicable.

2.9 Field Service

At the request of the BHEL, Supplier shall send a Field Engineer to provide technical assistance during construction/installation and commissioning free of cost.

BHEL will give Supplier sufficient notice prior to the site requirement for field service.
Supplier stipulations that require a field service engineer or technician, such as inspection prior to equipment start up, shall be indicated in writing.

2.10 Spare Parts

The Supplier shall provide a list of recommended spare parts including start-up and commissioning spares and special tools, with and without pricing, and a schedule of part replacements based on the operation and service conditions specified.

2.11 Operation and Maintenance Manual

The operation and maintenance instructions must be supplied with manuals or cut sheets for all purchased components, plus sufficient specific equipment information to accomplish the following:

Proper identification of the equipment, including nameplate data where applicable.
Proper handling and storage on-site prior to installation and commissioning.
Proper installation.
Performance and necessary pre-operation conditioning or checkout and test.
Safe and successful initial and subsequent operation.
Proper maintenance, by describing schedule and activity.
Proper lubrication, by providing lubrication schedule, lubricant specifications, and alternates.
Proper calibration, both initial and after prolonged usage.
Proper ordering of parts, components, and sub-assemblies, by supplying appropriate identification and ordering information.
Proper spare parts inventory.
Equipment checks and tests, by supplying performance curves, charts, etc., as applicable.

2.12 Documents to be submitted along with the offer

a) Filled in data sheets
b) Point wise compliance to the specification
c) Deviations to the specification (if any) shall be clearly spelt out in detail.
d) Overall dimensional assembly drawing for the selected variant along catalogues, drawings and O&M manuals.
e) Cross sectional drawing with parts and materials identified with sonic horn assembly details.
f) Full designation with description of the designation codes for the selected variant.
g) Relief valve dimensional drawing, data sheet and selection criteria.

2.13 Documents to be submitted after placement of order

Following documents shall be submitted along with the supplies.

a) Functional write up
b) Equipment training manual
c) O&M instruction in soft version
d) Dimensional drawing
e) Cross section drawing with material identification and sonic horn assembly details and Data sheets.
f) Erection drawings along with BOM clearing all the interferences in boiler and SCR for BHEL review. BHEL will provide necessary General arrangement and floor plan drawings for preparation of erection drawings.

2.14 Packing

a) All opening shall be firmly capped against ingress of water or dust.

b) Shall be seaworthy packed in wooden boxes with water proof under cover for export jobs and road worthy packing for inland jobs.

c) Liberal packing material & struts shall be used to arrest rolling & to protect from transit damages.

2.15 Marking

Stainless steel name plates with following boldly engraved shall be firmly fixed to the body with Maker's name & production serial number, tag number and sonic horn designation.

2.16 Guarantee

Vendor shall guarantee for manufacturing defects for a period of 12 months from the date of commissioning or 18 months from the date of supply whichever is earlier.

Vendor shall guarantee the performance of the de dusting system as per performance guarantee SCR/DD/PG/001.

3 Attachments and Reference Documents

3.1 Datasheets

Document No.	Description
Sub section of Section 5.0	Sonic horn selection and Data sheets
1	General information
2	Performance data
3	Requirements from BHEL to sonic horn supplier to meet performance guarantees
4	Design criteria
5	Construction
6	Filter
7	Receiver tank
8	Sonic horn performance guarantee (required of the seller)

4 Customer Specifications, Attachments, and Reference Documents

4.1 Customer Specifications & data sheets

Nil

4.2 Reference Drawings

Nil

5 Sonic Horn Selection and Data Sheets

		SONIC HORN SELECTION	
		Owner / Client: MAHAGENCO	Customer Number: 1727
		Plant: BHUSAWAL	**Data Sheets**
Confidential	Data Revision Date	Unit No: #6	
See NOTICE below	…	Location: MAHARASHTRA	

5.1	**GENERAL INFORMATION**	
5.1.1	Equipment Name	Sonic Horn
5.1.2	Quantity	*
5.1.3	Tag Number(s)	SH"XX" to SH"YY"
5.1.4	Indoor/Outdoor:	Outdoor
	Reference documents	**Drawing / document number**
5.1.5	SCR – Key Diagram	0-SR-000-00049
5.1.6	P&ID for ash sweeper system	3-SR-500-00006
5.1.7	P&ID SCR System	0-SC-288-90002
5.1.8	SCR Reactor arrangement	1-SR-000-00005
5.1.9	P&ID for sonic horn system	3-SR-500-00005
5.1.10	Valve list	SR/DD/1727/valve/001

* - Vendor to fill

5.2 PERFORMANCE DATA

		Units	Value / unit
5.2.1	Number of Units	No	1
5.2.2	Number of reactors per unit	No	2
5.2.3	Reactor designations per unit	A / B / C / D, etc.	A,B
5.2.4	Number of levels of horns per reactor	No	3 (2 Present + 1 Future) #
5.2.5	Number of horns per level per reactor	No	8$
5.2.6	Total number of horns per reactor	No	16$ Present + 8$ Future #
5.2.7	Total of horns (per unit)	No	32$ Present + 16$ Future #
5.2.8	Reactor size (inside casing dimensions)	mm x mm	12682 X 16772
5.2.9	Configuration (horn placement per level: front wall, rear wall, north, south, other)	--	Left Side Wall, Right Side Wall
5.2.10	Arrangement type (bell section "C" inside reactor, flush mounted, or other)	--	*
5.2.11	Advocated horn type (straight, curved, or other)	--	Straight
5.2.12	Thermal Wrap	Yes / No	No
5.2.13	Verification System	Yes / No	No
5.2.14	Flue Gas Dust Loading	g/Nm^3	80.1
5.2.15	Low Dust or High Dust SCR	--	High Dust SCR
5.2.16	Fuel / Type of Coal		As furnished below
5.2.17	Mounting components & blanking plates to allow future mounting in spare catalyst layer	Number	Required/~~Not required~~

$ - Vendor to confirm

* - Vendor to fill

- Provision for future is required including valves, pipes and necessary accessories making the system complete except sonic horns.

5.2.16 COAL PROPERTIES

DESCRIPTION (Source / Type)	UNIT	Indigenous coal				
		DESIGN COAL (Washed)	WORST COAL (3500kcal/kg HHV)	RANGE	New Worst COAL (3200 kcal/kg HHV) $	
PROXIMATE ANALYSIS						
Fixed carbon	% by wt	28.83	25.50	24-30	25	
Volatile matter	% by wt	26.61	21.30	20-30	20	
Moisture (Total)	% by wt	10.80	12.00	6-15	12	
Ash	% by wt	33.76	41.20	30-43	43	
Total	% by wt	100	100	100	100	
HHV	kcal / kg	3731	3500	3300-4000	3200	
ULTIMATE ANALYSIS						
Carbon	% by wt	40.34	35.87	30-45	35.71	
Hydrogen	% by wt	2.61	2.66	2.5-4.0	2.07	
Sulphur	% by wt	0.70	0.60	0.5-0.7	0.75	
Nitrogen	% by wt	0.97	0.72	0.4-1.5	0.57	
Oxygen (difference)	% by wt	10.82	6.95	Upto 12	5.90	
Moisture	% by wt	10.80	12.00	6-15	12	
Ash	% by wt	33.76	41.20	30-43	43	
HARD GROVE INDEX		55	50	45-60	50	
ASH CHARACTERISTICS						
IT - Initial deformation temp.	°C	1160	1100	1050-1250		
ST - Softening temp. H = W	°C	-	-	-		
HT - Hemispherical temp. = W / 2	°C	1200-1300	1150-1300	1150-1350		
FT - Fusion temp.	°C	1400	1400	1350-1450		
ASH CONSTITUENTS						
A - Si O2	% by wt	61	58	57.2-63.8		
A - Al2 O3	% by wt	29.2	31	26.7-31.8		
B - Fe2 O3	% by wt	5	7	2.0-7.2		
B - CaO	% by wt	1.5	1.5	1.1-1.6		
B - MgO	% by wt	0.4	0.8	0.4-1.0		
B - Na2 O	% by wt	0.12	0.12	0.12		
B - K2 O	% by wt	0.4	0.4	0.4		
A - TiO2	% by wt	1.5	1.0	1.0-1.5		
P2O5	% by wt	0.8	0.2	0.2-0.8		
SO3	% by wt	Trace	Trace	Trace		

5.2.14 Flue gas conditions

As furnished below

Sl. No.	Description	Unit	TMCR DC	BMCR NWC	50% TMCR DC
			Guarantee Point	Design Point	Min Operating Point
1.	Flue Gas flow	t/h	2460	2740	1282
2.	Volumetric Gas Flow (wet-dust free)	Nm^3/s	537	601	280
3.	Flue Gas temperature	°C	334	346	314
4.	Pressure at Eco outlet	mmWc	-107	-121	-60
5.	Flue gas constituents, Wet Basis - % by weight				
	i. CO_2	% by wt	21.539	21.250	21.539
	ii. N_2	% by wt	68.591	68.842	68.591
	iii. SO_2	% by wt	0.204	0.243	0.204
	iv. Moisture	% by wt	6.220	6.203	6.220
	v. O_2	% by wt	3.446	3.461	3.466
	vi. HCl (wet basis)	ppm	--	--	--
	vii. HF (wet basis)	ppm	--	--	--
6.	O_2 (dry vol. basis)	%	3.548	3.560	3.548
7.	Inlet Particle dust conc. (wet)	gm/Nm^3	54.1	80.1	54.1

REQUIREMENTS FROM BHEL TO SONIC HORN SUPPLIER TO MEET PEROFRMANCE

5.3 GUARANTEES

5.3.1	**Requirement**	**Units**	**Value**	**Coverage (% Of Surface)**	**Deviation**
5.3.2	Gas velocity distribution at catalyst inlet	%	±10	80	Deviation from Mean
5.3.3	Gas velocity distribution at catalyst inlet	%	±20	100	Deviation from Mean
5.3.4	No substantial accumulation of popcorn ash is deposited on catalyst surface				

NOTES:

1) Insulation by BHEL.
2) All sonic horns are supplied and installed at the start of the project.

5. 4	**DESIGN CRITERIA**	**Units**	**Value**
5.4.1	Frequency	Hz	*
5.4.2	Noise level	dB	*
5.4.3	Required air pressure	Kg/cm2 (Gauge)	*
5.4.4	Required air flow rate when operating	Nm^3/hr	*
5.4.5	Recommended Receiver Size (one per reactor)	Litre	*
5.4.6	Allowable oil particle size	Microns	*
5.4.7	Maximum oil content within ambient operating temperature range	PPM	*
5.4.8	Allowable solid particle size	microns	*
5.4.9	Allowable solid particle content	PPM	*
5.4.10	Allowable dew point	°C	*
5.4.11	Interval between horn soundings	minutes	*
5.4.12	Duration of horn sounding	seconds	*
5.4.13	Area of coverage per horn	depth/width	*
5.4.14	Total catalyst surface area to be cleaned by the horns	m^2	*
5.4.15	Life of titanium diaphragm	hours	*
5.4.16	Piping material		*

5.5	**CONSTRUCTION**	**Units**	**Value**
5.5.1	Sound generator diaphragm construction		*
5.5.2	Diaphragm material		Titanium alloy $
5.5.3	Diaphragm thickness		*
5.5.4	Diaphragm thickness tolerance		*
5.5.5	Diaphragm diameter		*

5.5.6	Diaphragm diameter tolerance		*
5.5.7	Bell section “A” material (ASTM number & grade)	ASTM number & Grade	*
5.5.8	Bell section “B” material (ASTM number & grade)	ASTM number & Grade	*
5.5.9	Bell section “C” material (ASTM number & grade)	ASTM number & Grade	*
5.5.10	Mounting assembly material (ASTM number & grade)	ASTM number & Grade	*
5.5.11	Minimum size casing opening for the mounting arrangement		*
5.5.12	Flange gasket material		*
5.5.13	Gasket for driver required	(Y / N)	*

5.6	**Filter**	**Units**	**Value**
5.6.1	Quantity	No	2
5.6.2	Filter Type	-	*
5.6.3	Allowable DP across filter	Kg/Cm2	*
5.6.4	Make	-	*
5.6.5	Model	-	*
5.6.6	Size	-	*
5.6.7	End Connection Details	-	*

5.7	**Receiver Tank**	**Units**	**Value**
5.7.1	Size	-	*
5.7.2	Hyd Test pr.	-	*
5.7.3	GA drawing number with Foundation details	-	*
5.7.4	Make of Relief valve	-	*
5.7.5	Model of relief Valve	-	*

* - Vendor shall fill.
$ - Vendor to confirm

6 ANNEXURE-A

BHEL APPROVED VENDOR LIST FOR SCR DE-DUSTING SYSTEM

Sl.no	Component/ equipment		Vendor
1	Sonic horns	a)	Integrated Global Services
		b)	Clyde Bergemann
		c)	Martin Engineering Company India Private
2	Ash Sweepers (Air Cannons)	a)	Integrated Global Services
		b)	Martin Engineering
NOTE 1 : Vendor list to be submitted for BHEL review along with credentials.			
NOTE 2 : All applicable components, electrical equipment and accessories which are part of the skid shall have PESO/CCOE certification and the same to be provided to BHEL.			
NOTE 3: Any other alternate vendor shall be subjected to BHEL approval on submission of credentials to the fullest satisfaction of BHEL.			

TERMINAL POINT 'TP1'

	MEDIUM	NO	NB	FLOW	PR	TEMP
1	LIQUID NH3	1	80	20403	11.5	27
2	VAPOUR NH3	1	40	282	12	27

TERMINAL POINT 'TP2' (3 nos)

	MEDIUM	NO	NB	FLOW	PR	TEMP
1	NITROGEN	1	25	3	7	27
2	POTABLE WATER	1	25	4750	3.5	33

TERMINAL POINT 'TP3' (2 nos)

	MEDIUM	NO	NB	FLOW	PR	TEMP
1	SERVICE AIR	1	50	215	7	27

TERMINAL POINT 'TP4'

	MEDIUM	NO	NB	FLOW	PR	TEMP
1	SERVICE WATER	1	80 (03)	9000	6	33

TERMINAL POINT 'TP5'

	MEDIUM	NO	NB	FLOW	PR	TEMP
1	WASTE WATER	1	80	10000	-	-

TERMINAL POINT 'TP6'

	MEDIUM	NO	NB	FLOW	PR	TEMP
1	POTABLE WATER	1	100	23750	3.5	27

TERMINAL POINT 'TP7A & TP7B'

	MEDIUM	NO	NB	FLOW(f)	PR(p)	TEMP(t)
1	NITROGEN	2	25	3	7	27
2	POTABLE WATER	2	25	4750	3.5	27
3	LIQUID AMMONIA	1	40	442	17.5	27
4	WASTE AMMONIA	2	25	-	-	27

TERMINAL POINT 'TP7C'

	MEDIUM	NO	NB	FLOW(f)	PR(p)	TEMP(t)
1	STEAM	1	80	1000	16	290
2	CONDENSATE	1	80	1000	16	201

TERMINAL POINT 'TP8'

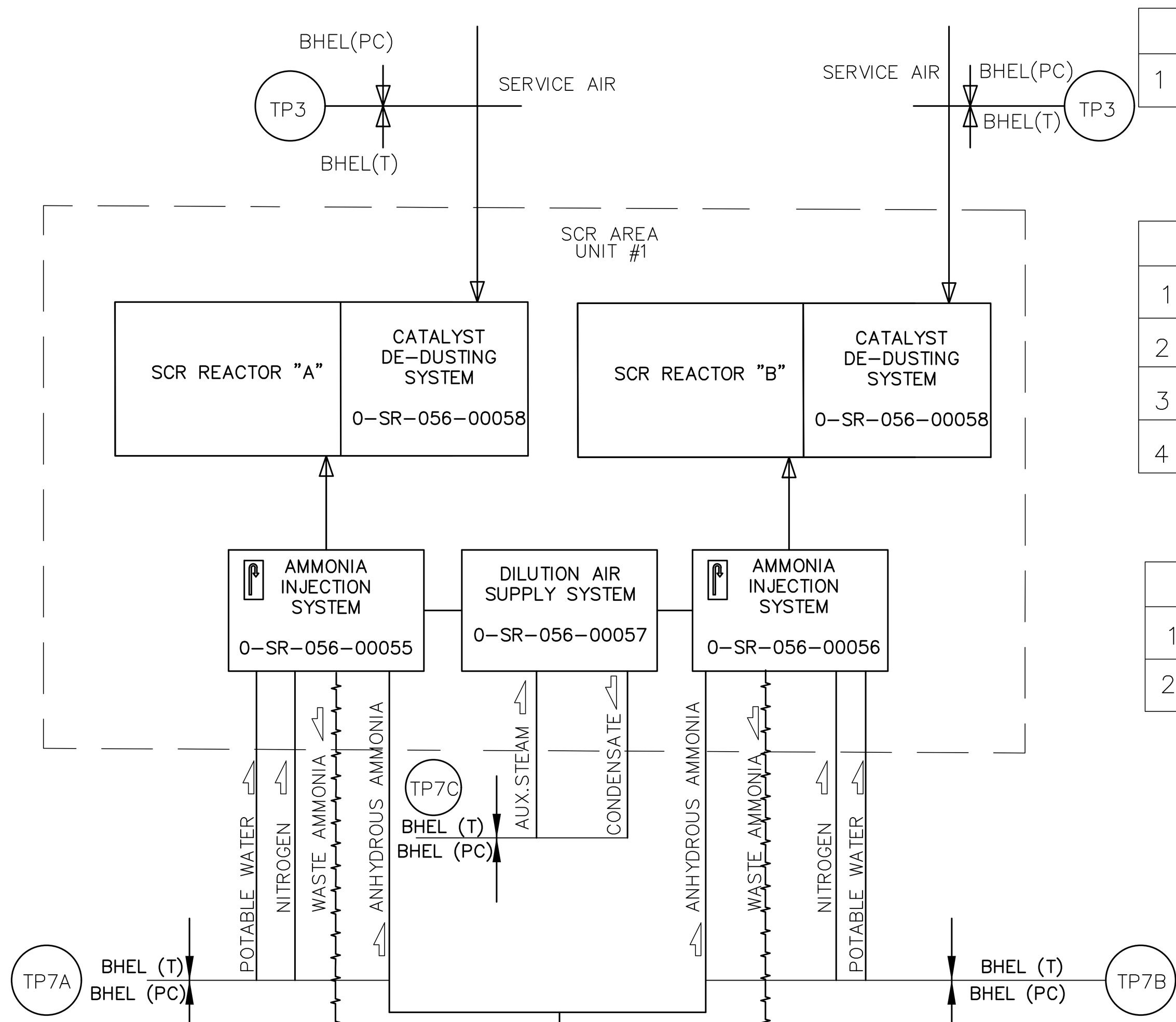
	MEDIUM	NO	NB	FLOW(f)	PR(p)	TEMP(t)
1	SULPHURIC ACID	1	25	510	-	AMB

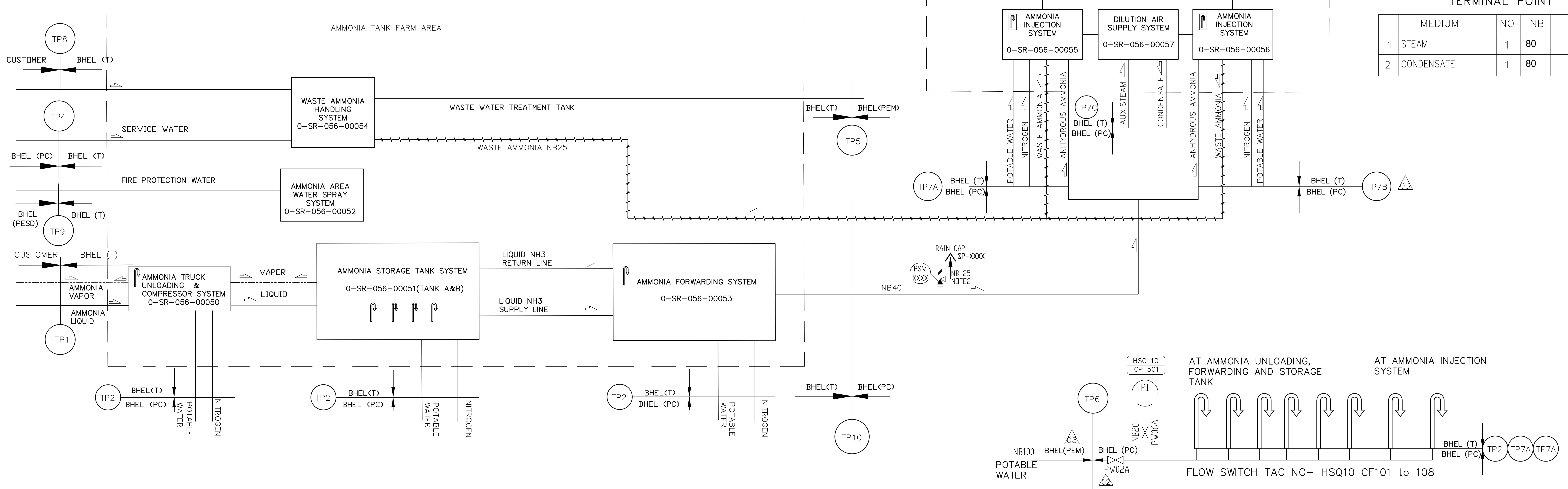
TERMINAL POINT 'TP9'

	MEDIUM	NO	NB	FLOW(f)	PR(p)	TEMP(t)
1	FIRE PROTECT. WATER	1	80	100000	6	27

TERMINAL POINT 'TP10'

	MEDIUM	NO	NB	FLOW	PR	TEMP
1	WASTE AMMONIA	1	25	-	-	27
2	LIQUID AMMONIA	1	40	442	17.5	27





REFERENCE DRAWINGS FOR P&ID

1. 0-SR-056-00050 P&ID of SCR system - Ammonia truck unloading system
2. 0-SR-056-00051 P&ID of SCR system - Ammonia storage system tank A&B
3. 0-SR-056-00052 P&ID of SCR system - Ammonia area water spray system
4. 0-SR-056-00053 P&ID of SCR system - Ammonia Forwarding system
5. 0-SR-056-00054 P&ID of SCR system - Waste ammonia handling systems
6. 0-SR-056-00055 P&ID of ammonia injection system reactor A
7. 0-SR-056-00056 P&ID of ammonia injection system reactor B
8. 0-SR-056-00057 P&ID of dilution air supply system
9. 0-SR-056-00058 P&ID for catalyst de-dusting System

NORMAL LINE PARAMETERS ARE IN,

'p' = PRESSURE IN Kg/Sq.CM(g)

't' = TEMPERATURE IN DEG'C.

AMB = Ambient

'f' = FLOW IN NCu.M/hr FOR AIR, NITROGEN.

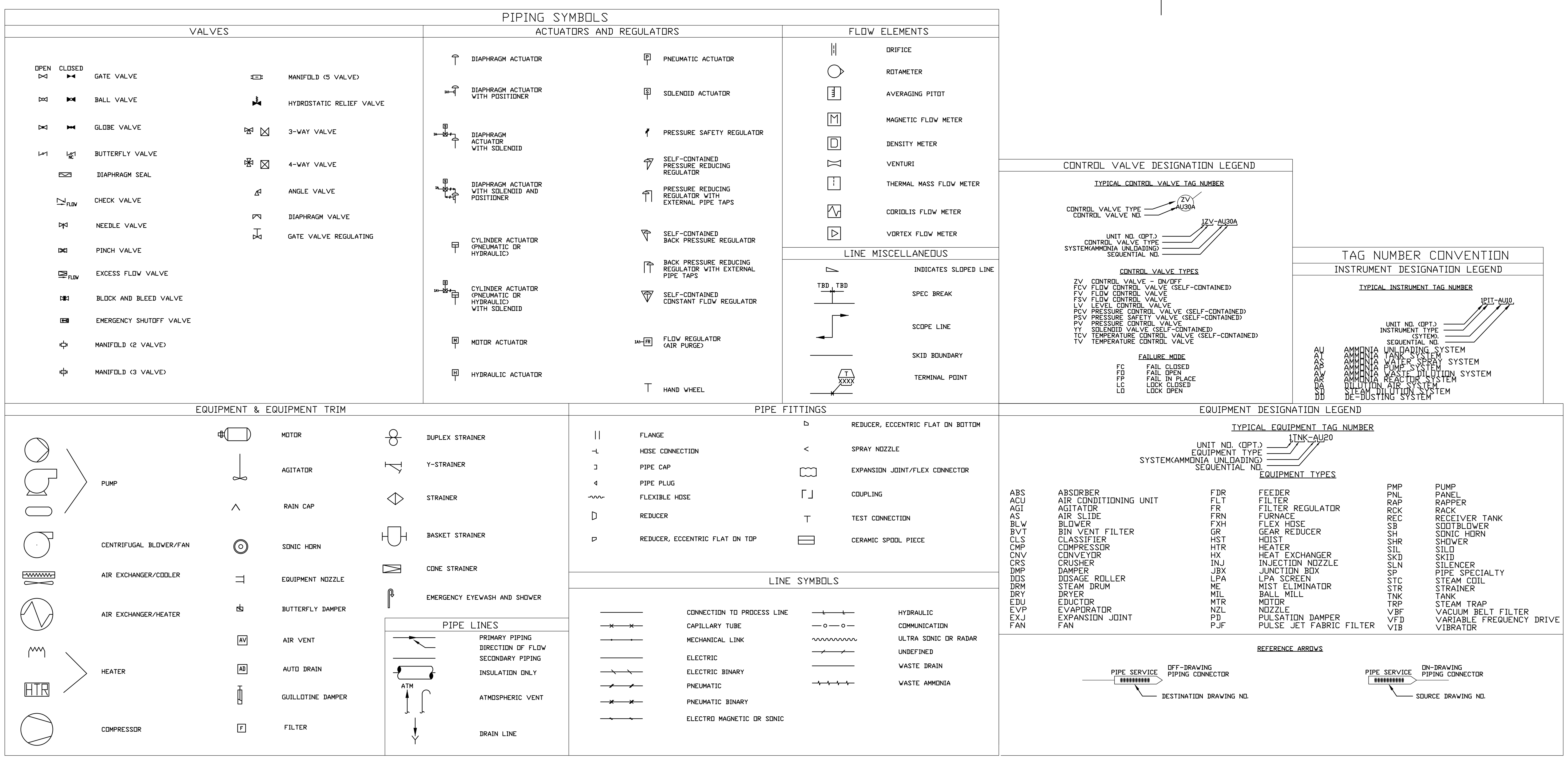
'f' = FLOW IN Kg/hr. FOR AMMONIA, ACID, WATER & STEAM. (01)

NOTES

1. (01) THE FLOWS INDICATED ARE INTERMITTENT EXCEPT AT TP3 . STEAM & DILUTION AIR TO SCAPH AND AMMONIA TO REACTOR ARE CONTINUOUS.
2. AMMONIA PSV/DRAIN/ISOLATION VALVES SHALL BE PROVIDED IN AMMONIA SUPPLY AS WELL AS WASTE AMMONIA LINES BY BHEL (PC). FOR THE QTY. AND EXACT LOCATION SEE THE PIPING LAYOUT DRG BY BHEL (PC).
3. (03) PIPE SCHEDULE :

PIPE SPECIFICATION – SA210 GrA1 OR SA106 GrB OR SA106 Gr C

NB10 – 14 x 2	NB80 – 88.9 x 5.49
NB15 – 21.34 x 2.77	NB100 – 114.3 x 6.02
NB25 – 33.4 x 3.38	NB150 – 168.27 x 7.11
NB40 – 48.26 x 3.68	NB200 – 219.07 x 6.35
NB50 – 60.32 x 3.91	



REV	DATE		
03	07.03.2021	ALTERED : BALAJI_D	CHD & APPD : SHANKAR_NAIK
ZONE	SCOPE CLARITY UPDATED.		
02	20.03.2020	ALTERED : BALAJI_D	CHD & APPD : SHANKAR_NAIK
ZONE	SCOPE CLARITY UPDATED.		
01	26.08.2019	ALTERED : VIKAS_SETHI	CHD & APPD : SHANKAR_NAIK
ZONE	STEAM FLOW UNIT ADDED AND NOTE 1 UPDATED.		

CUSTOMER NO.: 1727

PROJECT: 1x660 MW BHUSAWAL TPS UNIT-6

OWNER: MAHAGENCO — MAHARASHTRA STATE POWER GENERATION CO. LTD.

CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS VASHI, NAVI MUMBAI

EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD BOILER PLANT UNIT; TIRUCHIRAPALLI-620014, INDIA.

DRG TITLE:

P&ID OF SCR SYSTEM - KEY DIAGRAM

QSCRM

Babcock Power ENVIRONMENTAL a Babcock Power Inc. company

ALL DIMENSIONS IN MILLIMETERS

PROJECTION | SCALE NTS

DRAWN BY : VIKAS_SETHI	DATE : 30.05.2019
CHECKED BY : SHANKAR_NAIK	DATE : 30.05.2019
CHECKED BY : BPP	DATE : 30.05.2019
APPROVED BY : SARAVANA_KUMAR	DATE : 30.05.2019
VETTED BY : BPE	DATE :

DRAWING NO. 0-SR-056-00049 REV. 03

SCR/DD/PG/001 REV00

DE-DUSTING SYSTEM /PERFORMANCE GUARANTEE

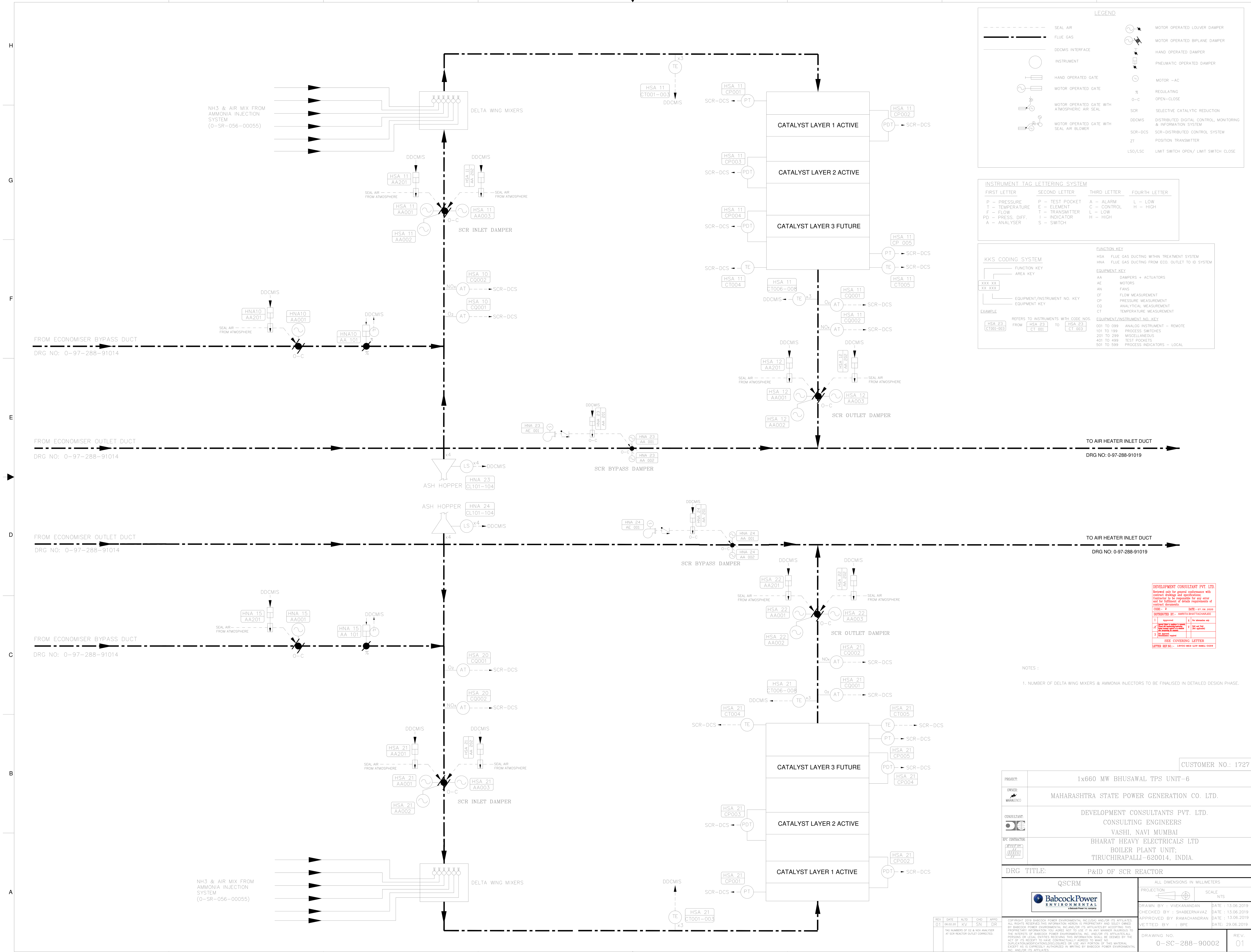
The vendor shall provide robust catalyst de-dusting system considering very high ash content of Indian coals. Vendor shall establish/ recommend de-dusting device frequency and their performance tuning based on the actual operation through controlled tests/measurements. Cleaning effectiveness shall target recovery, as measured through gas pressure drop and visual inspection, up to a near pressure drop value with reference to completely clean reactor as measured at the time of commissioning.

DE-DUSTING SYSTEM PERFORMANCE GUARANTEE DATA

Sl. No	DESCRIPTION	UNIT	PERFORMANCE GUARANTEE
1.	The operating Sonic horn's sound level within the reactor at any point	dBA	>125 dBA at all loads
2.	Exterior reactor noise level at 1 meter from the sonic horn/ash sweeper #	dBA	<85 dBA at all loads
3.	Catalyst surface cleaning requirement	-	Catalyst surface shall be free of ash accumulations that would harm or cause loss of catalyst performance.
4.	Boiler load condition for measurement of max pressure drop across reactor catalyst layers		**TMCR Design Coal- Guarantee point**
a.	Max pressure drop across the catalyst layer (from top of top catalyst to bottom to bottom catalyst layer)	mmwc	18.6
5.	Maximum service air consumption per unit (Service air pressure 7 kg/cm2(g) at ambient temperature)	Nm^3/hr	<430

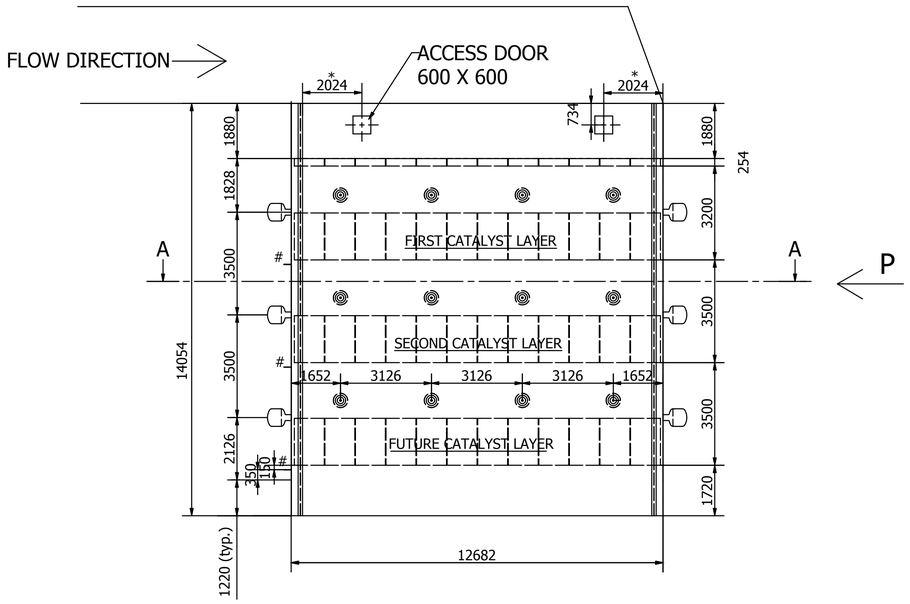
- Sonic horn and Ash sweeper vendor to suggest a suitable insulation to achieve the above mentioned sound level.

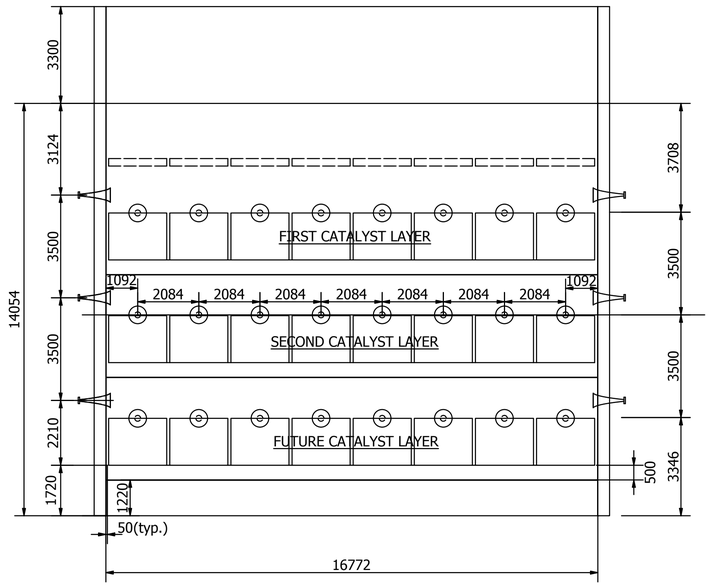
Supplier's sign and seal


LEGEND
SEAL AIR
FLUE GAS
DDCMIS INTERFACE
INSTRUMENT
HAND OPERATED GATE
MOTOR OPERATED GATE
MOTOR OPERATED GATE WITH ATMOSPHERIC AIR SEAL
MOTOR OPERATED GATE WITH SEAL AIR BLOWER
MOTOR OPERATED LOUVER DAMPER
MOTOR OPERATED BIPLANE DAMPER
HAND OPERATED DAMPER
PNEUMATIC OPERATED DAMPER
MOTOR -AC
REGULATING
OPEN-CLOSE
SCR SELECTIVE CATALYTIC REDUCTION
DDCMIS DISTRIBUTED DIGITAL CONTROL, MONITORING & INFORMATION SYSTEM
SCR-DCS SCR-DISTRIBUTED CONTROL SYSTEM
ZT POSITION TRANSMITTER
LSO/LSC LIMIT SWITCH OPEN/ LIMIT SWITCH CLOSE
INSTRUMENT TAG LETTERING SYSTEM
FIRST LETTER: P - PRESSURE, T - TEMPERATURE, F - FLOW, PD - PRESS. DIFF., A - ANALYSER
SECOND LETTER: P - TEST POCKET, E - ELEMENT, T - TRANSMITTER, I - INDICATOR, S - SWITCH
THIRD LETTER: A - ALARM, C - CONTROL, L - LOW, H - HIGH
FOURTH LETTER: L - LOW, H - HIGH
KKS CODING SYSTEM
FUNCTION KEY
HSA FLUE GAS DUCTING WITHIN TREATMENT SYSTEM
HNA FLUE GAS DUCTING FROM ECO. OUTLET TO ID SYSTEM
EQUIPMENT KEY
AA DAMPERS + ACTUATORS
AE MOTORS
AN FANS
CF FLOW MEASUREMENT
CP PRESSURE MEASUREMENT
CQ ANALYTICAL MEASUREMENT
CT TEMPERATURE MEASUREMENT
EQUIPMENT/INSTRUMENT NO. KEY
001 TO 099 ANALOG INSTRUMENT - REMOTE
101 TO 199 PROCESS SWITCHES
201 TO 299 MISCELLANEOUS
401 TO 499 TEST POCKETS
501 TO 599 PROCESS INDICATORS - LOCAL
NH3 & AIR MIX FROM AMMONIA INJECTION SYSTEM (0-SR-056-00055)
DELTA WING MIXERS
CATALYST LAYER 1 ACTIVE
CATALYST LAYER 2 ACTIVE
CATALYST LAYER 3 FUTURE
SCR INLET DAMPER
SCR OUTLET DAMPER
SCR BYPASS DAMPER
ASH HOPPER
FROM ECONOMISER BYPASS DUCT
DRG NO: 0-97-288-91014
FROM ECONOMISER OUTLET DUCT
DRG NO: 0-97-288-91014
TO AIR HEATER INLET DUCT
DRG NO: 0-97-288-91019
SEAL AIR FROM ATMOSPHERE
DDCMIS
SCR-DCS
NOTES :
1. NUMBER OF DELTA WING MIXERS & AMMONIA INJECTORS TO BE FINALISED IN DETAILED DESIGN PHASE.
CUSTOMER NO.: 1727
PROJECT 1x660 MW BHUSAWAL TPS UNIT-6
OWNER MAHARASHTRA STATE POWER GENERATION CO. LTD.
CONSULTANT DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS VASHI, NAVI MUMBAI
EPC CONTRACTOR BHARAT HEAVY ELECTRICALS LTD BOILER PLANT UNIT; TIRUCHIRAPALLI-620014, INDIA.
DRG TITLE: P&ID OF SCR REACTOR
QSCRM
BabcockPower ENVIRONMENTAL
ALL DIMENSIONS IN MILLIMETERS
DRAWN BY : VIVEKANANDAN DATE : 13.06.2019
CHECKED BY : SHABEERNAVAZ DATE : 13.06.2019
APPROVED BY : RAMACHANDRAN DATE : 13.06.2019
VETTED BY : BPE DATE : 29.06.2019
DRAWING NO. 0-SC-288-90002
REV. 01

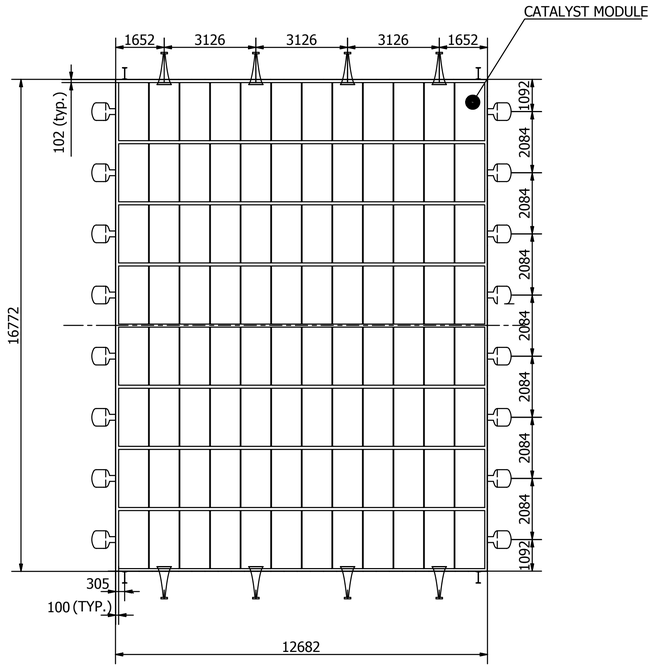
DRAWING NO. 1-SR-000-00005

FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER PLANT STD. NO TP 023 0299





VIEW - P



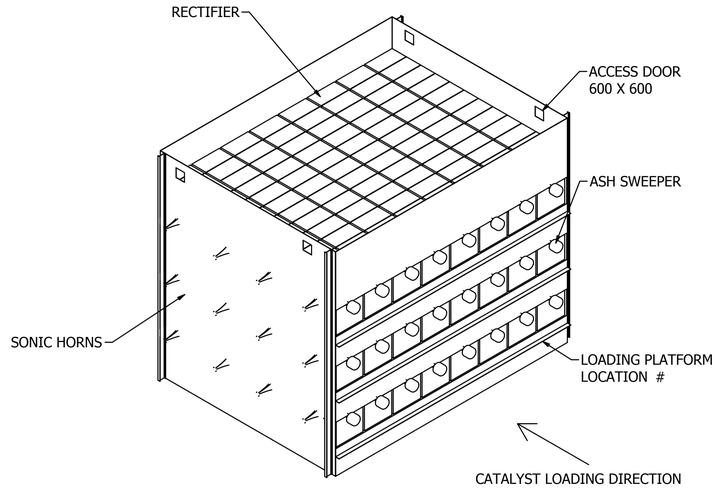
SECTION-A-A (1 : 100)

NOTES:

1. NUMBER OF REACTORS PER BOILER: 2
2. NUMBER OF CATALYST MODULE PER LAYER: 96 (8W X 12D)
3. # CATALYST MODULE LOADING PLATFORM

ASH SWEEPER, 32 NOS PER REACTOR, 64 NOS PER BOILER

SONIC HORN, 16 NOS PER REACTOR, 32 NOS PER BOILER



ISO. VIEW

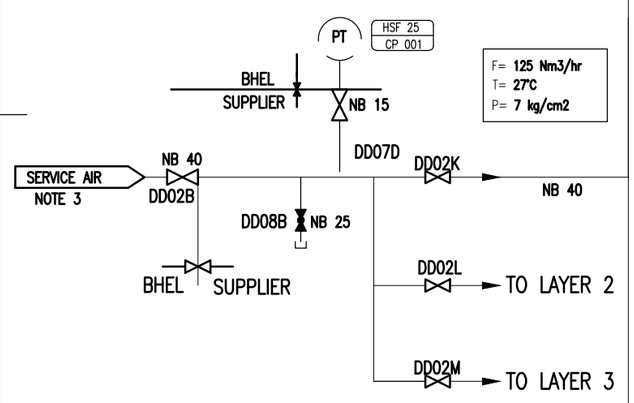
CUST NO. 1727

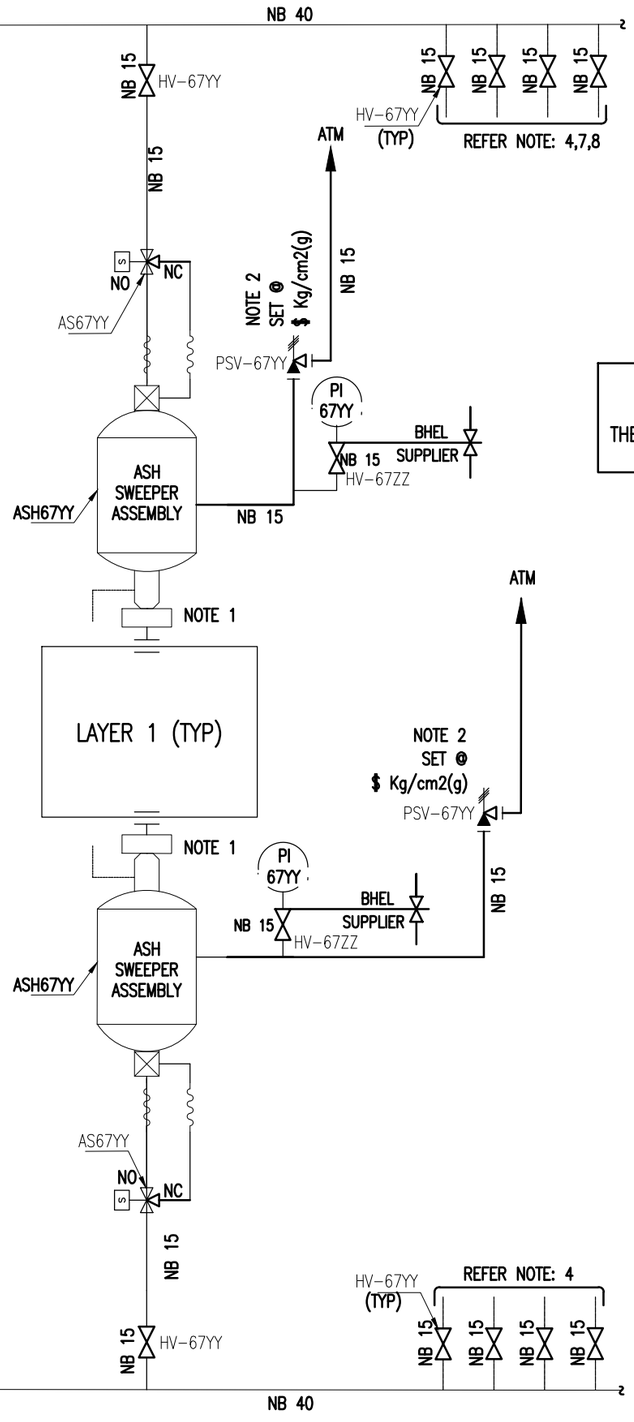
TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT	MAHARASHTRA STATE POWER GNERATION CO.LTD. 1 X 660 MW TPS BHUSAWAL UNIT -6		
Bharat Heavy Electricals Ltd UNIT: HIGH PRESSURE BOILER PLANT TIRUCHIRAPALLI - 620014	DRN RAVI SHANKAR PRASAD		03.06.2019
355-053	CHD SRINIVASU ARUGULA		03.06.2019
	APPD SARAVAN KUMAR G		03.06.2019
DEPT FS / CODE 129	ALL DIMENSIONS ARE IN MM	PROJECTION	SCALE NTS / WEIGHT (Kg) ---
REF TO ASSY / OLD DWG			
TITLE: SCR REACTOR ARRANGEMENT	DRAWING NO : 1-SR-000-00005		REV 01

REV	DATE	ALTERED :D Balaji
01	30.07.21	CHD & APPD :SA
ZONE	ORIENTATION OF ASH SWEEPERS AND SONIC HORNS ARE INTER CHANGED & NOTES CORRECTED	

DRAWING NO: 3-SR-500-00006

FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER PLANT STD.NO TP 023 0299





ONE CATALYST LAYER ASH SWEEPERS ARRANGEMENT SHOWN.
THERE ARE THREE LAYERS ON THIS CONTRACT

NOTES:

1. THERMAL SAFETY SHIELD.
2. VENDOR TO ADEQUATELY SIZE THE PRESSURE RELIEF VALVE WITH APPLICABLE STANDARDS AND MENTION THE SIZE IN THE OFFER. ($)- PRESSURE RELIEF VALVE INTEGRAL TO ASH SWEEPER BODY. VENDOR SHALL SPECIFY THE SET PRESSURE.
3. ALL PIPE SIZES ARE PRELIMINARY, VENDOR SHALL CHECK AND CONFIRM THE LINE SIZES FOR EFFECTIVE WORKING OF THE EQUIPMENT.
4. THE ASH SWEEPERS SHOWN ARE INDICATIVE ONLY. NUMBER OF ASH SWEEPERS PER LAYER AND THE TOTAL NO OF ASH SWEEPERS SHALL BE DECIDED BY VENDOR AND THE BASIS OF SELECTION SHALL BE SUBMITTED BY VENDOR.
5. FLEX HOSE FROM SOLENOID VALVE TO ASH SWEEPER ASSEMBLY; NO HARD PIPE.
6. TOTAL FLOW REQUIRED SHALL BE SPECIFIED BY VENDOR.
7. TAG NUMBERS SHOWN FOR REACTOR A WITH PREFIX "67"YY; WHEREAS FOR REACTOR B PREFIX "68" YY SHALL BE USED.
8. DEPENDING ON THE FINAL QUANTITY OF ASH SWEEPERS, THE "YY" "ZZ" IN TAG NUMBERS TO BE SUITABLY NUMBERED BY VENDOR AS 01,02 ETC.
9. ALL EQUIPMENT, PIPING, INSTRUMENTS AND THEIR ROOT VALVES TO BE SUPPLIED BY VENDOR AS PER MARKED SCOPE.
10. PIPING MATERIAL SHALL BE STAINLESS STEEL AS PER ASTM A312 Gr 304.

REV	DATE	ALTERED : BALAJI D
01	02.08.2021	CHD & APPD: SHANKAR NAIK
ZONE		NOTE 10 ADDED.

CONTRACT No.: 1727

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: BHUSAWAL THERMAL POWER STATION
UNIT 6 (1X660 MW)

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI – 620014
355-055

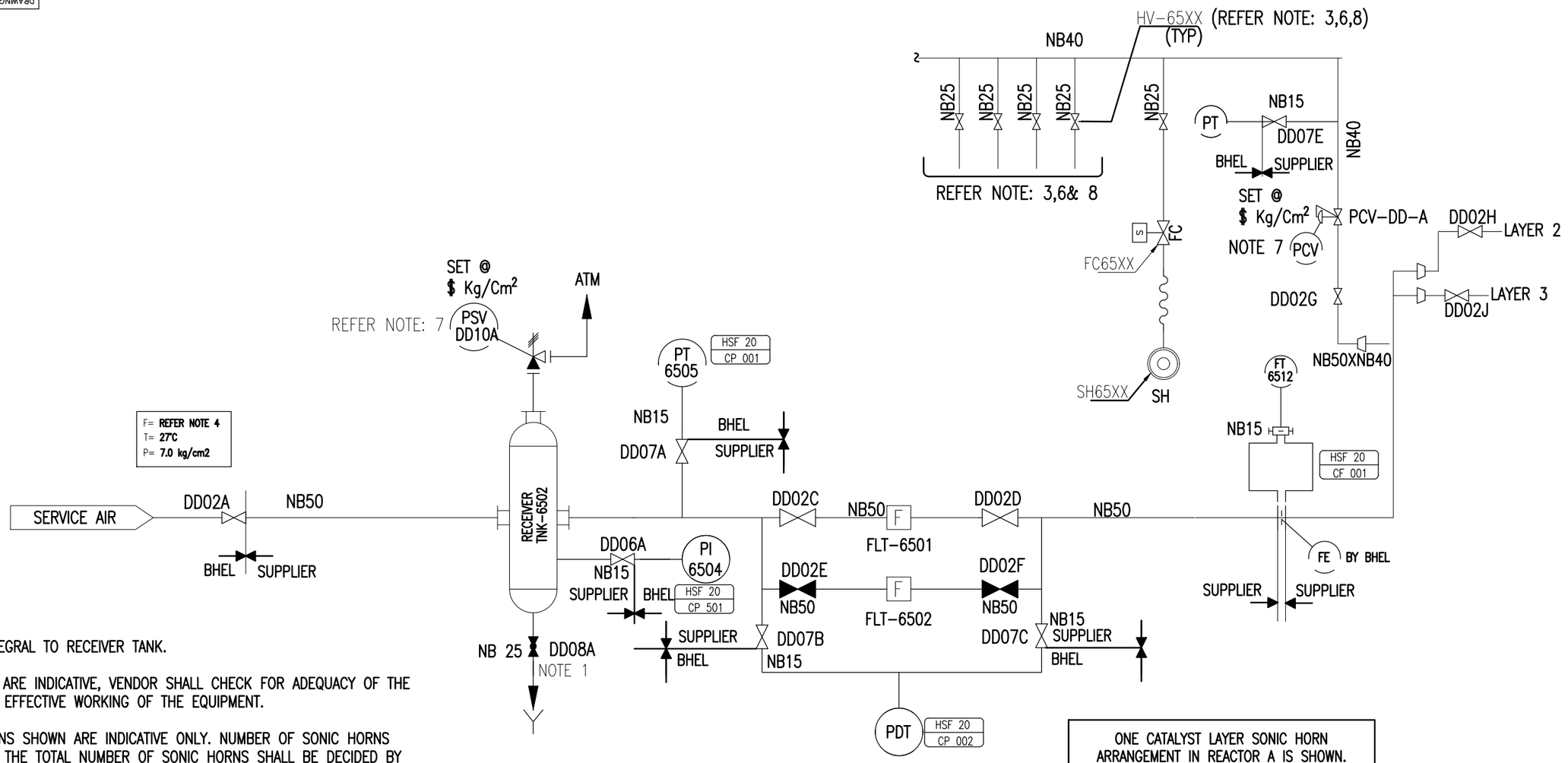
	NAME	SIGNATURE	DATE
DRN	BALAJI D	-sd-	02/07/2020
CHD	PREETAM KUMAR	-sd-	02/07/2020
APPD	SHANKAR NAIK	-sd-	02/07/2020

DEPT	ALL DIMENSIONS ARE IN MM	PROJECTION	SCALE	WEIGHT (Kg)	REF TO ASSY / OLD DWG
FS			-	NA	NA
CODE 129					

TITLE: P&ID FOR ASH SWEEPER SYSTEM

DRAWING NO : 3-SR-500-00006 REV 01

DRAWING NO: 3-SR-500-00005



NOTES:

1. AUTO DRAIN INTEGRAL TO RECEIVER TANK.
2. ALL PIPE SIZES ARE INDICATIVE, VENDOR SHALL CHECK FOR ADEQUACY OF THE LINE SIZES FOR EFFECTIVE WORKING OF THE EQUIPMENT.
3. THE SONIC HORNS SHOWN ARE INDICATIVE ONLY. NUMBER OF SONIC HORNS PER LAYER AND THE TOTAL NUMBER OF SONIC HORNS SHALL BE DECIDED BY VENDOR AND THE BASIS OF SELECTION SHALL BE SUBMITTED BY VENDOR. TAG NUMBERS SHALL BE NAMED ACCORDINGLY.
4. TOTAL AIR FLOW REQUIRED FOR DE-DUSTING SHALL BE FURNISHED BY VENDOR.
5. ALL EQUIPMENT, PIPING, INSTRUMENTS AND THEIR ROOT VALVES TO BE SUPPLIED BY VENDOR AS PER MARKED SCOPE.
6. TAG NUMBERS SHOWN ARE FOR REACTOR A WITH PREFIX "65"XX; WHEREAS FOR REACTOR B PREFIX "66" XX SHALL BE USED.
7. VENDOR TO ADEQUATELY SIZE THE PRESSURE RELIEF VALVE WITH APPLICABLE STANDARDS AND MENTION THE SIZE IN THE OFFER.
   ($) – PRESSURE RELIEF VALVE INTEGRAL TO ASH SWEEPER BODY. VENDOR SHALL SPECIFY THE SET PRESSURE .
8. DEPENDING ON THE FINAL QUANTITY OF SONIC HORNS, THE "XX" IN TAG NUMBERS TO BE SUITABLY NUMBERED BY VENDOR AS 19,20,21., ETC.
9. FLEX HOSE FROM SOLENOID VALVE TO ASH SWEEPER ASSEMBLY; NO HARD PIPE.
10. AIR PIPING MATERIAL SHALL BE STAINLESS STEEL AS PER ASTM 312 Gr304.

ONE CATALYST LAYER SONIC HORN ARRANGEMENT IN REACTOR A IS SHOWN. THERE ARE THREE LAYERS PER REACTOR ON THIS CONTRACT

REV	DATE	ALTERED : BALAJI D
01	02.08.2021	CHD & APPD:
ZONE	NOTE 10 ADDED.	

CUSTOMER No. :1727

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: BHUSAWAL THERMAL POWER STATION
UNIT 6 (1X660 MW)

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI – 620014
355-055

	NAME	SIGNATURE	DATE
DRN	BALAJI D	-sd-	30/12/2020
CHD	PREETAM KUMAR	-sd-	30/12/2020
APPD	SHANKAR NAIK	-sd-	30/12/2020

DEPT	ALL DIMENSIONS ARE IN MM	PROJECTION	SCALE	WEIGHT (Kg)	REF TO ASSY / OLD DWG
FS			-	NA	NA
CODE 129					

TITLE: P&ID FOR SONIC HORN SYSTEM

DRAWING NO : 3-SR-500-00005 REV 01

VALVE SCHEDULE FOR SCR DE-DUSTING SYSTEM

MAHARASTRA STATE POWER GENERATION COMPANY LIMITED

BHUSAWAL THERMAL POWER STATION :: 1 X 660 MW

CUSTOMER NO: 1727

REFERENCE P&ID NUMBERS : 0-SR-056-00049, 3-SR-500-00005 & 3-SR-500-00006

DOCUMENT NO: SR/DD/1727/VALVE/001

	NAME	SIGNATURE	DATE	DOCUMENT NO: SR/AFS/1727/VALVE/001	REV:00
PREPARED	BALAJI D	-sd-	1/14/2021		
CHECKED	PREETAM KUMAR S	-sd-	1/14/2021		
APPROVED	SHANKAR NAIK V	-sd-	1/14/2021	SHEET: 01 OF 05	

SCHEDULE OF VALVES AND FITTINGS

CUSTOMER : M/S MAHAGENCO

PROJECT: BHUSAWAL THERMAL POWER PLANT UNIT 6 - 1X660 MW

CUST. NO :1727

REFERENCE P&ID NUMBERS : 0-SR-056-00049, 3-SR-500-00005 & 3-SR-500-00006

LEGEND

ATM - ATOMISING	ELVN - ELEVATION	LS - LIMIT SWITCH	C150 - CLASS 150 LBS	150F -ANSI 150LBS,FLN
AS - AUX STM	EREC - ERECTION	MATL - MATERIAL	C300 - CLASS 300 LBS	300F -ANSI 300LBS,FLN
AUX - AUXILIARY	FCS - FORGED CS	MAX - MAXIMUM	C800 - CLASS 800 LBS	SD - SUB DELIVERY
BKT - BUCKET TYPE	FG - FUEL GAS	MIN - MINIMUM	SCR - SCREWED	NA-NOT APPLICABLE
BLR - BOILER	FLN - FLANGED	MOP - MAX OPRG PR	SIMP - SIMPLEX	
BW - BUTT WELD	FLR - FLOOR	MOT- MAX OPRG TEMP	SOLN - SOLENOID	
BY - BYPASS	FM - FLOW METER	MOTR - MOTOR OPRN	SPR - SPRING	
CCS - CAST CS	GLOB - GLOBE VLV	NRV - NON-RET VLV	STM - STEAM	
CI - CAST IRON	HDR - HEADER	NRFV- NON RETURN FLAP TYPE VALVE	STN - STATION	
COMG - COMMISSIONING	HO - HFO		STR - STRAINER	
COML - COMMERCIAL	HTR - HEATER	NG - NITROGEN	SUCN - SUCTION	
CONN - CONNECTION	IGNR - IGNITOR	OD - O/LER DIA	SUPP - SUPPLY	
CONT - CONTROL	IMP - IMPULSE TYPE	OPRG - OPERATING	SW - SOCKET WELD	
CS - CARBON STEEL	IN - INLET	OPRN - OPERATION	TAP - TAPPING	
CUST - CUSTOMER	INSTR - INSTRUMENT	OS - OIL-STM	TCV - TEMP CONT VLV	
DELY - DELIVERY	ISOL - ISOLATION	O/L - OUTLET	TEMP - TEMPERATURE	
DIA - DIAMETER	LIQ- LIQUID	PCV - PR CONT VLV	THK - THICKNESS	
DIFF - DIFFERENTIAL	PRG - PURGING	PG - PR-GAUGE	VLV - VALVE	
DISCH - DISCHARGE	VPR - VAPOUR	PGV - PG VLV	UNL - UNLOADING	
DP - DIFF PR		PNM - PNEUMATIC	WAF - WAFER	
DUPL-DUPLEX		PR - PRESSURE	WUO - WARMUP OIL	
d1 - ROOT DIA		PRV - PR REG VLV	W/ - WITH	
DRN - DRAIN		RECIRC - RECIRCULATION	WO/ - WITHOUT	
		REG - REGULATING		
		RET - RETURN		

SHEET: 02 OF 05

SCHEDULE OF VALVES AND FITTINGS- SR/DD/1727/VALVE/001

CUSTOMER: M/S MAHAGENCO

PROJECT: BHUSAWAL TPS UNIT 6, (1X660MW), Cust. No 1727

PGMA: SR500 - CATALYST DE DUSTING SYSTEM -REACTOR A & B

REFERENCE SCHEME DWG NO: 3-SR-000-00005 & 3-SR-000-00006

Sl.no	TAG NO	SERVICE DESCRIPTION	VALVE TYPE	SIZE/NB /INCH	Oper	MAX.WORK PRESS Temp		BODY MAT	BODY RATING	END CONN	MAKE	QTY PER BLR	Remarks
						PR	Temp						
1	DD02A	ISOL FOR RECIEVER TANK	GATE	50	HAND	7	27	CS	C800	SW	BHEL	1	
2	DD10A	PRESSURE RELIEF VALVE	ANGLE RELIEF	*	SELF	7	27	CS	C800	FLANGED	supplier	1	* supplier to fill
3	DD08A	RECEIVER TANK DRAIN ISOL	GLOBE	25	HAND	7	27	CS	C800	SW	supplier	1	
4	DD06A	PI INST ISOL	GATE	15	HAND	7	27	CS	C800	SW	supplier	1	
5	DD07A	PT INST ISOL	GATE	15	HAND	7	27	CS	C800	SW	supplier	1	
6	DD02C	FILTER ISOL IN	GATE	50	HAND	7	27	CS	C800	SW	supplier	1	
7	DD02D	FILTER ISOL OUT	GATE	50	HAND	7	27	CS	C800	SW	supplier	1	
8	DD02E	FILTER ISOL IN	GATE	50	HAND	7	27	CS	C800	SW	supplier	1	
9	DD02F	FILTER ISOL OUT	GATE	50	HAND	7	27	CS	C800	SW	supplier	1	
10	DD07B	PDT ISOL VALVE IN	GATE	50	HAND	7	27	CS	C800	SW	supplier	1	
11	DD07C	PDT ISOL VALVE OUT	GATE	50	HAND	7	27	CS	C800	SW	supplier	1	
12	DD02G	SONIC HORN REACTOR-A LAYER 1 ISOL	GATE	40	HAND	7	27	CS	C800	SW	supplier	1	
13	DD-A	SELF REGULATING VALVE REACTOR-A LAYER 1	REG	40	SELF	7	27	CS	C300	FLANGED	supplier	1	
14	DD02H	SONIC HORN REACTOR-A LAYER 2 ISOL	GATE	40	HAND	7	27	CS	C800	SW	supplier	1	
15	DD-B	SELF REGULATING VALVE REACTOR-A LAYER 2	REG	40	SELF	7	27	CS	C300	FLANGED	supplier	1	
16	DD02J	SONIC HORN REACTOR-A LAYER 3 ISOL	GATE	40	HAND	7	27	CS	C800	SW	supplier	1	
17	DD-C	SELF REGULATING VALVE REACTOR-A LAYER 3	REG	40	SELF	7	27	CS	C300	FLANGED	supplier	1	
18	DD07E	PT INST ISOL	GATE	15	HAND	7	27	CS	C800	SW	supplier	1	
19	DD07F	PT INST ISOL	GATE	15	HAND	7	27	CS	C800	SW	supplier	1	
20	DD07G	PT INST ISOL	GATE	15	HAND	7	27	CS	C800	SW	supplier	1	
21	DD02B	ASH SWEEPER ISOL	GATE	40	HAND	7	27	CS	C800	SW	supplier	1	
22	DD07D	PT INST ISOL	GATE	15	HAND	7	27	CS	C800	SW	supplier	1	
23	DD08B	PIPE LINE DRAIN ISOL- RACTOR A	GLOBE	20	HAND	7	27	CS	C800	SW	supplier	1	
24	DD02K	ASH SWEEPER REACTOR- A- LAYER 1 ISOL	GATE	40	HAND	7	27	CS	C800	SW	supplier	1	
25	DD02L	ASH SWEEPER REACTOR-A- LAYER 2 ISOL	GATE	40	HAND	7	27	CS	C800	SW	supplier	1	

SCHEDULE OF VALVES AND FITTINGS- SR/DD/1727/VALVE/001

CUSTOMER: M/S MAHAGENCO

PROJECT: BHUSAWAL TPS UNIT 6, (1X660MW), Cust. No 1727

PGMA: SR500 - CATALYST DE DUSTING SYSTEM -REACTOR A & B

REFERENCE SCHEME DWG NO: 3-SR-000-00005 & 3-SR-000-00006

	TAG NO	SERVICE DESCRIPTION	VALVE TYPE	SIZE/NB /INCH	Oper	MAX.WORK PRESS	Temp	BODY MAT	BODY RATING	END CONN	MAKE	QTY PER BLR	Remarks
26	DD02M	ASH SWEEPER REACTOR-A- LAYER 3 ISOL	GATE	40	HAND	7	27	CS	C800	SW	supplier	1	
27	DD02A1	ISOL FOR RECIEVER TANK	GATE	50	HAND	7	27	CS	C800	SW	BHEL	1	
28	DD10A1	PRESSURE RELIEF VALVE	ANGLE RELIEF	*	SELF	7	27	CS	C800	FLANGED	supplier	1	* supplier to fill
29	DD08A1	RECEIVER TANK DRAIN ISOL	GLOBE	25	HAND	7	27	CS	C800	SW	supplier	1	
30	DD06A1	PI INST ISOL	GATE	15	HAND	7	27	CS	C800	SW	supplier	1	
31	DD07A1	PT INST ISOL	GATE	15	HAND	7	27	CS	C800	SW	supplier	1	
32	DD02C1	FILTER ISOL IN	GATE	50	HAND	7	27	CS	C800	SW	supplier	1	
33	DD02D1	FILTER ISOL OUT	GATE	50	HAND	7	27	CS	C800	SW	supplier	1	
34	DD02E1	FILTER ISOL IN	GATE	50	HAND	7	27	CS	C800	SW	supplier	1	
35	DD02F1	FILTER ISOL OUT	GATE	50	HAND	7	27	CS	C800	SW	supplier	1	
36	DD07B1	PDT ISOL VALVE IN	GATE	50	HAND	7	27	CS	C800	SW	supplier	1	
37	DD07C1	PDT ISOL VALVE OUT	GATE	50	HAND	7	27	CS	C800	SW	supplier	1	
38	DD02G1	SONIC HORN REACTOR-B LAYER 1 ISOL	GATE	40	HAND	7	27	CS	C800	SW	supplier	1	
39	DD-A1	SELF REGULATING VALVE REACTOR-B LAYER 1	REG	40	SELF	7	27	CS	C300	FLANGED	supplier	1	
40	DD02H1	SONIC HORN REACTOR-B LAYER 2 ISOL	GATE	40	HAND	7	27	CS	C800	SW	supplier	1	
41	DD-B1	SELF REGULATING VALVE REACTOR-B LAYER 2	REG	40	SELF	7	27	CS	C300	FLANGED	supplier	1	
42	DD02J1	SONIC HORN REACTOR-B LAYER 3 ISOL	GATE	40	HAND	7	27	CS	C800	SW	supplier	1	
43	DD-C1	SELF REGULATING VALVE REACTOR-B LAYER 3	REG	40	SELF	7	27	CS	C300	FLANGED	supplier	1	
44	DD07E1	PT INST ISOL	GATE	15	HAND	7	27	CS	C800	SW	supplier	1	
45	DD07F1	PT INST ISOL	GATE	15	HAND	7	27	CS	C800	SW	supplier	1	
46	DD07G1	PT INST ISOL	GATE	15	HAND	7	27	CS	C800	SW	supplier	1	
47	DD02B1	ASH SWEEPER ISOL REACTOR B	GATE	40	HAND	7	27	CS	C800	SW	supplier	1	
48	DD07D1	PT INST ISOL	GATE	15	HAND	7	27	CS	C800	SW	supplier	1	
49	DD08B1	PIPE LINE DRAIN ISOL- RACTOR B	GLOBE	20	HAND	7	27	CS	C800	SW	supplier	1	
50	DD02K1	ASH SWEEPER REACTOR-B-LAYER 1 ISOL	GATE	40	HAND	7	27	CS	C800	SW	supplier	1	

SCHEDULE OF VALVES AND FITTINGS- SR/DD/1727/VALVE/001

CUSTOMER: M/S MAHAGENCO

PROJECT: BHUSAWAL TPS UNIT 6, (1X660MW), Cust. No 1727

REFERENCE SCHEME DWG NO: 3-SR-000-00005 & 3-SR-000-00006

PGMA: SR500 - CATALYST DE DUSTING SYSTEM -REACTOR A & B

	TAG NO	SERVICE DESCRIPTION	VALVE TYPE	SIZE/NB /INCH	Oper	MAX.WORK PRESS	Temp	BODY MAT	BODY RATING	END CONN	MAKE	QTY PER BLR	Remarks
51	DD02L1	ASH SWEEPER REACTOR-B-LAYER 2 ISOL	GATE	40	HAND	7	27	CS	C800	SW	supplier	1	
52	DD02M1	ASH SWEEPER REACTOR-B-LAYER 3 ISOL	GATE	40	HAND	7	27	CS	C800	SW	supplier	1	
53	FC65XX	ON/OFF VALVE INDIVIDUAL SH	*	*	PNEU	7	27	CS	*	*	supplier	*	* supplier to fill
54	HV65XX	ISOL VALVE TO INDIVIDUAL SH	GATE	25	HAND	7	27	CS	C800	SW	supplier	*	* supplier to fill
55	HV67YY	ISOL VAL TO INDIVIDUAL ASW	GATE	15	HAND	7	27	CS	C800	SW	supplier	*	* supplier to fill
56	HV67ZZ	ISOL VAL TO INDIVIDUAL PI TO ASW	GATE	15	HAND	7	27	CS	C800	SW	supplier	*	* supplier to fill
57	PSV67YY	PRESSURE SAFETY VALVE	ANGLE RELIEF	*	SELF	7	27	CS	C800	FLANGED	supplier	*	* supplier to fill
58	AS67YY	ON/OFF VALVE INDIVIDUAL ASW	*	*	PNEU	7	27	CS	*	*	supplier	*	* supplier to fill
59	FC66XX	ON/OFF VALVE INDIVIDUAL SH	*	*	PNEU	7	27	CS	*	*	supplier	*	* supplier to fill
60	HV66XX	ISOL VALVE TO INDIVIDUAL SH	GATE	25	HAND	7	27	CS	C800	SW	supplier	*	* supplier to fill
61	HV68YY	ISOL VAL TO INDIVIDUAL ASW	GATE	15	HAND	7	27	CS	C800	SW	supplier	*	* supplier to fill
62	HV68ZZ	ISOL VAL TO INDIVIDUAL PI TO ASW	GATE	15	HAND	7	27	CS	C800	SW	supplier	*	* supplier to fill
63	PSV68YY	PRESSURE SAFETY VALVE	ANGLE RELIEF	*	SELF	7	27	CS	C800	FLANGED	supplier	*	* supplier to fill
64	AS68YY	ON/OFF VALVE INDIVIDUAL ASW	*	*	PNEU	7	27	CS	*	*	supplier	*	* supplier to fill

NOTE: VALVE SCHEDULE FURNISHED IS FOR LAYER1 OF REACTOR A & B, SUPPLIER TO FURNISH THE VALVE SCHEDULE FOR FOR OFFERED LAYERS.