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OWNER



VAN PHONG POWER COMPANY LIMITED

PROJECT

Van Phong 1 BOT Thermal Power Plant Project

OWNER'S ENGINEER

AFRY Switzerland Ltd.



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REV

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DOCUMENT TITLE

System Description & Control Philosophy for Condenser Vacuum Pump

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System Description & Control Philosophy for Condenser Vacuum Pump

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1 INTRODUCTION

This document describes the functional description and recommended control logic for one Main Condenser Vacuum Pump system but is equally applicable to all systems.

Please refer to the latest revisions of the following documents for system scope of supply and configuration details:

- Outline Drawing of Condenser vacuum pump, VP1-C-L2-M-MAJ-00003
- Piping & Instrumentation Diagram of Condenser vacuum pump, VP1-C-L2-P-MAJ-00001

2 VACUUM SYSTEM

The system includes the following equipment items applicable to this document:

- Process Inlet Isolation Valve (BFV-1_10MAJ10AA401,10MAJ20AA401,20MAJ10AA401,20MAJ20AA401) fitted with Air Supply Solenoid Valve (SOV-1_10MAJ10AA651,10MAJ20AA651,20MAJ10AA651,20MAJ20AA651) Open ZSO-1 (10MAJ10AA653,10MAJ20AA653,20MAJ10AA653,20MAJ20AA653) and Close ZSC-1 (10MAJ10AA654,10MAJ20AA654,20MAJ10AA654,20MAJ20AA654) Limit Switches.
- Process Inlet Pressure Transmitter (PT-1_10MAJ10CP001, 10MAJ20CP001, 20MAJ10CP001, 20MAJ20CP001).
- Process Inlet Pressure Transmitter (PT-2_10MAJ10CP002, 10MAJ20CP002, 20MAJ10CP002, 20MAJ20CP002).
- Vacuum Pump (VP-1_10MAJ10AP010KP01, 10MAJ20AP010KP01, 20MAJ10AP010KP01, 20MAJ20AP010KP01) complete with Electric Motor (M-1_10MAJ10AP010-M01, 10MAJ20AP010-M01, 20MAJ10AP010-M01, 20MAJ20AP010-M01)
- Seal Water Make-Up Solenoid Valve (SOV-2_10MAJ10AA652,10MAJ20AA652,20MAJ10AA652,20MAJ20AA652).
- Seal water flow indicator cum switch (FIS-1_10MAJ11CF502,10MAJ21CF502,20MAJ11CF502,20MAJ21CF502)
- Seal Water Low Level Switch (LLS-1_10MAJ10CL102,10MAJ20CL102,20MAJ10CL102,20MAJ20CL102).
- Seal Water High Level Switch (HLS-1_10MAJ10CL101,10MAJ20CL101,20MAJ10CL101,20MAJ20CL101).
- Seal Water Recirculation Pump (PMP-1_10MAJ11AP020KP01, 10MAJ21AP020KP01, 20MAJ11AP020KP01, 20MAJ21AP020KP01) complete with Electric Motor (M-2_10MAJ10AP020-M01, 10MAJ20AP020-M01, 20MAJ10AP020-M01, 20MAJ20AP020-M01).
- Seal Water Temperature Switch (TS-1_10MAJ11CT101, 10MAJ21CT101, 20MAJ11CT101, 20MAJ21CT101).
- Differential pressure switch for Duplex strainer (DPIS_10MAJ15CP101, 10MAJ25CP101, 20MAJ15CP101, 20MAJ25CP101)

3 PRE-START CHECKS

Note: Pre-Start checks shall be ensured for standby pump also before putting it on auto standby.



WARNING

Do not operate the Vacuum pump or recirculation pump without seal water in the pump. If you do, there may be a risk of fire or damage to the pump.



WARNING

Do not start the Vacuum pump full of seal water as this could damage the pump.

- 1 Upstream system is completely free of water.
 - 2 System volume is leak tight; prove by leak test if necessary.
 - 3 Turbine gland sealing steam gland sealing is on. This is to minimise air ingress during commissioning.
 - 4 Installation is according to Edwards' instructions.
 - 5 Terminal Points and associated lines are clear and free from blockages and Process Outlet Check Valve (NRV-1_10MAJ10AA001, 10MAJ20AA001, 20MAJ10AA001, 20MAJ20AA001) opens freely.
 - 6 Following valves shall be closed
BV-1 (10MAJ10AA003, 10MAJ20AA003, 20MAJ10AA003, 20MAJ20AA003), BV-2 (10MAJ10AA004, 10MAJ20AA004, 20MAJ10AA004, 20MAJ20AA004), BV-5 (10MAJ10AA005, 10MAJ20AA005, 20MAJ10AA005, 20MAJ20AA005), BV-6 (10MAJ10AA951, 10MAJ20AA951, 20MAJ10AA951, 20MAJ20AA951), BV-7 (10MAJ10AA951, 10MAJ20AA951, 20MAJ10AA951, 20MAJ20AA951)
 - 7 Electrical power and control are available.
 - 8 Instrument air is available
 - 9 Seal Water make-up and Cooling Liquid are available.
 - 10 Open all instrument isolating valves, and termination point isolating valves to process except Discharge Separator Flow Meter Isolating Valve (BV-2_10MAJ10AA004, 10MAJ20AA004, 20MAJ10AA004, 20MAJ20AA004). Termination point isolating valves to drain shall remain closed.
Process Inlet Isolation Valve (BFV-1_10MAJ10AA401, 10MAJ20AA401, 20MAJ10AA401, 20MAJ20AA401) and Seal Water Make-Up Solenoid Valve (SOV-2_10MAJ10AA652, 10MAJ20AA652, 20MAJ10AA652, 20MAJ20AA652) remain closed.
 - 11 Open the following manual valves:
 - Seal Water Supply Regulating Valve (GBV-1_10MAJ11AA007, 10MAJ21AA007, 20MAJ11AA007, 20MAJ21AA007).
 - Level gauge isolation valve BV-3(10MAJ10AA301, 10MAJ20AA301, 20MAJ10AA301, 20MAJ20AA301)
 - Level gauge isolation valve BV-3(10MAJ10AA302, 10MAJ20AA302, 20MAJ10AA302, 20MAJ20AA302)
 - Vacuum Pump Anti cavitation valve Valve (BV-5_10MAJ10AA005, 10MAJ20AA005, 20MAJ10AA005, 20MAJ20AA005).
- Note: All other manual valves, (BV-1_10MAJ10AA003, 10MAJ20AA003, 20MAJ10AA003, 20MAJ20AA003), (BV-2_10MAJ10AA004 , 10MAJ20AA004, 20MAJ10AA004, 20MAJ20AA004), (BV-6_10MAJ10AA951 , 10MAJ20AA951, 20MAJ10AA951, 20MAJ20AA951), (BV-7_10MAJ10AA952, 10MAJ20AA952, 20MAJ10AA952, 20MAJ20AA952) shall be closed.*
- 12 Vacuum system is primed according to the following procedure:

- Open Discharge Separator Liquid Make-up Valve (BV-8_10MAJ10AA006, 10MAJ20AA006, 20MAJ10AA006, 20MAJ20AA006) at TP-3 until service water level reaches the priming level (+0%, -10%) approximately 600 mm above the bottom of the Discharge Separator.
- Start Seal Water Recirculation Pump Electric Motor (M-2_10MAJ10AP020-M01, 10MAJ20AP020-M01, 20MAJ10AP020-M01, 20MAJ20AP020-M01) and operate for 40 seconds.
- Stop Seal Water Recirculation Pump Electric Motor (M-2_10MAJ10AP020-M01, 10MAJ20AP020-M01, 20MAJ10AP020-M01, 20MAJ20AP020-M01).
- Close Discharge Separator Liquid Make-up Valve (BV-8_10MAJ10AA006, 10MAJ20AA006, 20MAJ10AA006, 20MAJ20AA006).

3.1 START PERMISSIVE

- Vacuum Pump Electric Motor not current overloaded (M-1) (10MAJ16AP010-M01, 10MAJ17AP010-M01, 10MAJ18AP010-M01, 10MAJ19AP010-M01)
- Seal water inlet temperature not *high* (TS-1) (10MAJ11CT101, 10MAJ21CT101, 20MAJ11CT101, 20MAJ21CT101) set point 50 °C.
- Seal water flow not *low* (FIS-1) (10MAJ11CF102, 10MAJ21CF102, 20MAJ11CF102, 20MAJ21CF102) set point 21 m³/h
- Seal Water level not *low* (LLS-1) (10MAJ10CL102, 10MAJ20CL102, 20MAJ10CL102, 20MAJ20CL102) 390 mm above Discharge Separator base.

4 OPERATION, HOGGING MODE

4.1 Sequence of Operation

During initial evacuation (Hogging) all Main Condenser Vacuum Pumps operate in parallel for rapid evacuation of the Condenser and L.P. Turbine from atmospheric pressure down to a predetermined pressure (12 kPa-abs.). Once achieved, the designated 'assist' Main Condenser Vacuum Pump is stopped signifying the end of the Hogging phase. The remaining 'duty' designated Main Condenser Vacuum Pump continues to evacuate the system down to the minimum steam condensing pressure consistent with the physical dimensions and heat transfer of the condenser. The Main Condenser Vacuum Pump is now in the vacuum maintaining (Holding) phase.



4.2 Start Sequence

All inputs and outputs are provided to and from the End User's Distributed Control System (hereby referred to as DCS) except electric motor inputs and outputs which are provided to and from the End User's Motor Control Centre (hereby referred to as MCC).

1) Normal Start Sequence :

Press the 'System Start' push-button.

For all Main Condenser Vacuum Pumps:

Vacuum Pump Electric Motor (M-1_10MAJ10AP010-M01, 10MAJ20AP010-M01, 20MAJ10AP010-M01, 20MAJ20AP010-M01) starts, Process Inlet Isolation Valve (BFV-1_10MAJ10AA401, 10MAJ20AA401, 20MAJ10AA401, 20MAJ20AA401) opens and after 10 second delay the Seal Water Recirculation Pump Electric Motor (M-2_10MAJ10AP020-M01, 10MAJ20AP020-M01, 20MAJ10AP020-M01, 20MAJ20AP020-M01) starts.

Once set pressure attained, monitored by Process Inlet Pressure Transmitter (PT-1_10MAJ10CP001, 10MAJ20CP001, 20MAJ10CP001, 20MAJ20CP001), normal shut down sequence is triggered for designated 'assist' Vacuum Pump (VP-1_10MAJ10AP010KP01, 10MAJ20AP010KP01, 20MAJ10AP010KP01, 20MAJ20AP010KP01).

Designated 'duty' Vacuum Pump (VP-1_10MAJ10AP010KP01, 10MAJ20AP010KP01, 20MAJ10AP010KP01, 20MAJ20AP010KP01) continues to evacuate down to the minimum steam condensing pressure consistent with the physical dimensions and heat transfer of the condenser.

Notes:

a) During initial start up all Main Condenser Pumps operate for rapid evacuation.

4.3 Normal Operation

All inputs and outputs are provided to and from the End User's DCS except electric motor inputs and outputs which are provided to and from the End User's MCC.

Each Main Condenser Vacuum Pump operates normally with protection for the following conditions:

- a) Vacuum Pump Electric Motor (M-1_10MAJ10AP010-M01, 10MAJ20AP010-M01, 20MAJ10AP010-M01, 20MAJ20AP010-M01) current overload.
- b) Process Inlet Isolation Valve (BFV-1_10MAJ10AA401, 10MAJ20AA401, 20MAJ10AA401, 20MAJ20AA401) closed, Limit Switch (ZSC-1_10MAJ10AA654, 10MAJ20AA654, 20MAJ10AA654, 20MAJ20AA654).
- c) Seal Water level *low* (LLS-1_10MAJ10CL102, 10MAJ20CL102, 20MAJ10CL102, 20MAJ20CL102) 390 mm above Discharge Separator (DS) base.
- d) Seal Water level *high* (HLS-1_10MAJ10CL101, 10MAJ20CL101, 20MAJ10CL101, 20MAJ20CL101) 570 mm above Discharge Separator (DS) base.
- e) Seal water flow low (FIS-1_10MAJ11CF502, 10MAJ21CF502, 20MAJ11CF502, 20MAJ21CF502) set point 21m³/hr
- f) Seal Water temperature *high* (TS-1_10MAJ11CT101, 10MAJ21CT101, 20MAJ11CT101, 20MAJ21CT101) set point 50 °C.
- g) Dual-filter differential pressure *high* (DPIS-1_10MAJ15CP101, 10MAJ25CP101, 20MAJ15CP101, 20MAJ25CP101), set point 15 Kpa.

4.4 Shutdown Sequence

All inputs and outputs are provided to and from the End User's DCS except electric motor inputs and outputs which are provided to and from the End User's MCC.

1) Normal Stop Sequence:

Press the 'System Stop' push-button.

Seal Water Recirculation Pump Electric Motor (M-2_10MAJ10AP020-M01, 10MAJ20AP020-M01, 20MAJ10AP020-M01, 20MAJ20AP020-M01) stops, Process Inlet Isolation Valve BFV-1 (10MAJ10AA401, 10MAJ20AA401, 20MAJ10AA401, 20MAJ20AA401) closes and Vacuum Pump Electric Motor (M-1_10MAJ10AP010-M01, 10MAJ20AP010-M01, 20MAJ10AP010-M01, 20MAJ20AP010-M01) stops.

2) Emergency Stop Sequence:

Vacuum Pump Electric Motor (M-1_10MAJ10AP010-M01, 10MAJ20AP010-M01, 20MAJ10AP010-M01, 20MAJ20AP010-M01) stops, Seal Water Recirculation Pump Electric Motor (M-2_10MAJ10AP020-M01, 10MAJ20AP020-M01, 20MAJ10AP020-M01, 20MAJ20AP020-M01) stops and Process Inlet Isolation Valve (BFV-1_10MAJ10AA401, 10MAJ20AA401, 20MAJ10AA401, 20MAJ20AA401) closes.

4.5 Alarm Conditions

- a) Vacuum Pump Electric Motor M-1(10MAJ10AP010-M01, 10MAJ20AP010-M01, 20MAJ10AP010-M01, 20MAJ20AP010-M01) current overload.

Vacuum pump VP-1(10MAJ10AP010KP01, 10MAJ20AP010KP01, 20MAJ10AP010KP01,20MAJ20AP010KP01 emergency stop sequence triggered
Alarm and indications.

- b) Process Inlet Isolation Valve Limit Switch ZSC-1(10MAJ10AA654, 10MAJ20AA654, 20MAJ10AA654, 20MAJ20AA654 closed.

Vacuum pump VP-1 (10MAJ10AP010KP01, 10MAJ20AP010KP01, 20MAJ10AP010KP01, 20MAJ10AP010KP01 emergency stop sequence triggered.
Alarm and indication.

- c) Low Level Switch (LLS-1_10MAJ10CL102,10MAJ20CL102,20MAJ10CL102,20MAJ20CL102) *low* (390 mm above discharge separator base). Seal Water Make-Up Solenoid Valve (SOV-2) (10MAJ10AA652 10MAJ20AA652,20MAJ10AA652,20MAJ20AA652) opens.

If Low Level Switch low signal is not de-activated within 120 seconds after the Low Level Switch low signal is detected. Emergency stop sequence triggered.
Alarm and indication.

- d) High Level Switch (HLS-1_ 10MAJ10CL101,10MAJ20CL101,20MAJ10CL101,20MAJ20CL101) *high* (570 mm above discharge separator base). Seal Water Make-Up Solenoid Valve SOV-2(10MAJ10AA652 10MAJ20AA652,20MAJ10AA652,20MAJ20AA652) closes.

- e) Seal Water Temperature Switch (TS-1_10MAJ11CT101, 10MAJ21CT101, 20MAJ11CT101, 20MAJ21CT101) High (50 deg C) Vacuum pump VP-1(10MAJ10AP010KP01, 10MAJ20AP010KP01, 20MAJ10AP010KP01, 20MAJ20AP010KP01) emergency stop sequence triggered.
Alarm and indication.

- f) Seal water flow switch (FIS-1_10MAJ11CF502, 10MAJ21CF502, 20MAJ11CF502, 20MAJ21CF502) Low. Set point (21 m3/hr) Vacuum Pump (VP-1_10MAJ10AP010KP01, 10MAJ20AP010KP01, 20MAJ10AP010KP01, 20MAJ20AP010KP01) emergency stop sequence triggered.
Alarm and indication.

If Emergency Stop Sequence triggered: Operator to investigate the problem and take all necessary remedial action. Reset the system when the fault has been cleared and reset.

5 OPERATION, HOLDING MODE

5.1 Sequence of Operation

Once the minimum steam condensing pressure consistent with the physical dimensions and heat transfer of the condenser has been attained, the duty Main Condenser Vacuum Pumps are now in the Holding mode. On rising pressure the designated 'assist' Main Condenser Vacuum Pump starts but remains isolated from the Condenser and L.P. Turbine. The 'assist' Process Inlet Isolation Valve remains closed until the 'assist' Main Condenser Vacuum Pump process pipework downstream of the Process Inlet Isolation Valve is evacuated close to the operating pressure. Once the differential pressure from the two Process Inlet Pressure Transmitters approaches 1kPa the 'assist' Process Inlet Isolation Valve opens. This minimises pressure fluctuations when introducing the 'assist' Main Condenser Vacuum Pump.

5.2 Normal Operation

All inputs and outputs are provided to and from the End User's DCS except electric motor inputs and outputs which are provided to and from the End User's MCC.

Each Main Condenser Vacuum Pump operates normally with protection for the following conditions:

- a) Vacuum Pump Electric Motor (M-1_10MAJ10AP010-M01, 10MAJ20AP010-M01, 20MAJ10AP010-M01, 20MAJ20AP010-M01) current overload.

- b) Process Inlet Isolation Valve (BFV-1_10MAJ10AA401,10MAJ20AA401,20MAJ10AA401,20MAJ20AA401) closed, Limit Switch (ZSC-1_10MAJ10AA654,10MAJ20AA654,20MAJ10AA654,20MAJ20AA654).
- c) Seal Water level *low* (LLS-1_10MAJ10CL102,10MAJ20CL102,20MAJ10CL102,20MAJ20CL102) set point (390 mm) above Discharge Separator (DS) base.
- d) Seal Water level *high* (HLS-1_10MAJ10CL101,10MAJ20CL101,20MAJ10CL101,20MAJ20CL101) set point (570 mm) above Discharge Separator (DS) base.
- e) Seal water flow *low* (FIS-1_10MAJ11CF502, 10MAJ21CF502, 20MAJ11CF502, 20MAJ21CF502) set point (21m³/hr)
- f) Seal Water temperature *high* (TS-1_10MAJ11CT101, 10MAJ21CT101, 20MAJ11CT101, 20MAJ21CT101) set point (50 °C.)
- g) Dual-filter differential pressure *high* (DPIS-1_10MAJ15CP101, 10MAJ25CP101, 20MAJ15CP101, 20MAJ25CP101), set point 15 Kpa.

5.3 Shutdown Sequence

All inputs and outputs are provided to and from the End User's DCS except electric motor inputs and outputs which are provided to and from the End User's MCC.

1) Normal Stop Sequence:

Press the 'System Stop' push-button.

Seal Water Recirculation Pump Electric Motor (M-2) stops, Process Inlet Isolation Valve (BFV-1_10MAJ10AA401,10MAJ20AA401,20MAJ10AA401,20MAJ20AA401) closes and Vacuum Pump Electric Motor (M-1_10MAJ10AP010-M01, 10MAJ20AP010-M01, 20MAJ10AP010-M01, 20MAJ20AP010-M01) stops.

2) Emergency Stop Sequence:

Vacuum Pump Electric Motor (M-1_10MAJ10AP010-M01, 10MAJ20AP010-M01, 20MAJ10AP010-M01, 20MAJ20AP010-M01) stops, Seal Water Recirculation Pump Electric Motor (M-2_10MAJ10AP020-M01, 10MAJ20AP020-M01, 20MAJ10AP020-M01, 20MAJ20AP020-M01) stops and Process Inlet Isolation Valve (BFV-1_10MAJ10AA401,10MAJ20AA401,20MAJ10AA401,20MAJ20AA401) closes.

5.4 Alarm Conditions

- a) Vacuum Pump Electric Motor (M-1_10MAJ10AP010-M01, 10MAJ20AP010-M01, 20MAJ10AP010-M01, 20MAJ20AP010-M01) current overload.
Vacuum Pump (VP-1_10MAJ10AP010KP01, 10MAJ20AP010KP01, 20MAJ10AP010KP01, 20MAJ20AP010KP01) emergency stop sequence triggered.
Alarm and indication.
- b) Process Inlet Isolation Valve Limit Switch ZSC-1 (10MAJ10AA654,10MAJ20AA654,20MAJ10AA654,20MAJ20AA654) closed.
Vacuum Pump (VP-1_10MAJ10AP010KP01, 10MAJ20AP010KP01, 20MAJ10AP010KP01, 20MAJ20AP010KP01) emergency stop sequence triggered.
Alarm and indication.
- c) Low Level Switch (LLS-1_10MAJ10CL102,10MAJ20CL102,20MAJ10CL102,20MAJ20CL102) *low*. Set point (390 mm above base of discharge separator) seal water make up solenoid valve SOV-2 (10MAJ10AA652,10MAJ20AA652,20MAJ10AA652,20MAJ20AA652, open



If Low Level Switch low signal is not de-activated within 120 seconds after the Low Level Switch low signal is detected. Emergency stop sequence triggered.

Alarm and indication.

- d) High Level Switch (HLS-1_10MAJ10CL101,10MAJ20CL101,20MAJ10CL101,20MAJ20CL101) *high*. Set point (570 mm above base of discharge separator), seal water make up solenoid valve SOV-2 (10MAJ10AA652,10MAJ20AA652,20MAJ10AA652,20MAJ20AA652, closes.
- e) Seal Water Temperature Switch (TS-1_10MAJ11CT101, 10MAJ21CT101, 20MAJ11CT101, 20MAJ21CT101) *high*. (50 deg C)
Vacuum Pump (VP-1_10MAJ10AP010KP01, 10MAJ20AP010KP01, 20MAJ10AP010KP01, 20MAJ20AP010KP01) emergency stop sequence triggered.
Alarm and indication.
- f) Seal water flow switch (FIS-1_10MAJ11CF502, 10MAJ21CF502, 20MAJ11CF502, 20MAJ21CF502) *Low*.
Set point (21 m3/hr)
Vacuum Pump (VP-1_10MAJ10AP010KP01, 10MAJ20AP010KP01, 20MAJ10AP010KP01, 20MAJ20AP010KP01) emergency stop sequence triggered.
Alarm and indication.
- g) Dual-filter differential pressure *high* (DPIS-1_10MAJ15CP101, 10MAJ25CP101, 20MAJ15CP101, 20MAJ25CP101), set point 15 Kpa.
Alarm and indication.

If Emergency Stop Sequence triggered: Operator to investigate the problem and take all necessary remedial action. Reset the system when the fault has been cleared and reset.

6 CHANGE-OVER, DUTY / DUTY TO DUTY / ASSIST

All inputs and outputs are provided to and from the End User's DCS except electric motor inputs and outputs which are provided to and from the End User's MCC.

- a) Process inlet pressure increases, monitored by Process Inlet Pressure Transmitter (PT-1_10MAJ10CP001, 10MAJ20CP001, 20MAJ10CP001, 20MAJ20CP001).

'Assist' Vacuum Pump Electric Motor (M-1_10MAJ10AP010-M01, 10MAJ20AP010-M01, 20MAJ10AP010-M01, 20MAJ20AP010-M01) starts with alarm and indication. After 10 seconds Seal Water Recirculation Pump Electric Motor (M-2_10MAJ10AP020-M01, 10MAJ20AP020-M01, 20MAJ10AP020-M01, 20MAJ20AP020-M01) starts.

Process Inlet Isolation Valve (BFV-1_10MAJ10AA401,10MAJ20AA401,20MAJ10AA401,20MAJ20AA401) opens when differential pressure across Process Inlet Isolation Valve (BFV-1_10MAJ10AP010KP01, 10MAJ20AP010KP01, 20MAJ10AP010KP01, 20MAJ20AP010KP01) decreases to set point (1 kPa).

After inlet pressure decreases to minimum steam condensing pressure consistent with the physical dimensions heat transfer of the condenser, 'Assist' Vacuum Pump (VP-1_10MAJ10AP010KP01, 10MAJ20AP010KP01, 20MAJ10AP010KP01, 20MAJ20AP010KP01) normal stop sequence is triggered with alarm and indication.

7 ACTUATED VALVE CONFIGURATION

- a) Process Inlet Isolation Valve (BFV-1_10MAJ10AA401,10MAJ20AA401,20MAJ10AA401,20MAJ20AA401): **Fail Locked.**
- b) Seal Water Make-Up Solenoid Valve
(SOV-2_10MAJ10AA652,10MAJ20AA652,20MAJ10AA652,20MAJ20AA652): **Fail Closed.**

8 MANUAL VALVE CONFIGURATION – NORMAL OPERATION

- a) BV-1 (10MAJ10AA003,10MAJ20AA003,20MAJ10AA003,20MAJ20AA003): Closed
- b) BV-2 (10MAJ10AA004,10MAJ20AA004,20MAJ10AA004,20MAJ20AA004): Closed
- c) BV-3 (10MAJ10AA301,10MAJ20AA301,20MAJ10AA301,20MAJ20AA301): Open
- d) BV-4 (10MAJ10AA304,10MAJ20AA304,20MAJ10AA304,20MAJ20AA304): Open
- e) BV-5 (10MAJ10AA004,10MAJ20AA004,20MAJ10AA004,20MAJ20AA004) Open (regulated to avoid cavitation if required)
- f) BV-6 (10MAJ10AA951,10MAJ20AA951,20MAJ10AA951,20MAJ20AA951): Closed
- g) BV-7(10MAJ10AA951,10MAJ20AA951,20MAJ10AA951,20MAJ20AA951): Closed
- h) GBV-1(10MAJ10AA007,10MAJ20AA007,20MAJ10AA007,20MAJ20AA007): Open (regulated to optimise Seal Water flow if required)