

BHARAT HEAVY ELECTRICALS LIMITED, JHANSI

(WORKS ENGG. & SERVICES DEPTT.)

SUPPLY & RETROFITTING OF PLC & SCADA BASED CONTROL AND MEASUREMENT SYSTEM FOR UPGRADATION OF VACUUM DRYING PLANT OF TRM BAY-8 (ME-6/1/2113).

The vacuum drying plant 2113 is for processing of 245 KV instrument transformers. The existing Vertical cylindrical shaped chamber is suitable to withstand for 0.1 mbar vacuum. The door and chamber are connected using Machined flanges (with grooves for O-Ring) on chamber and matching flanges on the door. The chamber had been painted with aluminium paint suitable to withstand high temperature. It is subsequently be insulated with mineral fibre/ wool. Suitable connections to connect to other assemblies are provided. The following specification of the existing chamber has been applicable.

- Shape : Cylindrical
- Loading : Top Loading
- Door Clamping : Manual
- Door Lifting : Motorized

The instrument transformers are processed for total moisture removal under vacuum and steam heating. The vessel is fitted with a steam heating system and vacuum pump sets having following capacities:

TEMPERATURE: 105 +/- 5 DEG. CEN.
VACUUM : 1000 to 0.1 mBAR.

A. SYSTEM REQUIREMENT:

PLC and SCADA system is to be retrofitted to control the operation of vacuum drying plant. The existing vessel tank, vacuum pumps sets, cooling system, heating system, compressed air system, operating material s and mediums shall be retained. All the non-functional valves, manual valves, pressure gauges and other mechanical & electrical items are to be replaced for complete automation inline of functioning of the plant.

Integration of data acquisition system is required for DATA logging of OIL Treatment plant operating process values (temperature & vacuum).

B. DETAILS OF EXISTING SYSTEM.

The vacuum drying plant is controlled by the old control system (manual system) consist of following:

1. Vacuum chamber
2. Vacuum pumping units
3. Steam heating system.
4. Chilled water circulation system.
5. Compressed air system.
6. Scavenging system and recirculating fans.
7. Aeration system

All operation and control of vacuum drying plant are done manually through control desk located at the control panel.

C. DETAILS OF EXISTING PROCESS CYCLE.

The process cycle for the HVR ESP transformer and Ct & VT basically consist of following steps :

1. Heating

2. Heat Soaking
3. Vacuum drying
4. Vacuum soaking at desired set point
5. Hot air scavenging
6. Manual oil filling
7. Oil Soaking
8. Final vacuum broken

The detailed process chart for the complete process cycle for different instrument transformers are enclosed as :

ANNEXURE A: FOR CT's & VT's

ANNEXURE B: FOR HVR ESP TRANSFORMER

The detailed process sequence for complete process cycle is enclosed as:

ANNEXURE C: OPERATIONAL PROCESS SEQUENCE FOR 2113 VDP

General graphical layout of VDP – 2113 for reference is enclosed as:

ANNEXURE D:

D. SCOPE OF SUPPLY UNDER RETROFITTING / REPLACEMENT OF THE PLC/SCADA SYSTEM OF THE PLANT

The basics scope of supply will be as follows:

Si. No.	Component for VDP Plant	QTY
1	Pressure measuring system (vacuum transmitter) with filter mesh, Measurement range : 1000 mBar – 0.001mBar A. EDWARDS/LEYBOLD MAKE FOR FINE VACUUM MEASUREMENT OF MAIN VESSEL TANK. B. JUMO / WIKA MAKE FOR COARSE MEASUREMENT AND ROOT PUMP SWITCHING WITH MOUNTING AND FITTING ACCESSORIES.	2 Nos. 4 Nos.
2	Vacuum sensor supply cable	120 Met.
3	Clamping Ring and centring ring with filter for Edward/leybold Vacuum transmitter	4 Nos. each
4	Control panel (HMI) with 6" touch screen having full operational control	1 Nos.
5	Temperature measuring through RTD Sensors for vessel/job/steam etc.	15 Nos.
6	Lead through terminal with 12 terminals for PT-100 Sensor with suitable sealing kits and mounting accessories.	2 Nos.
7	Compensating cable for RTD sensor Extension	120 Met.
8	Dial Type temperature gauges with thermo well for pine line mounting. Range 0 to 150 Deg. Cen.	10 Nos.
9	Electro pneumatic valve for vacuum & steam control a) Suck back valve on vacuum pump : size 15 NB b) Vacuum pump valve on vacuum pump : Size 100 NB c) Electro-pneumatic valve (Throttling) : Size 25 NB d) Main vacuum valve on vessel : Size 200 NB, Type right angle e) Main Steam inlet control valve: Size 40 NB for temperature control of 105+/- 5 deg. Cen. f) Scavenging Valve on vessel :Size 75 NB, Type right angle g) Out let air valve on vessel : Size 75 NB, Type right angle h) Water cooling inlet and outlet valve : Size 15 NB i) EP operated condensate drain Valve : Size 15 NB	1 No. 1 No. 1 No. 1 No. 1 No. 1 No. 2 No. 2 No. 1 No.

	<p>Note :</p> <p>A. All electro pneumatic valves shall be supplied as complete set of solenoid operated pneumatic actuator cast steel/aluminium with limit switch feedback and visual positioner for OPEN/CLOSE indication.</p> <p>B. All supplied valves/Pneumatic actuators shall be of make ROTEX/FLOWSERVE/HYDAC/KLINGER</p> <p>C. All supplied valves shall be suitable for vacuum application (leak proof) of upto .001 mBar</p>	
10	<p>Programmable Logic Controller (PLC) : Suitable PLC System of make : SIEMENS/GE-IP/ABB is to be supplied for logic control and safety interlocks. Approximately input and output given below :</p> <p>A. Digital Input : 48</p> <p>B. Digital Output : 48</p> <p>C. Analog Input : 24</p> <p>D. Analog Output : 08</p> <p>E. RTD Module for temperature measurement : 24 Channels</p> <p>The PLC system should have facility for uploading and down loading of application logic program through remote PC.</p>	1 Set
11	<p>A INDUSTRIAL GRADE desktop PC of make SIEMENS/ADVANTECH/PHOENIX should be provided for online monitoring, program trouble shooting of PLC and for display & control of process by SCADA. The minimum configuration should be as below :</p> <ol style="list-style-type: none"> 1. CPU – Pentium i5 processor. 2. RAM – 4 GB 3. Hard disk – min. 500 GB 4. Rs232 communication port 5. LED monitor 19" min. screen size. 6. Keyboard and mouse 7. CPU with DVD writer to suit application with windows 7 licensed version 8. UPS (2KVA) 9. B&W Laser printer <p>Full operation control of the complete processing plant in AUTO/MANUAL Mode shall be provided with the PC through SCADA Software.</p>	1 set
12	<p>A diagnostic/trouble-shooting portable laptop PC is to be supplied with PLC system software(licenced version) for PLC ladder logic project backup upload / download and diagnostic / on-line monitoring of PLC variables.</p> <p>The supplied software has to be installed on industrial PC for remote diagnostic</p>	1 set
13	<p>SCADA software with license of minimum "2048 TAGS" along with communication cable and other necessary hardware.</p>	1 Set
14	<p>PLC-PC Communication cable with necessary hardware / line drivers for remote operation / monitoring of plant and PLC system.</p>	100 Met.
15	<p>Control panel with Suitable contactors, fuses, MCB's, push buttons, indication lamps, switchgears etc. , PLC, HMI and RTD converters as per requirement.</p>	1 set
16	<p>Field Control wiring and control panel wiring with cable tray and accessories as required</p>	1 set
17	<p>3 Phase supply isolator switch for main ON/OFF on panel (200 amperes)</p>	1 Nos.
18	<p>Supply and replacement of main "O" Ring of "nitrile material" for vessel door.</p>	1 set

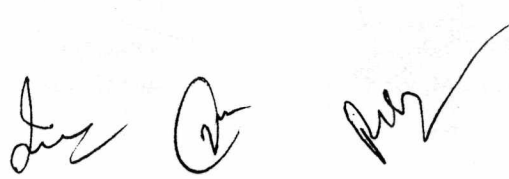
19	Limit switches for door open / close detection	2 Nos.
20	Vacuum sealing kit for circulating fans	4 Set
21	Moisture separator for input air line	1 Nos.
22	Pressure gauge for air and steam pressure , Range : 0-10 Kg/cm sq. with mountings and fittings	2 Nos. each
23	Pneumatic pipe line connectors, solenoid valves etc. as required. Make:FESTO	1 set
24	Water flow switch (in main cooling water outlet line)	2 Nos.
25	Temperature Gauges pipe line mounted for chilling water inlet /outlet (0 to 50 deg.cen.)	2 Nos.
26	Interlocking Temperature sensor for monitoring Vacuum pump surface temperature	2 Nos.
27	Hygrometer sensor for scavenging system	1 Nos.
28	Flow meter with totalizer for transformer oil filling monitoring for main line (Line Size : 2 inches / 50 NB) of make FLUIDWELL / AQUA MERTO / ENDRESS HAUSER	1 Nos.

Note: The above items are indicative. Any additional item(s) required for smooth functioning of VDP Plant will be in supplier's scope

E. SCOPE OF WORK

1. Complete commissioning of supplied PLC system and SCADA with the load trials and proving of the system.
2. Complete MIMIC of the plant has to be developed and displayed on the touch panel HMI and SCADA system. Touch panel shall control the complete process cycle in fully AUTO & MANUAL mode.
3. REMOTE PC with SCADA shall have complete control over the complete operation of the process plant and configured as master control of whole process vessel. The touch panel HMI shall have facility to load process set point values, recipe for process cycle and AUTO/MANUAL operations for operator control.
4. Process cycle recipe shall be editable as per the requirement through touch panel and SCADA PC both. The user/operator should able to create new recipe for new process cycle and same could be saved for future applications.
5. SCADA graphics shall be developed for operator friendly operations and control of the process vessel.
6. Complete LED MIMIC with graphical representation of the plant shall be developed and has to be fitted on the control panel. The LED MIMIC should be laminated with clear glass /acrylic protection sheet. The LED shall be dual colour LED for ON/OFF indication.
7. SCADA System shall record all the process parameters and should generate a consolidated report with date/time and process parameter punching. The generated report for the complete process cycle should be in formats as per annexure A and B for respective instrument transformers process chart. The desktop PC should have PLC diagnostic software for troubleshooting and uploading/downloading of application program.
8. Micafil Oil treatment plant operating temperature , system vacuum and plant running status has to be integrated in the newly supplied SCADA / PLC System for DATA Logging (DAS) Only and separate report generation is required through SCADA system in desired format with date /time stampings
9. Re-fitting of circulating fans – 4 Nos. (Circulating fans will be provided by BHEL free of cost). Following works shall be done on circulating fans :
 - A. Refitting of circulating fans in the vessel
 - B. Vacuum sealing
 - C. Connection of cooling pipe line

10. Overhauling of SCAVANGING System (Items required for the overhauling will be provided by BHEL free of cost). Temperature Sensor and hygrometer is to be supplied & installed on the scavenging unit and shall be interfaced with the control system for auto and manual operation.
11. Fully automated temperature control of vessel as per the Job temperature set point shall be provided through steam control valves. The desired accuracy for the temperature control shall be min. 5% of FS.
12. Interlocking of following valves :
- A. Root pump should operate after vacuum reaches 20-25 mBAR
 - B. Main vacuum valve and Hot air valve interlocking for auto operation.
 - C. Vacuum pump tripping above 80 Deg. Cen. of Vacuum pump temperature and shall restart at 50 deg.
 - D. Vacuum pump operation interlocking with water flow switch.
13. Conversion of manual operated valve to electro pneumatic operated valves :
- A. Stem inlet valve
 - B. Main vacuum valve
 - C. Pump valve
 - D. Suck back valve
 - E. Hot air valve (scavenging)
 - F. Aeration valve.
 - G. Any other valve required for functional operation shall be supplier's scope.
14. Apart from total AUTO operation of the process cycle, provision for manual operation of plant for complete process cycle shall be provided through SCADA and manual switches fitted on control panel.
15. Dismantling of existing control system along with I/O wiring
16. Necessary arrangement shall be made for mounting of new PLC system and -wiring, switch gears for Integrating the new control system.
17. Complete integration of New PLC System with existing process cycle of the subject process plant shall be properly done for trouble free operation of the plant.
18. General assembly Drawings (GA) / schematic for interfacing of New PLC system with existing plant and its components shall be required submitted before starting of project.
19. Demonstration of PLC project upload/download operation through supplied diagnostic laptop with licensed PLC system software.
20. All software back-up for SCADA and PLC system (Ladder Logic back-up) is to be provided in hard & soft copies with cross reference and I/O listing / symbol details. SCADA and PLC back-up is to be provided for restoration of any future system crash during operation of plant in long run.
21. Fixing of new electrical panel and Laying / termination of electrical of electrical cables, pneumatic pipe lines, control wiring etc.
22. Fixing of new pneumatic valves with modification in vacuum /steam pipe line.
23. Installation and functional proving of oil flow meter.
24. Any type of pipe line (vacuum line / other auxiliary pipe lines) and other mechanical assemblies required to be replaced for trouble free auto-operation of plant shall be assessed by the vendors during the pre-visit and same shall be included in the techno-commercial offer.
25. Documentation :
- A. Complete electrical schematic / interfacing drawing shall be provided in 5 nos. hard copies.
 - B. Complete technical literature /brochure of all bought-out items shall be provided.
 - C. Complete operation and maintenance manual shall be provided in 5 nos. hard copies.



26. Training :

- A. Complete operational training for SCADA systems with AUTO/MANUAL MODE shall be provided to 4 nos. persons : Duration 1 week
- B. Complete maintenance training shall be provided (Mechanical, Electrical and Electronics) to concerned persons: Duration 1 week.
- C. PLC and SCADA system operation and maintenance training (system restoration) is to be provided to concerned persons : Duration 1 week

F. GENERAL CONDITION

- (a) Retrofitting work to be done by the party in BHEL, JHANSI.
- (b) Party shall prove the process plant with full capacity by way of producing desired output after completion of process.
- (c) Offer must be submitted with details i.e. scope of supply and scope of work.
- (d) Details of supplied items to be given with quantity in Nos.
- (e) Price brake up to be given.
- (f) Time required for the retrofitting work to be given from the date of handing over the plant.
- (g) Performance and reliability prove out of the plant by processing job (CT / VT and ESP transformer) on the plants as per our specific requirement for 3 complete job processing cycle.
- (h) Guarantee of the work shall be minimum 12 month from the completion of work.
- (i) Complete activity Bar Chart with no. of days required to complete the desired work is to be submitted with the offer.

G. QUALIFYING CONDITIONS:

- (a) Vendor to visit for technical discussion / pre-assessment of work and site inspection i.e. 2113 VDP in bay-8 so as to have complete understanding of technical requirements and to analyses the quantum of work before submission of techno-commercial offer.
- (b) Vendor should have experience of supply / installation and commissioning of new automatic PLC/SCADA based VDP plant OR reconditioning/retrofitting of similar type VDP process plant. Relevant certificate in this context for successful installation and commissioning of minimum two Numbers VDP process plant within the past seven years from the date of enquiry shall necessarily be submitted along with offer.
- (c) Performance certificate with respect to above point No.(b) necessarily be submitted along with offer.




Vijay Verma

Dy. Manager, WEX



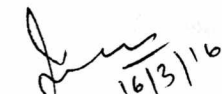
Sujeet Shrivastava

Manager, WEX




P. Par

Sr. Manager, TRM



Inder Mathur

DGM, WEX



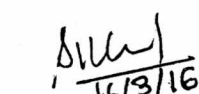
M K Nagayach

Sr. DGM, WEX



S Rastogi

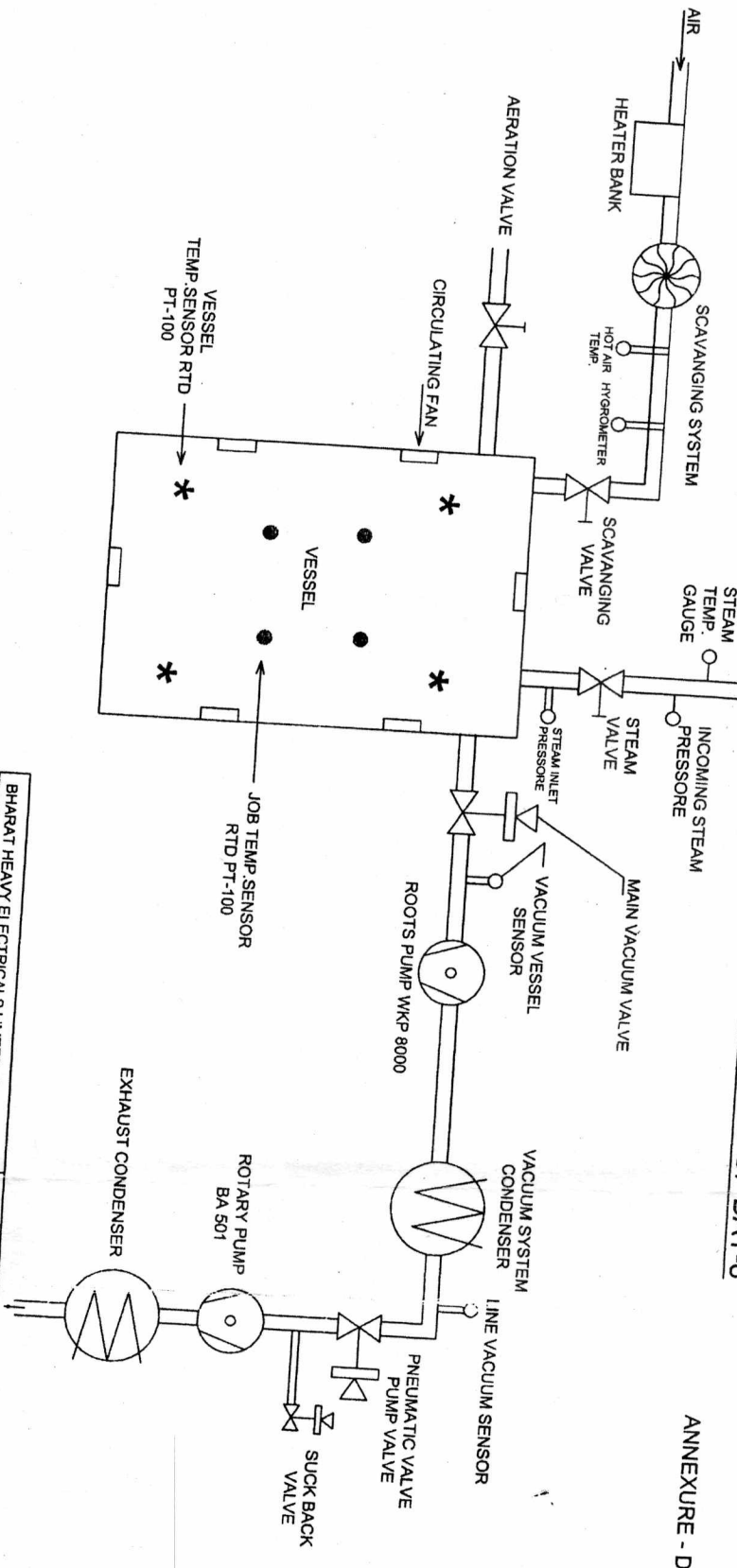
AGM, TRM



S J Chakraborty

AGM, WEX

GENERAL GRAPHICAL LAYOUT OF VACUUM DRYING PLANT-2113 OF BAY-8



ANNEXURE - D

BHARAT HEAVY ELECTRICALS LIMITED JHANSI		DRG NO. -BHE/JHSW&S/A4-2038	
TITLE:			
VACUUM DRYING PLANT-2113			
BAY-8			
DRAWN	ANAND KUMAR	SING	DATE-
CHECKED	JLALY VARMA		03.02.2016
APPROVED	INDER MATHUR		03.02.2016





ANEXURE 'A' PROCESSING CHART FOR CTs & VTs

ANNEXURE-A

No. :
 Drum Pot No. :
 Loading Date:

CT Sl. No. :
 VT Sl. No. :

Process Specification
 No.JS : 0690090

	First Cycle			Second Cycle			Third Cycle					
	Date	Time	Values	Sign operator	Date	Time	Values	Sign operator	Date	Time	Values	Sign operator
Temp Started at			
Temp Obtained at			
Temp Maintained at			
Temp Pulling Started on			12 Hrs				10 Hrs				
Temp above 80°C			
Temp Maintained on			
Temp above 80°C & Upto			1 Torr				0.5 Torr				
Blower Started at			8 Hrs				12 Hrs				0.5 Torr	
Blower inside the Vessel			
Blower kept running)			
Temp injected at 50 ° C			
Temp an inside the Vessel			
Temp be kept running)			
Temp stopped at			1/2 Hrs				
Temp 0°C Obtained at			
Temp ng Started at			
Temp g time			
Temp Vacuum Broken at			

Oil Test Results-BDV (at 2.5 mm Gap)=



PROCESSING CHART FOR HVR

No. :
 Job Pot No. :
 Loading Date:

W.O. No. :
 JOB SI. No. :
 Process Specification
 No.JS : 0690095

	First Cycle			Second Cycle		
	Date	Time	Values	Date	Time	Values
ing Started at		
5°C Obtained at		
5°C Maintained up to			4 Hrs			4 Hrs
m Pulling Started on Temp.		
80°C at		
m Maintained on Temp. above		
2 Upto			1 Torr			0.5 Torr
r Blower Started at (Fan inside			8 Hrs			8 Hrs
essel should be kept running)		
r injected at (50 ° C min) (Fan		
the Vessel should be kept		
ng)		
r stopped at			1/2 Hrs		
0°C Obtained at		
ng Started at		
g time		
vacuum Broken at		

Oil Test Results-BDV (at 2.5 mm Gap)=
 Note: This is for Silicon Oil Filled HVRS



OPERATIONAL PROCESS SEQUENCE

VACUUM DRYING PLANT 2113

ANNEXURE - C

PROCESS SEQUENCE DESCRIPTION	OPERATION	INTERLOCKING/REMARKS
DOOR CLOSING & CLAMPING		
De-clamp of door latch	Push button	Limit switch for de-clamping
Door close	Selector switch and push button	Select open/close movement and start by push button.
Clamping of door	Manually	Door close completed by bottom limit switch. First operate the hyd. Pump manually and remove the wedge. Clamp the door manually.
FIRST CYCLE		
Heating of vessel by steam	Switch ON/OFF	Switch ON Main steam inlet valve, ON/OFF Controlled 105±5 Degree C
Switch ON fans	Switches ON/OFF	Switch on circulating fan and maintained temp. 100-105 Degree C.
Vacuum pump suck back valve	Switch ON/OFF.	After 12 Hrs. stop circulating fan and Vacuum pump ON.
Vacuum Pump valve	Automatic	When vacuum pump start suck back valve closed.
Main vacuum valve	Switch ON/OFF	Run the pump for 15 Minutes and open the vacuum valve.
Roots pump	Switch ON/OFF	Valve control interlock with vacuum valve.
		Valve control interlock with vacuum pump.
		Achieve vacuum 20-25 mbar, start roots pump. Pull vacuum 1.0 Mbar or better
		Pull vacuum 1.0 Mbar or better and temp. maintained 80 Degree C for 8 Hrs
		After 8 Hrs. Switch OFF Main vacuum valve, Vacuum valve, Roots pump and Vacuum
		pump. When Vacuum pump OFF suck back valve automatically open.
		Switch ON blower, Switch ON heater
		Switch ON valve
		Open the out let air valve
		Switch ON circulating fans.
		After ½ Hrs. switch OFF scavenging valve, out let air valve and circulating fans.
SECOND CYCLE		
Heating of vessel by steam	Switch ON/OFF	Main steam inlet valve ON/OFF. Controlled 105±5 Degree C
Vacuum pump suck back valve	Switch ON/OFF.	After 10 Hrs. switch ON Vacuum pump.
Vacuum Pump valve	Automatic	When vacuum pump start suck back valve closed.
Main vacuum valve	Switch ON/OFF	Run the pump for 15 Minutes and open the vacuum valve.
		Valve control interlock with vacuum pump.
		Valve control interlock with vacuum pump.



Roots pump

Switch ON/OFF

Scavenging System
Scavenging valve
Out let air valve
Switch ON fans

Switch ON/OFF
Switch ON/OFF
Switch ON/OFF
Switches ON/OFF

HIRD CYCLE

Heating of vessel by steam

Vacuum pump
Suck back valve
Vacuum Pump valve

Switch ON/OFF
Switch ON/OFF.
Automatic
Switch ON/OFF

Main vacuum valve
Roots pump

Switch ON/OFF
Switch ON/OFF

OIL FILLING

Vacuum breaking
Scavenging System
Out let air valve

Switch ON/OFF
Switch ON/OFF

OPENING OF VESSEL

Door clamp

Manually

Door open

Selector switch and push button

Achieve vacuum 20-25 mbar, start roots pump. Pull vacuum 1.0 Mbar or better
 Pull vacuum 0.5 Mbar or better and temp. maintained 100-105 ±5 Degree C for 12 Hrs
 After 12 Hrs. Switch OFF Main vacuum valve, Vacuum valve, Roots pump and Vacuum
 pump. When Vacuum pump OFF suck back valve automatically open.
 Switch ON blower, Switch ON heater
 Open the out let air valve
 Switch ON circulating fans.
 After ½ Hrs. switch OFF scavenging valve, out let air valve and circulating fans.
 Switch ON Main steam inlet valve, ON/OFF Controlled 105±5 Degree C
 After 10 Hrs. switch ON Vacuum pump.
 When vacuum pump start suck back valve closed.
 Run the pump for 15 Minutes and open the vacuum valve.
 Valve control interlock with vacuum pump.
 Valve control interlock with vacuum pump.
 Achieve vacuum 20-25 mbar, start roots pump. Pull vacuum 1.0 Mbar or better
 Pull vacuum 0.5 Mbar or better and temp. maintained 100-105 ±5 Degree C for 20 Hrs
 After 20Hrs. Switch OFF Main vacuum valve, Vacuum valve, Roots pump and Vacuum
 pump. When Vacuum pump OFF suck back valve automatically open.

Allow the vessel to cool down upto 60 ±10 Degree C with our breaking vacuum.
 Filled the oil in transformer
 Oil filled transformer should be kept under vacuum for 12 Hrs.
 Switch ON blower, Switch ON heater
 Open the out let air valve

Open the door clamp (All door clamp opened **should be checked**)
 Operate the hyd. Pump manually and insert wedge.
 Select open movement and start by push button.
 Door open completed by top limit switch and door should be locked by door latch

