ISA Delhi Section

Setting the Standard for Automation™

RFCL Implementation Challenges

A Case study

ISA-D: “Fertiliser , Food and Pharma Symposium-2022”

Agenda

- PROJECT OVERVIEW
- CONTROL ROOM/ CONTROL SYSTEMS
- RFCL SALIENT FEATURES
- NEW CONCEPTS IN FERTILISER INDUSTRY
- SPECIAL INSTRUMENTS IN UREA
- CHALLENGES-PROCUREMENT AND ENGINEERING
- Q & A

REVIVAL OF RAMAGUNDAM FERTILIZERS

RFCL
रामागुण्डम फर्टिलाइजर्स एण्ड केमिकल्स लिमिटेड

नेशनल फर्टिलाइज़र्स लिमिटेड
एन.एफ.एल.
NATIONAL FERTILIZERS LIMITED

EIL
A Navratna Company

RAMAGUNDAM FERTILIZERS AND CHEMICALS LIMITED

- INCORPORATED ON 17TH FEB, 2015
- NATURAL GAS BASED FERTILIZER PLANT
- 2200 MTPD AMMONIA UNIT
- 3850 MTPD UREA PLANT
- Joint Venture of NFL (26%), EIL(26%),GAIL(14.5%), HTAS(11.5%), FCIL(11%) and Govt. of Telangana(11%)

PROJECT OVERVIEW

- OWNER : RAMAGUNDAM FERTILIZERS AND CHEMICALS LIMITED
- PROJECT : REVIVAL OF RAMAGUNDAM FERTILIZERS
- LOCATION : RAMAGUNDAM , TELANGANA
- UNITS : AMMONIA, UREA,AMMONIA STORAGE,BAGGING CPP, WATER BLOCK, U&O
- MODE OF EXECUTION : EPCM
- MECH.COMPLETION : JAN 2021
- COMMERCIAL OPERATION : MAR 2021

Dedicated to the Nation on 12th November 2022

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RFCL PANORAMIC VIEW

UNITWISE CAPACITY

UNIT	CAPACITY	LICENSOR	CONTRACTOR
AMMONIA	2200 MTPD	HTAS	EIL-EPCM
UREA	3850 MTPD	SAIPEM	EIL-EPCM
AMMONIA STORAGE	14700M3 (2 TANKS)		VTV
HRSG+UB+GTG+BOP	125TPH+85TPH+32.5MW		BHEL
WATERBLOCK (ETP/STP/RWTP/RO-DM/CPU)	35;35;1520;390;300 M3/HR		WIPRO
CONVEYING AND BAGGING	500 TPH 50,000 BAGS PER DAY 45KG EACH BAG		ELECON

UNITS AND CONTROL ROOMS

UNIT	CONTROL ROOM
AMMONIA	MAIN CONTROL ROOM
UREA	MAIN CONTROL ROOM
U&O (AMMONIA STORAGE, COMPRESSED AIR, COOLING WATER, FLARE)	MAIN CONTROL ROOM
HRSG+UB+GTG+BOP	POWER PLANT CONTROL ROOM
WATER BLOCK (RWTP,RO DM& CPU,FW,ETP,STP)	WATER BLOCK CONTROL ROOM
CONVEYING AND BAGGING	BAGGING CONTROL ROOM

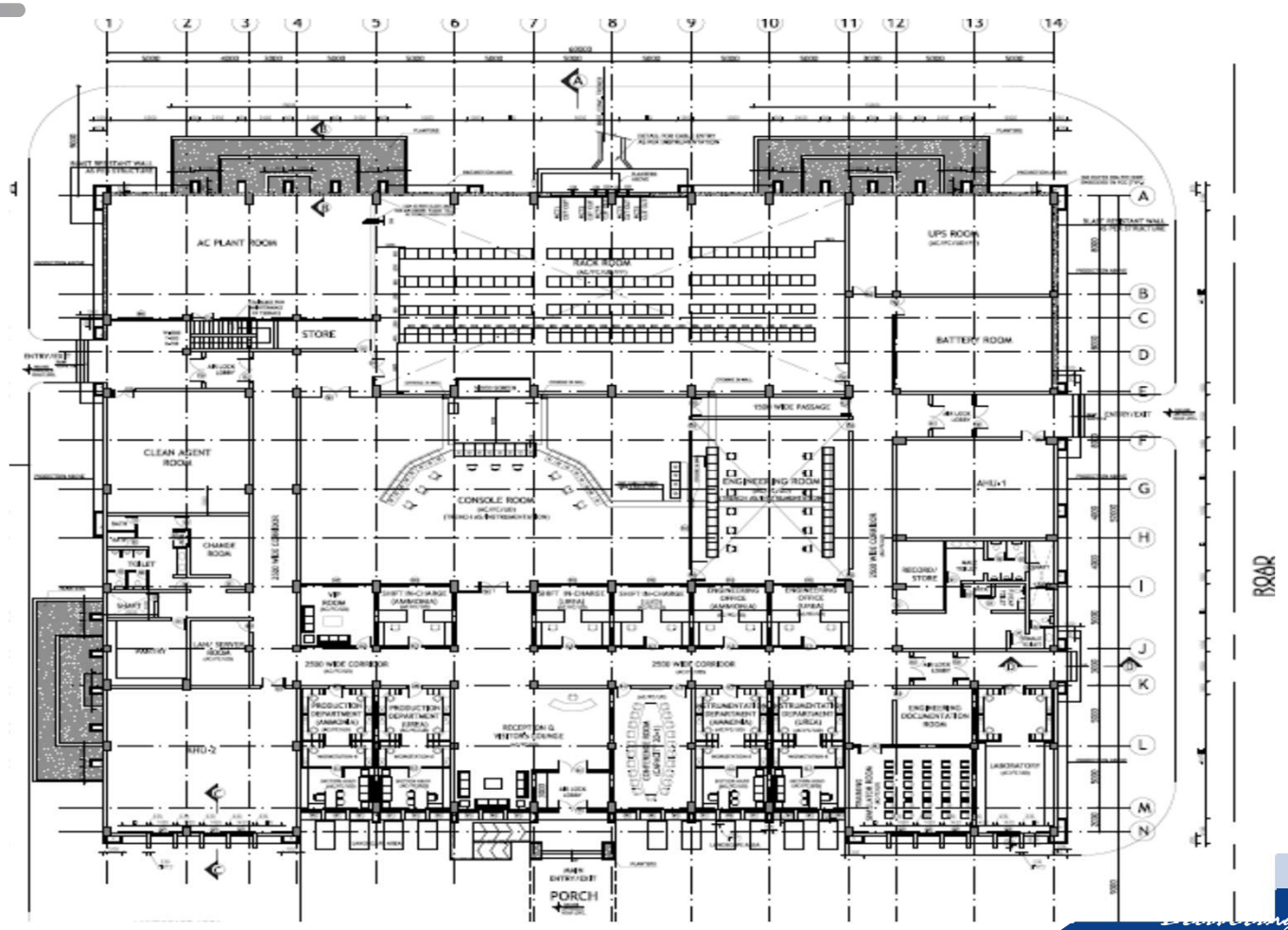
CONTROL SYSTEMS

CONTROL SYSTEM	PROCESS / UTILITY UNITS
EMERSON DELTA V DCS/SIS PLC	PROCESS UNITS- AMMONIA, UREA, AMMONIA STORAGE, U&O AND CPP (DCS)
ABB PLC based control system HRSG BMS + UB BMS + BOP PLC (MODEL NO. 800 HI)	HRSG BMS + UB BMS + BOP PLC
GE MARK VI E system	GTG
HAIL PLC based control system (MODEL NO. 200R)	WATER BLOCK (RWTP/ETP/STP/RO-DM)
ABB PLC based control system (MODEL NO. 800 HI)	Bagging & Conveying System
ROCKWELL PLCs (MODEL NO. CONTROL LOGIX)	LP Air Compressors, Inst Air Dryer

CONTROL SYSTEM IO COUNT

System	Installed IO (MCR)	Installed IO (Power Plant CR)	Installed IO (Water Block control room)	Installed IO (Bagging CR)
DCS	3800 Analog and Digital (including FF)	1000 (Analog and Digital)	-	-
ESD PLC/ SIL-3 certified	5600 Analog and Digital	2000 GTG MARKVI HRSG#1 PLC/ UB#1 PLC/ BOP PLC	3660 (Non-SIL Package PLC)	3000 (Non-SIL Package PLC)
F&G PLC (SIL-3 certified)	200	200	-	-

MAIN CONTROL ROOM LAYOUT



Net Zero by 2035

Delivering Excellence Through People

MAIN CONTROL ROOM LAYOUT

MAJOR PACKAGES IN AMMONIA UNIT

PACKAGE	CONTRACTOR
Reformer Package	M/s HPIP
ID/FD Blowers	M/s Boldrocchi
Fuel Gas Expander	M/s BHGE
BFW Pumps	M/s KSB
HPRT/Semi Lean Package	M/s BHGE
N2 Blower Package	M/s Atlas Copco
Ammonia Compressor	M/s BHGE
Synthesis Gas Compressor	M/s BHGE
NG Compressor	M/s BHGE
Process Air Compressor	M/s BHGE

MAJOR PACKAGES IN UREA UNIT

PACKAGE	CONTRACTOR
CO2 Compressor	M/s BHGE
HP Ammonia Pumps	M/s Ebara
HP Carbamate Pumps	M/s Ebara
Vacuum Ejector System	M/s GEA
Stripper Passivation Air Comp	M/s Burckhardt
Bulk Flow cooler	M/s Solex
Prilling tower package	M/s Simplex

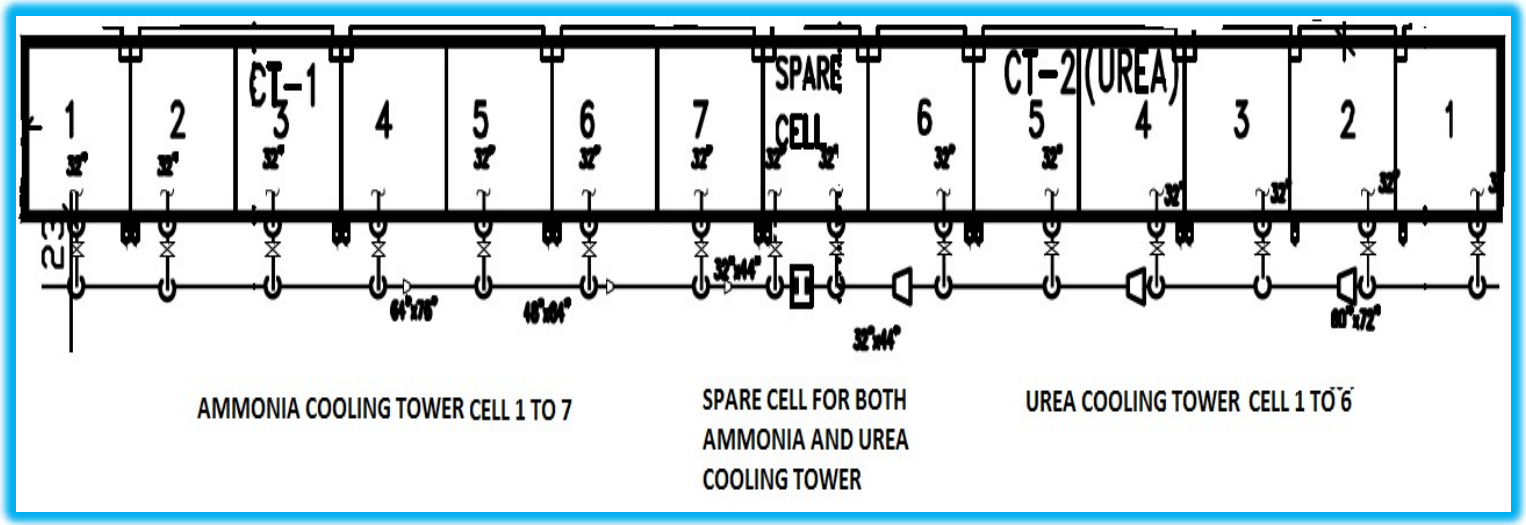
RFCL Plant Features

- *Low Capex plant among its contemporary plants in India (~30% lower)*
- *One of the lowest energy number plant in country. Technology Licensor provided their proprietary designs to optimize the energy consumption. (design Energy no. ~4.8-4.9 Gcal/MT of Urea)*
- *Appropriate selection of Technology (through NPV process) and ensuring PTR of catalyst and ensuring non-proprietary catalysts also perform.*

RFCL Implementation

- *Utilization of purge Gases*
- *Appropriate material of construction for Flare lines*
- *Common spare cooling tower for Ammonia & urea units.*
- *Proven ness of mega rotating machines w. r. to efficiency and performance*
- *Upfront detail engg with respect to Utility & Offsites systems.*

RFCL Cooling Towers



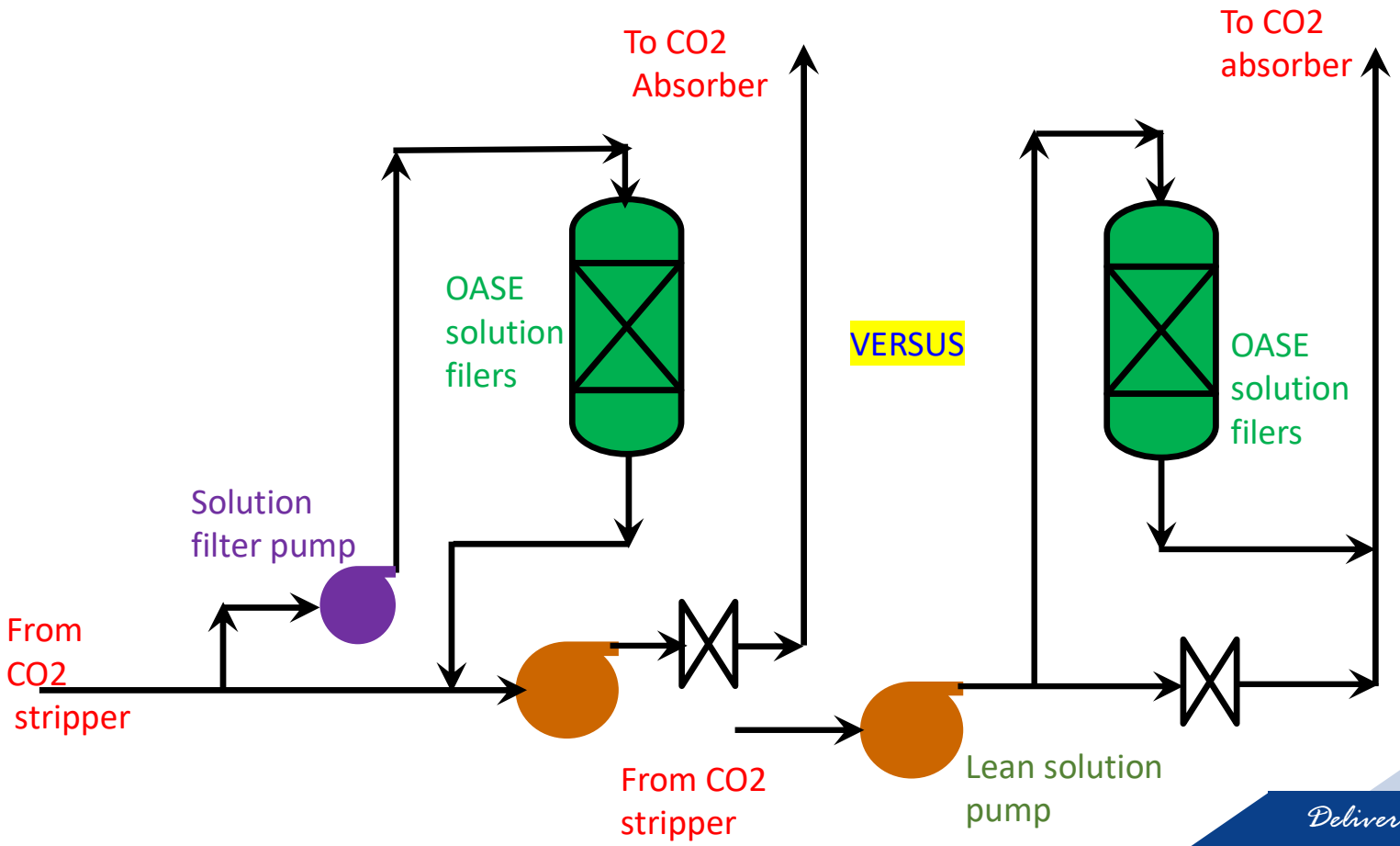
RFCL Challenges

- *Optimization of Cooling water pump NPSH*
- *Dual level steam was avoided through integration of steam generators/ consumers.*
- *Complex piping was accommodated within minimum space.*
- *Appropriate Heat Integration*

RFCL Challenges

- *MDEA solution filters were appropriately placed to reduce equipment costs.*
- *The thicknesses were reduced from 116 mm to 30 mm and hence reduction of weights to the extent of 30% of original weight.*
- *This led to availability of more vendors & ODC issues were also solved.*

RFCL Challenges



RFCL Flare header optimisation

- *The back pressure of front end flare is **1.5 kg/cm2g.***
- *The size of flare header was coming out to be **60”.***
- *The back pressure of some of the reliefs valves was optimised (without changing the type of relief valve) to reduce the header size to **40”.***

NEW CONCEPTS ADOPTED IN FERTILIZER

FOUNDATION FIELDBUS (OPEN LOOPS AND CLOSED LOOPS)
PREFABRICATED HOOK UPS FOR FIELD TRANSMITTERS
REMOTE I/Os CONCEPT FOR INTERFACING MCC I/Os WITH DCS/ESD
SINGLE NETWORK DCS FOR PROCESS UNITS AND CPP
OPERATOR TRAINING SIMULATOR (OTS) FOR AMMONIA UNIT
AMMONIA ANALYSER (TDLS TYPE) AT PRILLING TOWER TOP
LIQUID AMMONIA DESUPERHEATER

SPECIAL INSTRUMENTS

Special Instruments	Special features	Applications	Remarks
Urea Service Valves	• Angle type – AISI 316L (ASTM-A-182-F-316 L) Urea grade/ 25Cr-22Ni-2Mo alloy • Globe type Body material shall be as per licensor specification	• High Pressure Urea • Low or Medium pressure Urea services	○Internal parts as HVD1 hardened by "Gustav Grimm" for HP ○ Trim material shall be in HVD1 by "Gustav Grimm" on carbonate solution service and AISI 316L on Urea melt for LP/MP ○ Packing flushing 1/2" ○ Lenticular connection
Urea service PSVs	○ Body AISI316, Plug & Seat as HVD1	Urea and Carbamate service at high, medium and low pressure	○Steam Jacketed, Steam washing ○ Balance bellow sealing ○ Lenticular connection
Analysers Systems	• NH3 Analyser -TDLS • Process Gas Chromatograph/ IR Analysers/ TCD Analysers/ Paramagnetic O2 analyser	Priling tower top	Mass Spectrometer initially proposed but couldn't be implemented due to High cost /redundancy requirement.
Urea Service Field Instruments	PT, DPT, TE.		**Pipe flush membrane connections, special nozzle connections**

INSTRUMENT ITEMS PROCUREMENT

Items	Quantity (Nos)
Control Valves	250
On-off valves	180
PSV	240
Self actuated Pr control valve	8
Field Instruments	2000
Averaging Pitot Tubes	8
Mass Flow meters (Coriolis)	3
Ultrasonic flow meter	3
Magnetic Flow meter	9
Thermal Mass flow meter	1
Spl. Level Instruments	25
Analysers	12
Nucleonic Level Instruments	2
Gas detectors	150
Desuperheaters & PRDS	13
Signal Cables – Single pair/ triad	200 KM
Signal Cables – Multi pair/ triad	460 KM
Fieldbus Cables – Single pair (spur)	30 KM
Fieldbus Cables – Two pair (trunk)	70 KM

Challenges-Procurement and Engineering

- Urea **Licensor** strongly recommended the following vendors for **Control valves in urea service**: AST- Parcol -Uhde
- **Challenge :** Obtaining the offers from the above vendors and getting the valves only from vendors with an experience in urea service corresponding to Saipem technology.
- **Strategy** :The MR was split into following four Groups considering the variety of type of valves and floated global tender & finally ordered as below:

  Angle High Pressure Urea service valves – Ordered on M/s Provalve

  Butterfly Drilled Urea service valves – Ordered on M/s Samson

  Urea service 3 way Divertor valve – Ordered on M/s Samson

  LP/MP Urea service Globe valves – Ordered on M/s MIL

Challenges-Procurement and Engineering

Urea special service control valves:

- The weight and height of these valves posed a challenge.
- It was of the order of 2 tons to 5 tons for valves upto 12” 1500#.
- Co-ordination with Piping and Valve vendor to reduce the weight of the valves. Provalve changed the type of actuator to double acting to reduce weight and the orientation to fit in the space.
- Co-ordination with vessel vendor to ensure that the nozzles can take the load.

Challenges-Procurement and Engineering

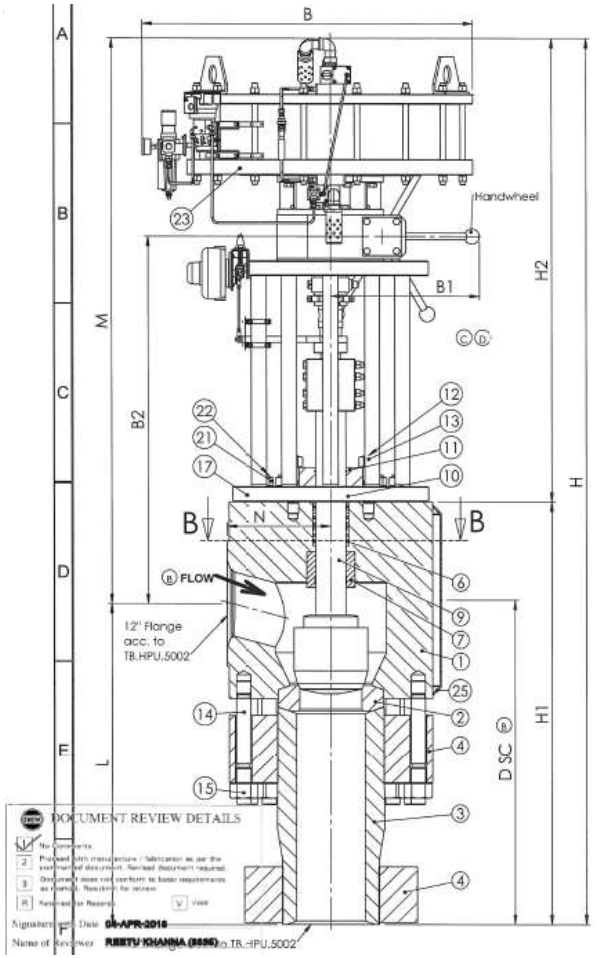
- For the following item vendors were not able to meet the process requirement nor Licensor furnished any recommended/ mandatory vendor

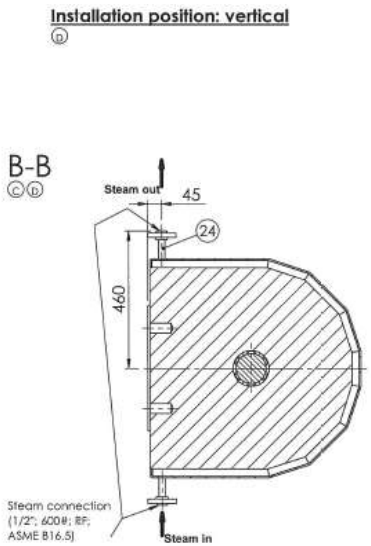
Self actuated pressure control valves (in ammonia and urea) in high pressure

I/L Pr. – 132.9 Kg/cm2g, Diff. Pr. 74.9 Kg/cm2

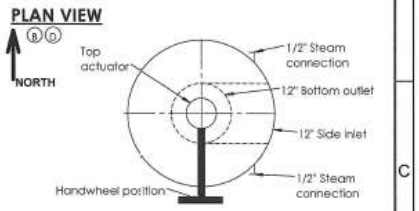
Matter was discussed with Licensor. Vendors given by Licensor were also not able to meet the requirement. Finally these were converted to control valves at later stage.

GAD OF UREA SERVICE CONTROL VALVE





200-XV-0701		
	NPS	12
	–	1080
	-/H1/H2 C	2970/1420/1550
	M C	1890
	N C	345
	B/B1/B2 C D	1350/720/1230
C	B SC (Distance to center of steam connect.)	1090
	Valve weight B E	3000
	Actuator weight C	1570
	Total weight C E	4570
	Painting D	RAL 1016 (yellow)



25	Heating jacket	1.4301 (~ AISI 304)
24	Steam socket D	ASTM A105
23	Actuator	Pneumatic diaphragm
14	Bolt	ASTM A193 B7
15	Nut	ASTM A194 2H
4	Threaded flange	ASTM A105
3	Tube C	1.4466 (X1CrNiMoN-25-22-2)
22	Bolt	ASTM A193 B7
21	Nut	ASTM A194 2H
17	Yoke	ASTM A105, galvanized
12	Bolt	ASTM A193 B7
13	Nut	ASTM A194 2H
11	Gland flange	ASTM A182 F316L
10	Gland	1.4466 (X1CrNiMoN-25-22-2)
6	Packing	Graphite
7	Guide bush C	HVD1 (X5CrNiMoCu-25-8) + PTFE
9	Stem B	HVD1 (X5CrNiMoCu-25-8)
2	Seat C	HVD1 (X5CrNiMoCu-25-8)
1	Body	ASTM A182 F316L UG
POS.	PART NAME	MATERIAL

Design
Angle valve with lens facing flanges
for UREA service B C D E

Design acc.	ASME B 16.34
Marking acc.	EN 19, MSS SP25
Testing acc.	ASME B16.34, API 598, FCI 70-2
Flanged ends acc.	Licensor document TB.HPU.5002
FTF dimension acc.	Manufacturer standard
Press.-Temp.-Rating	ASME B16.34
SPECIFICATION	

PROVALVE Armaturen GmbH & Co. KG

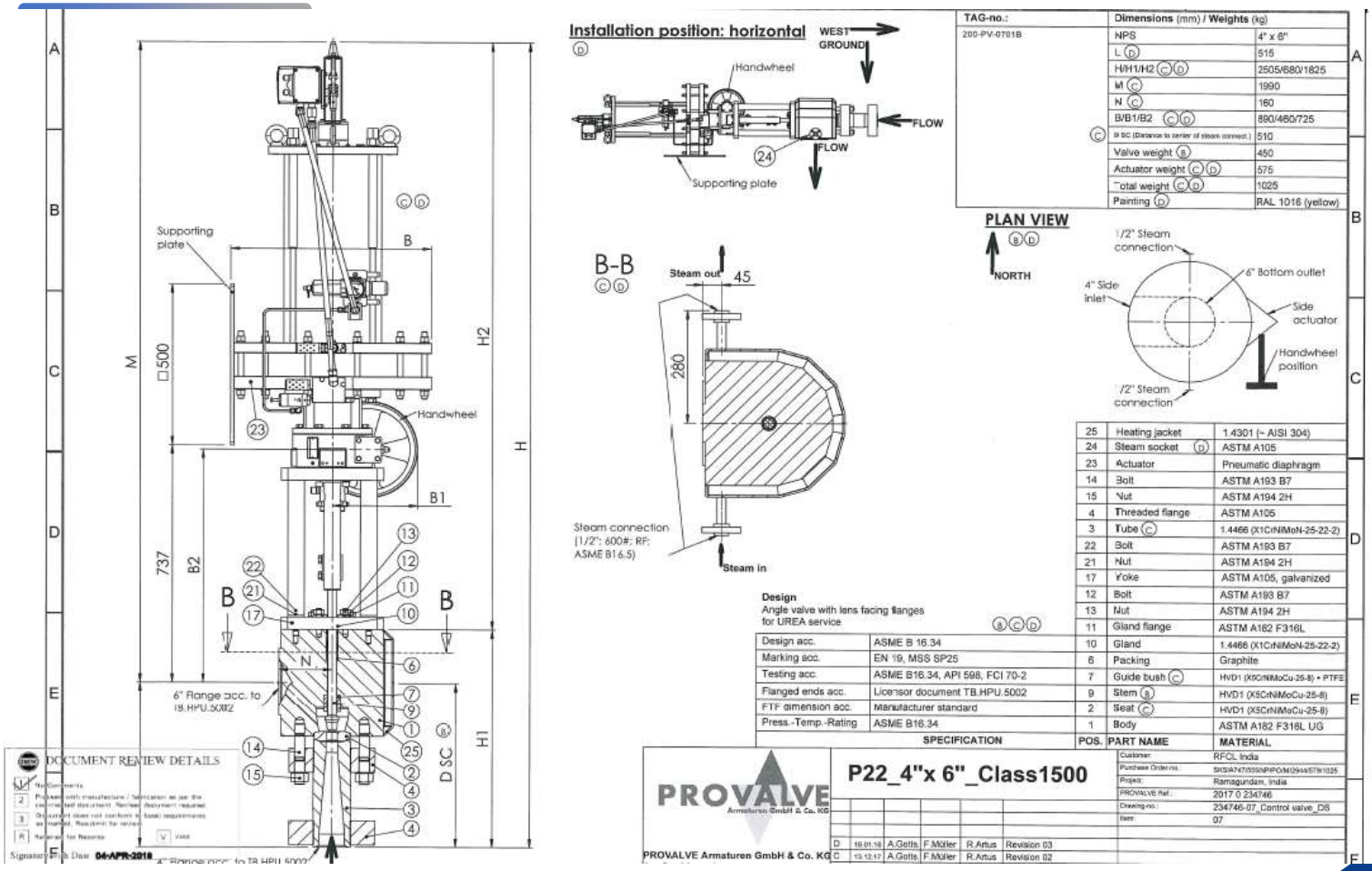
P22_12"_Class1500

E	01.02.19	A.Gotts.	F.Müller	R.Artus	Revision 04
D	17.01.18	A.Gotts.	F.Müller	R.Artus	Revision 03
C	13.12.17	A.Gotts.	F.Müller	R.Artus	Revision 02
B	13.11.17	A.Gotts.	F.Müller	R.Artus	Revision 01

Customer:	RFCL India
Purchase Order-no.:	SK5UA7471555/NPP/OM/0944/578/1025
Project:	Ramagundam, India
PROVALVE Ref.:	2017 0 234746
Drawing-no.:	234746-10_Shut-off valve_DS
Item:	10

PROVALVE Armaturen GmbH & Co. KG
Am Stadtberg 2a

GAD OF UREA SERVICE CONTROL VALVE



Challenges-Procurement and Engineering

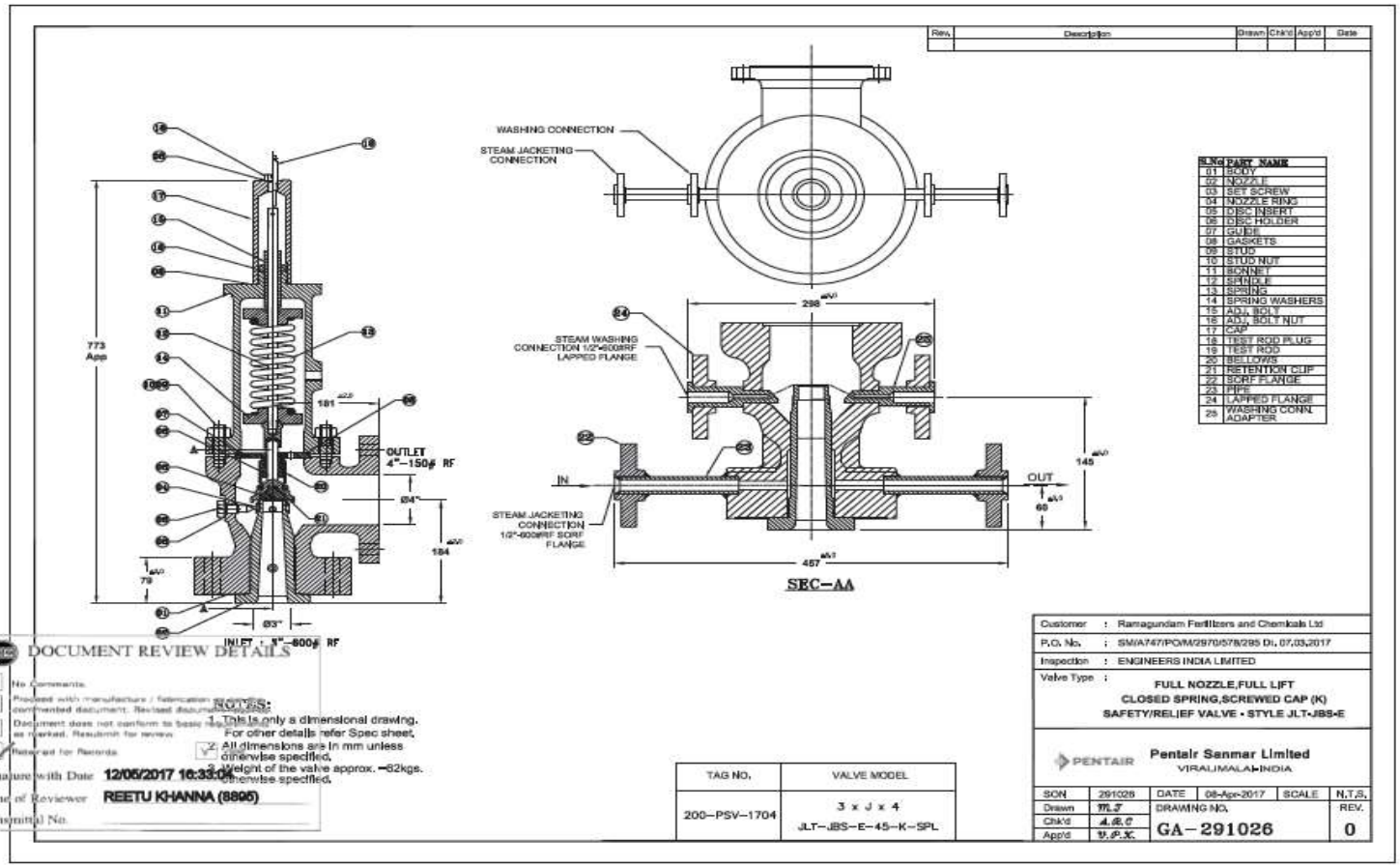
Urea service Pressure Relief Valves

- Licensor recommended Parcol and AST.
- Urea service special PSVs require nozzle Jacketing & Steam flushing connections on valve body .

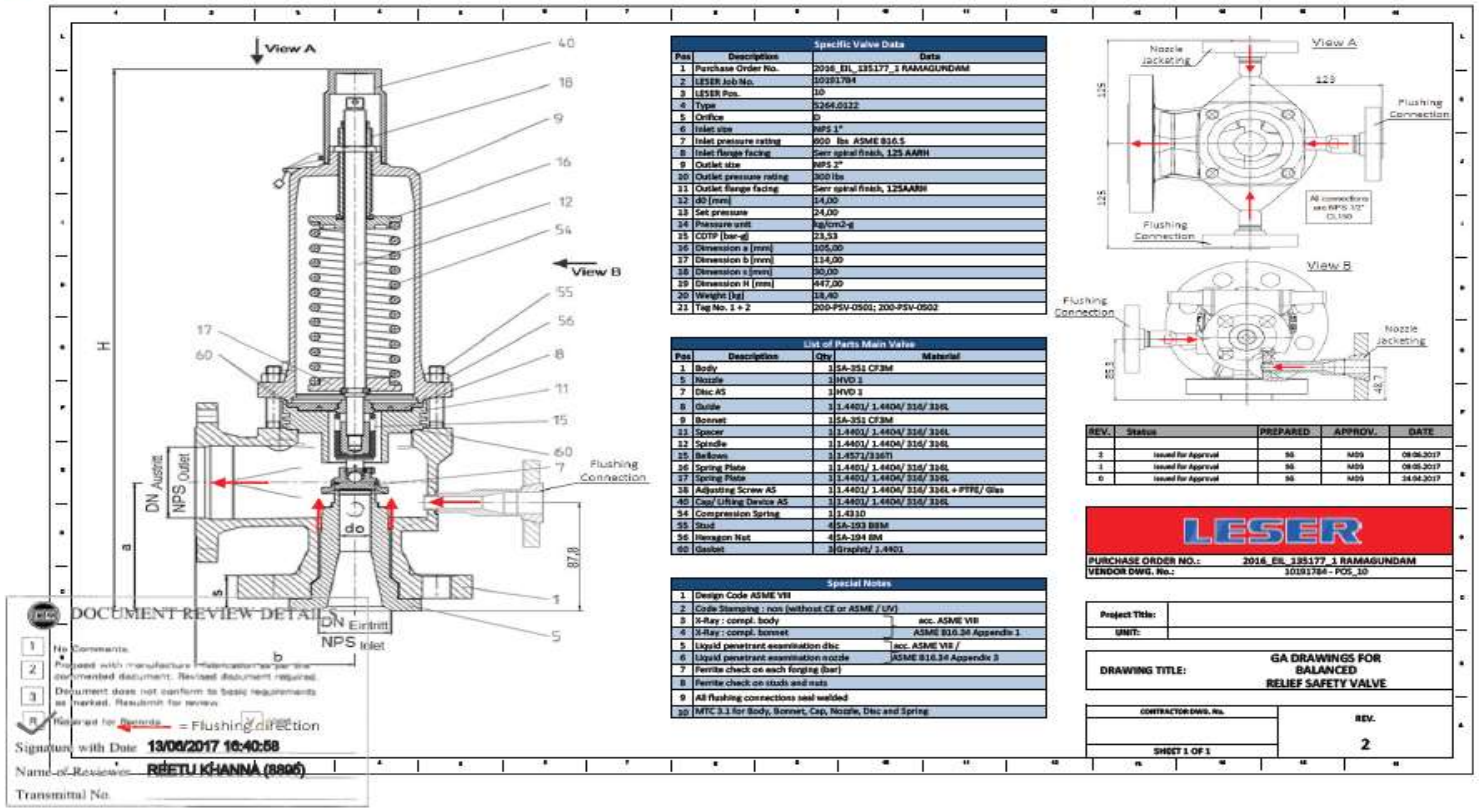
Two designs are available.

- In one design, there are two connections for steam jacketing of nozzle IN and OUT and Two separate nozzles for steam flushing in the body
- The selected valve design had nozzle jacketing with outlet inside the PSV Discharge. This design is working in other licensed urea plants. Additional steam flushing connections on the valve body.

GAD OF UREA SERVICE PRESSURE RELIEF VALVE



GAD OF UREA SERVICE PRESSURE RELIEF VALVE



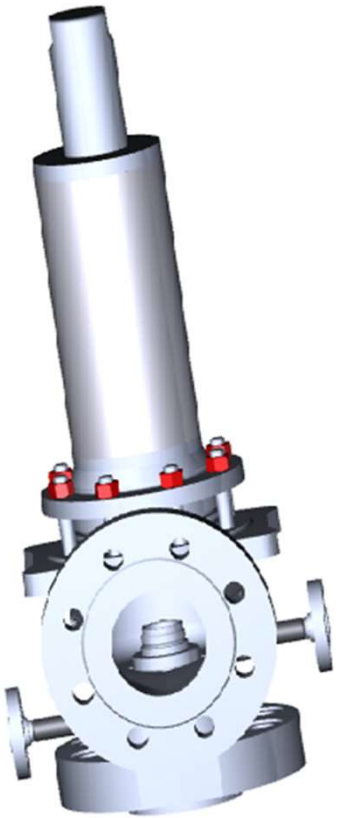
Specific Valve Data		
Pos	Description	Data
1	Purchase Order No.	2016_EIL_135177_1 RAMAGUNDAM
2	LESER Job No.	10191784
3	LESER Pos.	10
4	Type	5264.0122
5	Orifice	D
6	Inlet size	NPS 1"
7	Inlet pressure rating	600 lbs ASME B16.5
8	Inlet flange facing	Serr spiral finish, 125 AARH
9	Outlet size	NPS 2"
10	Outlet pressure rating	300 lbs
11	Outlet flange facing	Serr spiral finish, 125AARH
12	d0 [mm]	14,00
13	Set pressure	24,00
14	Pressure unit	kg/cm2-g
15	CDTP [bar-g]	23,53
16	Dimension a [mm]	105,00
17	Dimension b [mm]	114,00
18	Dimension s [mm]	30,00
19	Dimension H [mm]	447,00
20	Weight [kg]	18,40
21	Tag No. 1 + 2	200-PSV-0501; 200-PSV-0502

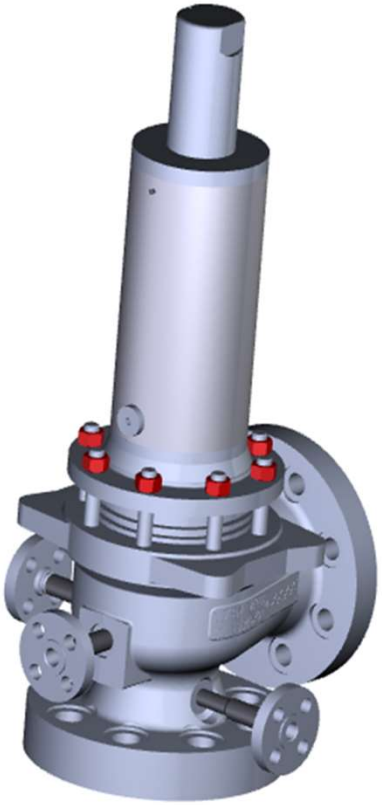
List of Parts Main Valve			
Pos	Description	Qty	Material
1	Body	1	SA-351 CF3M
5	Nozzle	1	HVD 1
7	Disc AS	1	HVD 1
8	Guide	1	1.4401/ 1.4404/ 316/ 316L
9	Bonnet	1	SA-351 CF3M
11	Spacer	1	1.4401/ 1.4404/ 316/ 316L
12	Spindle	1	1.4401/ 1.4404/ 316/ 316L
15	Bellows	1	1.4571/ 316Ti
26	Spring Plate	1	1.4401/ 1.4404/ 316/ 316L
27	Spring Plate	1	1.4401/ 1.4404/ 316/ 316L
38	Adjusting Screw AS	1	1.4401/ 1.4404/ 316/ 316L + PTFE/ Glas
40	Cap/ Lifting Device AS	1	1.4401/ 1.4404/ 316/ 316L
54	Compression Spring	1	1.4310
55	Stud	4	SA-193 B8M
56	Hexagon Nut	4	SA-194 8M
60	Gasket	3	Graphite/ 1.4401

Special Notes		
1	Design Code ASME VIII	
2	Code Stamping : non (without CE or ASME / UV)	
3	X-Ray : compl. body	acc. ASME VIII
4	X-Ray : compl. bonnet	ASME B16.34 Appendix 1
5	Liquid penetrant examination disc	acc. ASME VIII /
6	Liquid penetrant examination nozzle	ASME B16.34 Appendix 3
7	Ferrite check on each forging (bar)	
8	Ferrite check on studs and nuts	
9	All flushing connections seal welded	
10	MTC 3.1 for Body, Bonnet, Cap, Nozzle, Disc and Spring	

REV.	Status	PREPARED	APPROV.	DATE
2	Issued for Approval	SG	MDS	08.06.2017
1	Issued for Approval	SG	MDS	08.05.2017
0	Issued for Approval	SG	MDS	24.04.2017

UREA SERVICE JACKETED VALVE





Challenges-Procurement and Engineering

❖24” 2500# Butterfly Valves Cases

- ASME standard for flanges is available upto 12” 2500#.
- Dimensional drawing standard to be used shall be co-ordinated with Piping and Valve Vendor post award.
- The Lug design valve BCD (Bolt circle dia) should match with the flange hole dimensions.

❖Urea Reactor Inlet valve are designed for on off valve functionality . However, this requires control only during the start up .

- The Urea Start-up control case shall be discussed with the Licensor during BDEP Review stage.
- The above is to be ensured to obviate the need for necessary integration of the valves with new modulating schemes, using spare positioner.

❖High Pressure Ammonia services

- Vent/Drain ports shall be flanged for HP services

THANK YOU