TRANSNET PIPELINES

TARLTON

INTERMIXTURE REFRACTIONATOR

Engineering Design Specifications

G52001-T4043-U001

REV. 2.0

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APPROVAL

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AMENDMENT RECORD

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B	29/11/06		EDS review meeting changes	All
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E	23/3/2007		Changes following FAT and inclusion of Auxiliary motors – DOL with trip	15,19,26,32,36,,37,39,40,42,45,46,47,50 and 51
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1 ENGINEERING DESIGN DOCUMENT

1.1 GENERAL

This EDS is based on the Transnet Pipelines Automation Standard Document as specified in Reference 1.3 – 5.

This EDS has precedence over the automation standard in case of any ambiguity.

This document should be read in conjunction with the Transnet Pipelines Automation Standard Document as specified in Reference 1.3 - 5 below.

The Intermixture Refractionator Plant (IRP) comprises of the following:

- IRP intake of Intermix from Tarlton LP manifold.
- IRP intake of Intermix from Tarlton tank farm.
- IRP intake of Diesel from Tarlton tank farm.
- Offloading of Intermix from rail and road.
- Refractionation of Intermix.
- Manual transfer of Diesel from the Diesel Fuel storage tank (T-04) to the Diesel storage tank (T-06).
- Delivery of Diesel, Petrol, and Intermix to the Tarlton tank farm.
- Accumulator Tank Farm.

1.2 ABBREVIATIONS

ABBREVATION	DESCRIPTION
SCADA	Supervisory Control and Data Acquisition
MDS	Metering Database System..
PLC	Programmable Logic Controller
HP	High Pressure
LP	Low Pressure
FC	Flow Computer
MCC	Master Control Centre
OMS	Operations Management System (Transnet Pipelines)
S5	SIMATIC S5 Automation Equipment
S7	SIMATIC S7 Automation Equipment
EDS	Engineering Design Specification
API	American Petroleum Institute
LDS	Leak Detection System
BTM	Batch Tracking Module
ICP	Station Inlet Pressure
SDP	Station Outlet Pressure
WB	Wire Break
a	Available
o	Open
c	Closed
a/c	Available or Closed
rdy	Ready
IRP	Intermixture Refractionator Plant
BOL	Bill Of Lading

1.3 REFERENCES

- API Manual of Petroleum Measurement Standards
- Transnet Pipelines Automation Standard PL723 Rev 2.0
- Transnet Pipelines LSX Automation EDS PL723-1 Rev 2.0
- IRP Product Storage P&ID (25913-8820-25-1800 Rev: S2).
- IRP Feed Storage P&ID (25913-8820-25-1700 Rev: S1).
- IRP Rail Offloading Pump Station P&ID (25913-8820-25-1701 Rev: S1).
- IRP Distillation Column P&ID (25913-8820-25-1200 Rev: S1).
- IRP Feed/Bottoms Exchanger P&ID (25913-8820-25-1100 Rev: S2).
- IRP Reflux Drum P&ID (25913-8820-25-1300 Rev: S2).
- IRP Air, Pot water, Nitrogen UFD P&ID (25913-8820-25-1600 Rev: R2).
- IRP Fired Heater P&ID (25913-8820-25-1400 Rev: S1).
- IRP Utility flow P&ID (25913-8820-25-1900 Rev: S2).
- IRP Distillation Column Reboiler FH-001 (FH01-FD-801 Rev: 7).
- IRP Distillation Column Reboiler FH-001 (FH01-FD-802 Rev: 10).
- IRP Distillation Column Reboiler FH-001 (FH01-FD-803 Rev: 5).
- Transnet Pipelines Intermixture Refractionator Project (25913-8110-20-001 Rev: A3).
- IRP Process Control Functional Specification (25913-8110-PS-0001 Rev: A1).
- IRP Cause and Effect Chart (25913-8110-PS-0029 Rev: A8).
- RAT Schedule (Dated 31st of August 2006).
- Distillation Column Reboiler BMS & Interlock Narrative (FH01-FJ-801 Rev: 0).
- Distillation Column Reboiler FH-001 Cause and Effect Chart (FH01-FJ-803 Rev: 0).
- Column power failure start-up sequence (Email from B. Ligthelm of Forster Wheeler, Subject: Narrative for start-up sequences after power outages. Dated: 28th of November 2006)
- Column power failure start-up sequence (Email from B. Ligthelm of Forster Wheeler, Subject: Query on IRP column power failure sequence. Dated: 28th of November 2006)
- SIL Review Report (25913-8551-RP-0001)

2 CONTROL AND OPERATING PHILOSOPHY

2.1 DEFINITIONS

2.1.1 DEVICE

Devices are defined as any field equipment, inclusive of valves, pumps, motors and instrumentation that are monitored / controlled by the PLC System.

2.1.1.1 DEVICE FAULT

A Device Fault is defined as any condition prohibiting control from the PLC System (e.g. wire break, thermal overload and control error).

2.1.1.2 DEVICE AVAILABLE

A device is defined as being Available if the device is not in local and has no fault condition.
2.1.1.3

2.1.2 DEVICE GROUP

A Device Group is defined as a collection of devices, grouped both logically and functionally for the purposes of control and monitoring e.g. Receivers, Launchers. Note that Control Sequences (e.g. Start-up, Shutdown, On-line and Off-line) are unique to individual Device Groups.

The IRP plant SCADA graphics will have an overview as per drawing number 25913-8110-20-0001 rev F1. From this overview, the operator will be able to navigate the SCADA system to each device group as per the P&IDís. The SCADA system will include a tank farm group.

2.1.2.1 GROUP AVAILABLE

A device group is defined as being Available when all devices associated with a group are available and all associated process conditions are healthy (e.g. hand valves in the correct positions and vessels at correct levels).
Group availability is indicated on the group name banner. If the banner is green the group is available and if yellow the group is not available.

2.1.2.2 GROUP READY

A device group is defined as being ìReady” when the device group is available and in automatic mode of operation. If the group is not ready, associated sequences cannot be controlled.

2.1.2.3 GROUP FAULT

A device group is defined as being in a Fault condition when any of the devices in that group are in a fault condition. Fault conditions may activate offline sequences for groups where required.

2.1.3 PLC RESTART

If motors are running and there is a power failure, and upon restarting of the PLC, these motor will not automatically restart. The motors will not be started and a timeout error is displayed and an alarm logged.

2.1.4 MODES OF OPERATION

2.1.4.1 LOCAL

In this mode, control of a Device occurs either from the device itself (in the case of Rotork A/IQ Series Actuators) or from Starter Panels in the Switchgear Room (in the case of Motors). Note that although Control Action from the PLC is ignored in this mode, hard-wired interlock functionality remains enabled (e.g. Pump Switchgear Trips, etc.). The PLC still monitors and indicates the status of the devices in local.

2.1.4.2 MANUAL

In this mode, control of a Device occurs from the SCADA System (both in SCADA and TELE modes of control). Note that when in manual mode of operation, direct control of the device will be permissible with responsibility for control of the Plant resting with the Operator. Hard wired and PLC Interlocking shall be active in this mode.

Responsibility for selecting Control Modes of Operation (MAN/AUTO) for Device Groups shall remain the responsibility of the Operator who is in control of the Group i.e. a Group will remain in MANUAL Mode until the Operator changes to AUTOMATIC Mode and vice versa.

2.1.4.3 AUTOMATIC

In this mode, device groups are controlled by the PLC via control sequences initiated via the SCADA (both in SCADA and TELE modes of control).

Responsibility for selecting Control Modes of Operation (MAN/AUTO) for Device Groups shall remain the responsibility of the Operator who is in control of the Group is, i.e. a Group will remain in AUTOMATIC Mode until the Operator changes to MANUAL Mode and vice versa.

2.1.5 MODES OF CONTROL

Two modes of control are defined as follows:

2.1.5.1 SCADA

This is defined as the mode in which control requests to the Control System PLC's can only be issued from the local SCADA System situated at the remote station itself. All control requests emanating from sources other than the local SCADA System (e.g. control commands as issued from the Master Control Centre MCC) will be ignored.

2.1.5.2 TELECONTROL

This is defined as the mode in which control requests to the Control System PLC's can only be issued from the SCADA System situated at the Master Control Centre in Durban. All requests emanating from sources other than from the MCC (i.e. local SCADA System) will be ignored. The Tele-Control functionality does not apply the IRP plant. The MCC will be provided with an overview view only screen (as per P&ID 25913-8110-20-0001 rev A3) with an Emergency Stop button which is controllable from MCC to enable remote shutdown of the IRP plant.

2.1.6 INTERLOCKS

2.1.6.1 HARD WIRED INTERLOCKS

Hard-wired Interlocks are defined as interlocks, which are physically wired and due to safety reasons, may not be overridden. Hard-wired Interlock functionality remains active in all modes of operation i.e. ìAutomatic", ìManual" and ìLocal".

2.1.6.2 PLC INTERLOCKS

PLC Interlocks are defined as interlocks, which are programmed in the PLC and due to safety reasons, may not be overridden e.g. tank inlet valve is forced closed on activation of a high level switch. All PLC Interlock functionality remains active in both manual and automatic modes of operation i.e. not in local. Motor Protection trips remain active in local, manual and automatic modes of operation.

3 DEVICES

3.1 AUTO / MANUAL

3.1.1 DESCRIPTION

All stations are divided into device groups, which can be selected to either ìAutomatic" or ìManual" mode of operation.

3.1.2 PLC I/O SIGNALS

None

3.1.3 CONTROL METHODOLOGY

The Operator will issue a command to transfer control of the group from Auto to Manual or vice versa and this transfer from one mode to another shall be bump less i.e. no device within the device group shall change state.

This is defined at device group level and therefore it is possible on a single remote station to have device groups in different modes of operation i.e. Auto or Manual.

3.1.4 POWER FAILURE

After a power failure or cold restart of the PLC, all the groups will default to AUTO mode.

3.1.5 SCADA REPRESENTATION

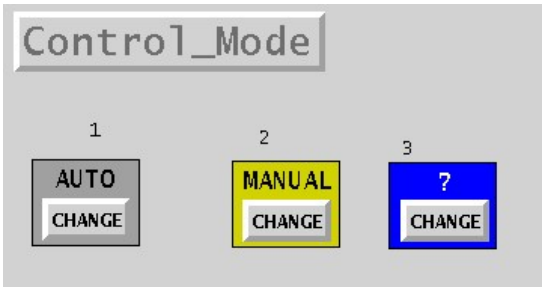

Figure 3.1: Mode representation on SCADA

3.2 VALVES

As per Transnet Pipelines Automation standard.

3.3 CONTROL VALVES (MODULATING)

As per Transnet Pipelines Automation standard.

3.4 PUMP SETS ñ DIRECT ON LINE

As per Transnet Pipelines Automation standard.

3.5 AUXILIARY MOTORS ñ DIRECT ON LINE

As per Transnet Pipelines Automation standard.

3.6 AUXILIARY MOTORS ñ DIRECT ON LINE WITH TRIP

This auxiliary motor is non-standard due to the additional switchgear trip signal.

3.6.1 DESCRIPTION

Auxiliary Motors are defined as motors that are powered from the LV Panel (400 VAC) and are used to perform such functions as Reboiler/bottom pumps, Petrol product transfer pump, and the Diesel product transfer pump. All auxiliary motors are fitted with thermal overload protection.

Motor Protection trips remain active in local, manual and automatic modes of operation.

3.6.2 PLC FIELD INTERFACE SIGNALS

LV motor control will be as follows from PLC: (Digital Outputs)

When a pump is switched on, the start output is pulsed high until the running feedback is received or a fault occurs. When a pump is switched off, the stop output is pulsed high until the stopped feedback is received.

The thermal overload and trip signals are hard wired into the switchgear and if activated, they need to be manually reset by technical staff before the pump can be re-started.

INPUTS	
Motor running Feedback (High when running)	(PON)
Motor stopped Feedback (High when stopped)	(POF)
Motor Local/Off or Remote feedback (High when remote selected)	(SLO)
Thermal overload (Low when active)	(TOP)
Emergency Stop feedback (High when activated)	(RES)
Soft starter Fault	(FLT)
OUTPUTS	
Motor Start (Temporary High to start)	(IRC)
Motor Stop (Temporary High to stop)	(IRT)

3.6.3 CONTROL METHODOLOGY

PLC control of Auxiliary Motor may be performed in either Manual or Automatic modes of operation. In manual the motor is controlled by the operator via the SCADA interface and therefore assumes responsibility. When in automatic mode of control the Motor is controlled by pre-programmed sequences. These sequences will be dealt with later in this document.

Should the Device be placed in LOCAL the Device status will indicate a LOCAL status on the SCADA. Transfer of a Device either from LOCAL to REMOTE or visa versa shall be bump less i.e. the device shall not change state.

When a Device is required to be in a specific state or PLC Interlocks are active, a ìforce" facility is available for this purpose. This will force the device to the desired state. The operator cannot change the status of the device in this condition. The Force command is not active in Local mode. Forced ON is never used. Forced off indicates that the Device is forced off due to an external interlock (e.g. Valid Flow Path) active.

Hard-wired interlocking, that due to safety reasons may not be overridden, is implemented in this case using the e-stop status. E_STOP indicates either a panel or field emergency stop button is activated.

3.6.4 POWER FAILURE

In the event of a loss of power to the Auxiliary Motor, the motor will stop.
When a power failure occurs causing the PLC to restart, all outputs are reset and the motor will stop.

3.6.5 SCADA REPRESENTATION

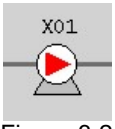

Figure 3.2: Pump symbol

3.7 ANALOGUE TRANSMITTER

As per Transnet Pipelines Automation standard.

3.8 SWITCHES

As per Transnet Pipelines Automation standard.

3.9 TANK STATUS

The tank statuses will be generated based upon the status of the field valves. The tanks will have the following tank status:

- Available
- Intake
- Feed (Transferring intermix to the column)
- Jet mixing
- Delivery (Transferring product to TLR)

3.10 DUTY/STANDBY CONTROLLER

3.10.1 DESCRIPTION

This determines, from a selection of two or more devices (e.g. fans or pumps), a duty and a standby depending on the time they are running. It also initiates switching of these devices in automatic mode.

Used for:

- Reboiler/bottom pumps
- Reflux/Overhead product pumps
- Compressors are duty cycled by their individual controllers.

3.10.2 DUTY/STANDBY SELECTION

The duty motor/fan is always indicated on the SCADA, regardless of the mode. In manual mode, the operator should ideally run the device that is selected as duty.

Each device has a counter (32bit) assigned which is incremented in minutes when running, regardless of the mode. Counters may be reset either from the PLC or in the event that either of the counters reaches its rollover value both the counters are reset to zero.

When counters are equal, device 1 is set to duty and device 2 is set to standby. Change over is determined if the one counter exceeds the other counter by the configurable set point given as follows:
Counter 1 – Counter 2 > Set point Device 2 duty Device 1 standby
Counter 2 – Counter 1 > Set point Device 1 duty Device 2 standby

The duty device is active for a period of twice the set point, since it will first have to reach the same running time and then exceed the running time by the set point. Should the duty device not be available, the standby is started and will continue running until the duty becomes available again.

The changeover of devices will only take place when the devices are not running. This implies that once the duty device is stopped by the duty/standby controller as a device is not required to run, and upon the duty/standby controller requiring a device to run, the standby device will be started and the status altered between the devices.

Devices are required to maintain their state when the Device Group is switched to Manual.

3.10.3 PLC FIELD INTERFACE SIGNALS

None.

3.10.4 POWER FAILURE

In the event of a loss of power to the Auxiliary Motor, the motor will stop.
When a power failure occurs causing the PLC to restart, all outputs are reset and the motor will stop.

3.10.5 SCADA REPRESENTATION

These alternatives were extracted from the Texts picture as it shared with others.

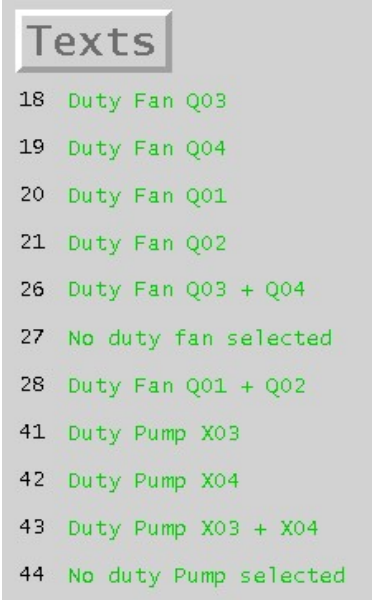

Figure 3.2: Duty Controller representation

3.11 PROCESS CONTROL SEQUENCE

The process control sequence is non-standard in relation to other Transnet Pipelines plants due to the type of process control that is required for the IRP.

The process control sequence methodology includes the use of steps and phases. The definition of a step is a unique operation that is performed until certain conditions are met. The steps of the sequence are executed and will only end once the step end conditions are met. For example, fill the column with intermix until the desired level setpoint is achieved.

The definition of a phase is a sequence of steps that are performed sequentially to perform a phase of the control sequence. For example, a phase may be fired heater start-up. The fired heater start-up may include purge permissive, ready to purge, purging, purge complete, ready to light pilot burners, main burner permissive, main burner ready, and main burner light steps. The phases of the sequence are executed sequentially or depending upon the process and operator actions, which includes the execution of the individual steps within each phase.

The process control sequence will be controlled using the following buttons.

BUTTON	FUNCTION	ENABLED WHEN:
Start	Start the sequence	Sequence is available, but not running or stopped.
Stop	Stop the sequence	Sequence is running.
Auxiliary	Perform auxiliary actions	When auxiliary actions is required, typically decisions such as shutdown or re-circulate.

The process control sequence will include the following information that will be displayed on the SCADA system:

STATUS	DESCRIPTION
Status	Running, stopped, aborted, not active. Running – Activations are performed. Stopped – The sequence is stopped in the current step and phase and the activations are disabled. Not active – The sequence is not running or stopped.
Phase description	The active phase description.
Step description	The active step description.
Availability	Displaying either yellow (not available) or green (available)

4 EQUIPMENT/GROUPS COMMON

4.1 GENERAL

Control and monitoring functionality shall be achieved by the following:

PCS PLC Panel 24 VDC Power Supply 1 Healthy	G51.G10 FA
PCS PLC Panel 24 VDC Power Supply 2 Healthy	G51.G11 FA
LV PLC Panel 24 VDC Power Supply 1 Healthy	G10.G10 FA
LV PLC Panel 24 VDC Power Supply 2 Healthy	G10.G11 FA
ESD Panel 24 VDC Power Supply 1 Healthy	G52.G10 FA
ESD Panel 24 VDC Power Supply 2 Healthy	G52.G11 FA
UPS Fault	LV31_FLT
UPS Bypass	LV31_BYP
General Plant Emergency Trip	ES 571
Fired Heater ES Shutdown from front of local panel	ES 597A
Fired Heater ES Shutdown control room	ES 597B
Fired Heater ES Shutdown field shutdown	ES 597C
Equipment room fan stopped	Q06_FOF
Switchgear room fan stopped	Q07_FOF
Fire Alarm Control Room	UA 193

4.2 ELECTRICAL DISTRIBUTION

4.2.1 GROUP DESCRIPTION

The electrical group consist of signals related to the electrical supply on the station. Control and Monitoring functionality shall be achieved via interface to the following devices:

Distribution Breakers – LV01F31

LV Board Incomer breaker status	LV01.F31_CL
LV Board Incomer breaker under voltage	LV01.F31_UV

Generator

Standby Generator On	E06-EON
Standby Generator Mains On	E06-EOF
Standby Generator in Local	E06-SLO
Standby Generator mechanical trip	E06-TVR
Standby Generator fuel low	E06-FLP
Standby Generator battery charge fail	E06-BCF

5 IRP PLANT

5.1 GENERAL

The IRP devices are split into three groups, which are intake, processing, and delivery. The device groups comprises of the following:

Intake:

a. Intake of Intermix from TLR LP to the IRP, controlled by the Tarlton Control System.
b. Intake of Intermix from TLR Intermix Tanks to the IRP, controlled by the Tarlton Control System.
c. Rail offloading.
d. Road offloading.
e. Manual intake of Diesel from TLR to T04

Processing:

f. Distillation column feed tank jet mixing.
g. Distillation column feed.
h. Distillation column control.
i. Distillation column fired heater.

Delivery:

j. Manual transfer of Diesel from T04 to T06.
k. Recycle off spec product from T05/6 to T07/8.
l. Delivery of Diesel to TLR, controlled by the Tarlton Control System.
m. Delivery of Petrol to TLR, controlled by the Tarlton Control System.

5.2 IRP INTAKE ROUTING GROUP

The IRP intake routing consists of Intermix routing from Tarlton Intermix Accumulators, Tarlton LP pipeline, and from the IRP rail and road offloading. The IRP intake is defined in two sections which are Intermix intake from Tarlton LP pipeline or tanks, and Intermix intake from IRP rail and road offloading.

5.2.1 INTERMIX INTAKE FROM TARLTON LP PIPELINE/ACCUMULATORS

5.2.1.1 GROUP DESCRIPTION

The intake of Intermix from Tarltonís LP pipeline or the Accumulators, is metered and proved on the Tarlton LP manifold and is monitored and controlled by the Tarlton control system as described in the Tarlton EDS. The Intermix intake from Tarlton is illustrated in figure 5.1.

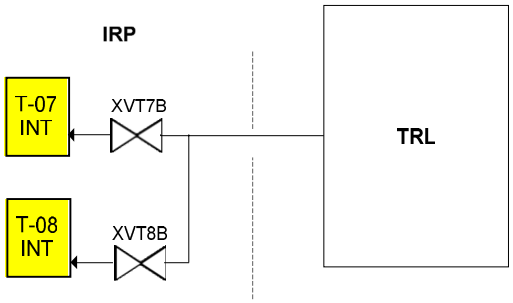

Figure 5.2.1: Intermix intake from Tarlton LP pipeline or tanks

Control and Monitoring functionality shall be achieved via interface to the following devices:

Instrumentation

Intermix feed storage tank T7 level transmitter	LT 557
Intermix feed storage tank T8 level transmitter	LT 558
T07 Fire foam bursting disc switch	PSE 193
T08 Fire foam bursting disc switch	PSE 194

5.2.1.2 GROUP FUNCTIONALITY

The transfer of intermix from Tarlton to the IRP intermix feed storage tanks will be controlled by the Tarlton control system. The IRP routing will be performed manually by the operator.

5.2.2 ALARM STRATEGIES

5.2.2.1.1 TANK HIGH LEVEL

If tank T07 high level is activated an alarm shall be issued.
If tank T08 high level is activated an alarm shall be issued.

5.2.3 INTERLOCKING STRATEGIES

The following interlocking strategies have been defined for this Device Group:

5.2.3.1 PLC INTERLOCKS

5.2.3.1.1 TANK HIGH LEVEL

If tank T07 high-high level is activated, the inlet valve XVT7B is closed and an alarm is generated.
If tank T08 high-high level is activated, the inlet valve XVT8B is closed and an alarm is generated.

5.2.4 INTERMIX INTAKE FROM IRP RAIL AND ROAD OFFLOADING

5.2.4.1 GROUP DESCRIPTION

The intake from the IRP rail and road offloading is performed through Contrec 1010 batch controllers. Refer to figure 5.2.

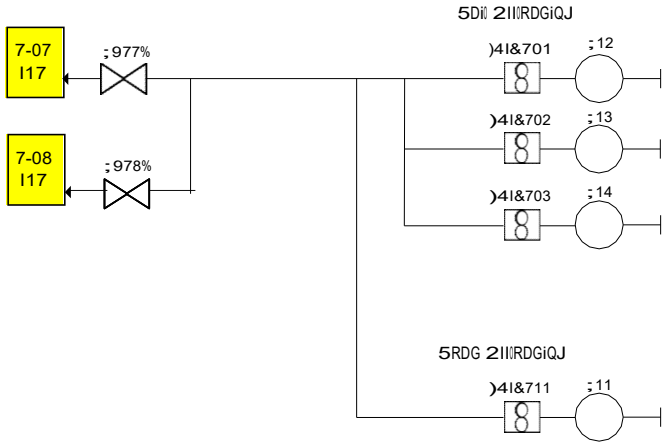

Figure 5.2.2: Intermix intake from IRP rail and road offloading

Control and Monitoring functionality shall be achieved via interface to the following devices:

Intermix Rail	
Intermix rail offloading pump 1	X 12
Intermix rail offloading pump 2	X 13
Intermix rail offloading pump 3	X 14
Intermix Road	
Intermix road offloading pump 1	X 11
Intermix Tanks	
Intermix feed storage tank T-07 inlet valve	XV T7B
Intermix feed storage tank T-08 inlet valve	XV T8B
Interfacing signals	
Batch controller 701 start request	FQIC 701IRC
Batch controller 702 start request	FQIC 702IRC
Batch controller 703 start request	FQIC 703 IRC
Batch controller 711 start request	FQIC 711 IRC
Batch controller 701 permissive	FQIC 701RDY
Batch controller 702 permissive	FQIC 702 RDY
Batch controller 703 permissive	FQIC 703 RDY
Batch controller 711 permissive	FQIC 711 RDY

5.2.4.2 DEVICE GROUP OBJECT CONTROL

The object controller signals for the Batch Controller sequences are as follows:

Signals	Alternatives	
START	Start active	Stop active
AVAILABLE	Not available	OK
PERMISSIVE	Not permissible	OK
FAULT	Sequence fault	OK

5.2.4.3 MODES OF CONTROL

The Intermix rail and road offloading Device Group shall be controllable locally from the SCADA System installed at the IRP and not remotely from the Master Control Centre in Durban.

5.2.4.4 MODES OF OPERATION

All devices related to Intermix rail and road offloading shall have the following modes of Operation:

- Local
- Manual

5.2.4.5 GROUP FUNCTIONALITY

5.2.4.5.1 PRINT INTERFACE

Batch controllers will operate in standalone mode. Provision is to be made for a printer in the control room for the printing of BOL dockets.

5.2.4.5.2 BATCH CONTROLLER

The tanker offloading arms have their own batch controllers. These are standalone devices which handle the safety interlocking and the intake flow rate and volume. The batch controller has a hardwired interface to the PLC as follows:

- The PLC issues a permissive (RDY) signal to the batch controller indicating that the route is available.
- The PLC receives a start request from the batch controller if all of its safety interlocks are met and a delivery is requested. This signal is high during the time of a delivery.

The start request signal is displayed on LSX.

The offloading bay safety and interlocking is handled by the batch controller internally.

5.2.4.5.2.1 BATCH CONTROLLER PERMISSIVE (RDY)

The batch controller permissive (RDY) signal is given if:

- The selected feed storage tank inlet is open.
- The selected feed storage tank has no high level.
- The selected pump is available.
- There is no intermix intake from Tarlton (XVM1F and XVG1F are closed).
- ESD signal healthy.
- Off-load granted (XA701_RDY via Tarlton).

The batch controller permissive (RDY) signal is to be wired in series with the earth/overfill input signal to the Batch controllers.

5.2.5 ALARM STRATEGIES

The following conditions will result in alarms being issued.

5.2.5.1.1 TANK HIGH LEVEL

If tank T07 high level is activated an alarm shall be issued.
If tank T08 high level is activated an alarm shall be issued.

5.2.6 INTERLOCKING STRATEGIES

The following interlocking strategies have been defined for this Device Group:

5.2.6.1 HARD WIRED INTERLOCKS

None.

5.2.6.2 PLC INTERLOCKS

5.2.6.2.1 TANK HIGH-HIGH LEVEL

If tank T07 high-high level is activated, the inlet valve XVT7B is closed.
If tank T08 high-high level is activated, the inlet valve XVT8B is closed.

5.3 RMD AND RAIL SIGNALLING

The RMD for Rail1 will need to be controlled by both Tarlton and IRP personnel. Two control panels have been provided: one on the Rail Loading Gantry and the other at the Rail Off-Loading Gantry to facilitate RMD control. The following interface to IRP will be provided.

5.3.1 CONTROL SYSTEM CLIENT DISPLAY

The IRP and Tarlton personnel will have access to the PCS7 client installed in the Tarlton Rail Dispatch Office. Login rights for IRP personnel will be limited to the associated RMD signals RMD alarms, and Control-System (PCS7) alarms.

5.3.1.1 RMD CONTROL

RMD is controlled entirely from Tarlton and is repeated in this document for information purposes.

5.3.1.1.1 EMERGENCY STOP CIRCUIT (PCS7 AT TARLTON)

The emergency stop circuit for RMD comprises the following electrical safeties:

- E-Stops on the Control Panels are healthy (loading and offloading only)
- E-Stop on the VSD panel is healthy.
- E-stop at the Winch end is healthy.
- Pull wire E-Stops are healthy.
- Final (Ultimate) travel limits are healthy.
- VSD is healthy.
- Brake Unit Thermal Overload is not tripped.
- Braking Resistor is not in a fault condition.

If any of the above safeties are not healthy prior to start-up, the VSD is inhibited from being powered up, by opening the Main Contactor Interposing relay ñK10 directly and thereby the Main Contactor ñK11. If any of the above safeties are triggered during operation of the RMD, power is removed from the VSD and the brake applied at the winch drum.
Once all safeties are returned to a healthy state, the safety circuit will remain latched in a trip state until reset from any of the control panels is affected. This is achieved by switching the keyswitch to RESET.
Provided all electrical safeties and process interlocks are healthy, the operator powers up the RMD control circuitry by selecting the control switch from OFF to ON. The main contactor then closes, and the VSD is powered up.
An auxiliary contact of the main contactor ensures that when the main contactor is opened, the brake is de-energised and provides emergency braking.

5.3.1.1.2 PLC PERMIT SIGNAL (PCS7 AT TARLTON)

PLC permit signal is a software interlock signal generated by the PLC remote ETR21.
In order to operate the RMD the following conditions are required to be met for this PLC Permit signal to be activated (high):

- No loading in progress – as indicated by the START request signal from the Contract Batch Controllers being held low. (Software interlock, Rail 1 and 2).

- No offloading in progress – as indicated by the START request signal from the Contract Batch Controllers being held low. (Software interlock, Rail 1).
- All loading arms in home (Retracted) position limits. (Software interlock via Profibus from Remote Station ETR21)
- All stairs in home in (Retracted) position limits. (Software interlock via Profibus from Remote Station ETR21)
- All IRP off-load hoses in home in (Retracted) position limits. (Software interlock via Profibus from Remote Station ETR21).

If any of the above process interlocks are not healthy prior to start-up and during operation of the RMD, the VSD is inhibited from being powered up by means of a PLC output being de-energised to the VSD (PLC Permit), causing a controlled shutdown of the VSD, ñK10 is opened, and thereby the Main Contactor ñK11.
Provided all these process interlocks are healthy, the operator powers up the RMD control circuitry by selecting the control keyswitch ñS12 from OFF to ON. The main contactor then closes, and the VSD is powered up. Unlike the electrical safety circuit, the process interlocks are not latched interlocks i.e. once all process interlocks are returned to the healthy state, the RMD device can be powered up (provided all electrical safeties are healthy as well).

5.3.1.1.3 PLC PERMIT SIGNAL (MODICON AT TARLTON)

PLC permit signal is a software interlock signal generated by the Modicon PLC comprises:

- No loading in progress – as indicated by the START request signal from the Contract Batch Controllers being held low. (Software interlock, Rail 1 and 2).
- No offloading in progress – as indicated by the START request signal from the Contract Batch Controllers being held low. (Software interlock, Rail 1).
- All loading arms in home (Retracted) position limits.
- All stairs in home in (Retracted) position limits.
- All IRP off-load hoses in home in (Retracted) position limits.

- E-stops healthy.

Functionality to be finalised with Modicon consultant

5.3.1.2 SIGNALS AT IRP FOR OFF-LOADING CONTROL

Digital Input (From TLR PLC)

Rail off-load granted	XA701_RDY

When the operator selects the Loading function via the selection switch (-S13) (M01_LOAD = 1) on panel (+25XA_M01A), the ready signal (XA701_RDY) for IRP off-loading will inhibited.

Digital Output (To TLR PLC)

Rail off-loading request	XA701_IRC

The loading request from IRP (XA701_IRC) will be generated when a start request is received from any of the following preset controllers (FQIC711_IRC, FQIC712_IRC, FQIC713_IRC). The signal will only be displayed on the TLR SCADA and an event will be generated.

5.3.1.3 SIGNALS AT TARLTON FOR OFF-LOADING CONTROL

Digital Output

IRP off-load grant (No rail movement)	XA701_RDY

Digital Input

IRP off-load request	XA701_IRC

When the operator selects the Loading function via the selection switch (-S13) (M01_LOAD = 1) on panel (+25XA_M01A), the ready signal (XA701_RDY) for IRP off-loading will inhibited.

5.4 IRP COLUMN ROUTING GROUP

The IRP column routing consists of intermix storage tanks jet mixing, column feed, and the column control. The column control includes bottom level control, pressure control, transfer of bottom product to the Diesel storage tank, and transfer of top product to the Petrol storage tank. Refer to figure 5.3. The intermix feed, the petrol transfer to storage, and the diesel transfer to storage are metered using flow meters which are not custody transfer meters.

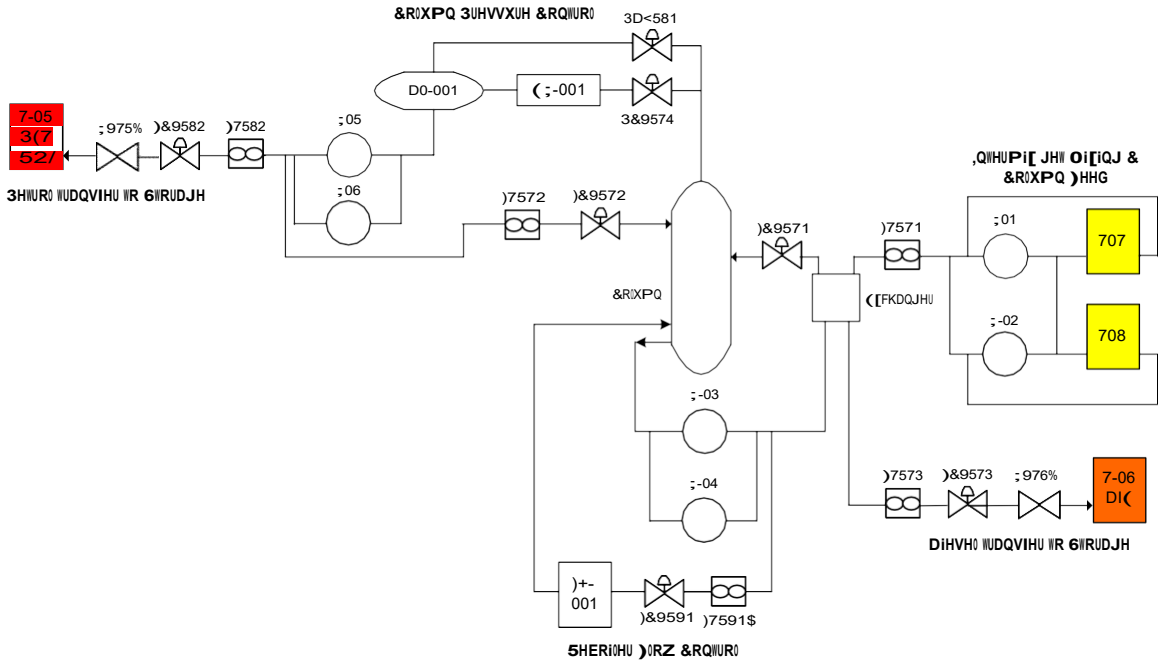

Figure 5.4: LP column routing

5.4.1 REBOILER FLOW CONTROL

5.4.1.1 GROUP DESCRIPTION

Control and Monitoring functionality shall be achieved via interface to the following devices:

Valves

Intermix feed pump X01 pump inlet valve	ZV X1A
Intermix feed pump X01 pump outlet valve	ZV X1E
Intermix feed pump X01 pump jet mixing valve	ZV X1F
Intermix feed pump X02 pump inlet valve	ZV X2A
Intermix feed pump X02 pump outlet valve	ZV X2E
Intermix feed pump X02 pump jet mixing valve	ZV X2F
Bottom pump 1 inlet valve	ZV X3A
Bottom pump 1 outlet valve	ZV X3E
Bottom pump 2 inlet valve	ZV X4A
Bottom pump 2 outlet valve	ZV X4E
Petrol storage tank inlet valve	XV T5B
Diesel storage tank inlet valve	XV T6B
Reflux/Overhead pump 1 suction valve	ZV X5A
Reflux/Overhead pump 1 discharge valve	ZV X5E
Reflux/Overhead pump 2 suction valve	ZV X6A
Reflux/Overhead pump 2 discharge valve	ZV X6E

Instrumentation

Diesel product to storage flow meter	FT 573
Bottom to Fired heater flow meter	FT 591A
Bottom level transmitter	LT 571
Bottom temperature transmitter	TT 575
Petrol product to storage flow meter	FT 582
Reflux Drum level	LT 582
Petrol to product storage tank temperature	TT 582

Pumps/Fans

Intermix feed pump 1	X 01
Intermix feed pump 2	X 02
Reboiler/Bottom pump 1	X 03
Reboiler/Bottom pump 2	X 04
Reflux/Overhead pump 1	X 05
Reflux/Overhead pump 2	X 06
Overhead cooler EX-001 fan 1	Q 01
Overhead cooler EX-001 fan 2	Q 02
Overhead cooler EX-001 fan 3	Q 03
Overhead cooler EX-001 fan 4	Q 04

5.4.1.2 DEVICE GROUP OBJECT CONTROL

There is no standard device group control for this group.

5.4.1.3 MODES OF CONTROL

The column control Device Group shall be controllable locally from the SCADA System installed at the IRP. Remote control from the Master Control Centre in Durban will not be possible.

5.4.1.4 MODES OF OPERATION

All devices related to Intermix intake shall have the following modes of Operation:

- Local
- Manual
- Automatic (Power failure and recovery)

5.4.1.5 GROUP FUNCTIONALITY

Under normal operating conditions, the column is controlled manually as described in the operating manual (Document Number: 25913-8110-OM-0001). Provision has however been made for an automatic power failure and recovery sequence.

5.4.1.5.1 COLUMN POWER FAILURE SEQUENCE

The power failure sequence includes four phases which are power monitoring, power dip, power failure, and power recovered.

Step No	Phase	Step description	Step end condition
0	Power Monitor	Power monitor	Power failure detected (LV01F31_UV trailing edge) (go to step 1)
1	Power Dip	Stop devices	
2		Wait for generator	Generator running (go to step 3)
3		FH cool down	TT599 <=375˚C and power not resumed, go to step 4. If power is resumed, go to step 7
4	Power Failure	Stop Reboiler/Bottom pumps, and start compressor	Feedbacks correct (go to step 5)
5		Standby	Operator request to recover (go to step 7), shutdown (go to step 6), or terminate (go to step 0)
6		Shutdown	Compressor stopped and fired heater not active (go to step 0)
7	Power Recovery	Recovery acknowledge	Operator acknowledge (go to step 8)
8		Start Reboiler/Bottom pumps	Feedbacks correct (go to step 9), or not correct abort (go to step 0)
9		Start compressors	Feedbacks correct (go to step 10), or not correct abort (go to step 0)
10		Start overhead cooler fans	At least 1 fan running (go to step 11), no fans able to run abort (go to step 0)
11		Start Reflux/Overhead pumps	Feedbacks correct (go to step 12), or not correct abort (go to step 0)
12		Start Diesel Fuel pumps	Feedbacks correct (go to step 13), or not correct abort (go to step 0)
13		Start FH main burners	>=2 Main flames detected (go to step 14)
14		Start Feed pumps	Level achieved (go to step 15) or time elapsed (go to step 0)
15		FH start-up temperature	TT599 >= 135˚C (go to step 16)
16		Wait for Petrol rundown temperature	TT582 <= 50˚C
17		Product rundown	Feedbacks correct (go to step 0)

The sequence is always active in step 0 monitoring the for power failure condition. If the power fails, the sequence will be initiated.

Refer to flow diagrams:
G52001-T4043-L200 – Column power failure sequence

Any device failure during the sequence will result in the sequence shutting down, complete with all associated alarming and event logging procedures.

The sequence is initiated irrespective of availability. The power dips and power failure phases will continue to completion irrespective of device failures or availability. However, power recovery phase will abort in the event of device failures or availability.

5.4.1.5.2 DEVICE GROUP AVAILABILITY

Not applicable

5.4.1.5.3 REBOILER/BOTTOM PUMP CONTROL

The two Reboiler/Bottom pumps (X03 and X04) are controlled according to the duty/standby controller typical.

Object controller

Signal	Alternative			
DUTY	X03 Duty	X04 Duty	X03 and X04 Duty	No Pump Duty
DUTY_CONTROL	Not Active	Active		

The PLC will keep track of the running hours of each pump. Automatic selection of duty and standby status of pumps is based on Run Hour differentials [Configurable in the PLC – Default 100 hours]. Note that each pump will run for a period of twice the set point, i.e. 200 hours. The pump with the lowest running hours is started first if available. Once a pump is running, no switching will occur due to run hours.

If the group is ready, the duty controller is started from a:
- Start sequence Request from the SCADA
- Start request from the Column control sequencer.

An indication ìcontrol active” is indicated on the SCADA. The duty controller is now activated and will start and stop the Reboiler/Bottom pumps accordingly. If the bottom product flow rate is low and the second Reboiler/Bottom pump is available, the second pump will be started.

The duty controller is stopped from a:
- Stop sequence Request from the SCADA
- Stop request from the Column control sequencer.

5.4.1.5.4 REFLUX/OVERHEAD PUMP CONTROL

The two Reflux/Overhead pumps (X05 and X06) are controlled according to the duty/standby controller typical.

Object controller

Signal	Alternative			
DUTY	X05 Duty	X06 Duty	X05 and X06 Duty	No Pump Duty
DUTY_CONTROL	Not Active	Active		

The PLC will keep track of the running hours of each pump. Automatic selection of duty and standby status of pumps is based on Run Hour differentials [Configurable in the PLC – Default 100 hours]. Note that each pump will run for a period of twice the set point, i.e. 200 hours. The pump with the lowest running hours is started first if available. Once a pump is running, no switching will occur due to run hours.

If the group is ready, the duty controller is started from a:
- Start sequence Request from the SCADA
- Start request from the Column control sequencer.

An indication ìcontrol active" is indicated on the SCADA. The duty controller is now activated and will start and stop the Reflux/Overhead pumps accordingly. If the bottom product flow rate is low for a PLC configurable time delay, and the second Reflux/Overhead pump is available, the second pump will be started.

The duty controller is stopped from a:
- Stop sequence Request from the SCADA
- Stop request from the Column control sequencer.

5.4.1.5.5 INTERMIX FEED PUMP CONTROL

The PLC will keep track of the running hours of each pump.

5.4.1.5.6 OVERHEAD COOLER FAN CONTROL

The PLC will keep track of the running hours of each fan.

5.4.1.6 ALARM STRATEGIES

5.4.1.6.1 REBOILER/BOTTOM PUMP NO FLOW (4342)

The Reboiler/Bottom pumps are controlled by a duty/standby controller typical. If the bottom total flow rate is low, the duty/standby controller will start the second pump if it is available. If the bottom total flow rate (FT591 + FT573) remains low for longer than a configurable PLC time, interlock 4342 of the cause and effect chart will be initiated and an alarm will be generated.

5.4.1.6.2 REFLUX/OVERHEAD PUMP NO FLOW (4343)

The Reflux/Overhead pumps are controlled by a duty/standby controller typical. If the Reflux/overhead total flow rate is low, the duty/standby controller will start the second pump if it is available. If the total flow rate (FT572 + FT582) remains low for longer than a configurable PLC time, interlock 4343 of the cause and effect chart will be initiated and an alarm will be generated.

5.4.1.6.3 COLUMN PRESSURE HIGH (4301)

If the column pressure high (PAH571/2/3) is activated, an alarm is generated and interlock 4301 initiated.

5.4.1.6.4 COLUMN TRAY 20 TEMPERATURE HIGH (4302)

If the column tray 20 temperature high (TAH574) is activated, an alarm is generated and interlock 4302 initiated.

5.4.1.6.5 COLUMN LEVEL HIGH (4303)

If the column level high (LAH571) is activated, an alarm is generated and interlock 4303 is initiated.

5.4.1.6.6 COLUMN LEVEL LOW (4304)

If the column level low (LAL571) is activated, an alarm is generated and interlock 4304 is initiated.

5.4.1.6.7 FEED PUMP X01 LOW FLOW (4305)

If the feed pump X01 low flow (FS551) is activated for a configurable time in the PLC while the pump is running, an alarm is generated and interlock 4305 is initiated.

5.4.1.6.8 FEED PUMP X02 LOW FLOW (4305)

If the feed pump X02 low flow (FS552) is activated for a configurable time in the PLC while the pump is running, an alarm is generated and interlock 4305 is initiated.

5.4.1.6.9 FEED PUMP X01 LOW FLOW ñ RECYCLE (4307)

If the feed pump X01 low flow (FS551) is activated for a configurable time in the PLC while the pump is running, an alarm is generated and interlock 4307 is initiated.

5.4.1.6.10 FEED PUMP X02 LOW FLOW ñ RECYCLE (4308)

If the feed pump X02 low flow (FS552) is activated for a configurable time in the PLC while the pump is running, an alarm is generated and interlock 4308 is initiated.

5.4.1.6.11 PETROL PRODUCT PUMP LOW FLOW (4315)

If the petrol flow rate (FT551) remains low for longer than configurable PLC time, an alarm is generated and interlock 4315 is initiated.

5.4.1.6.12 DIESEL PRODUCT PUMP LOW FLOW (4316)

If the Diesel flow rate (FT552) remains low for longer than configurable PLC time, an alarm is generated and interlock 4316 is initiated.

5.4.1.6.13 AIR COOLER FAN Q01 VIBRATION (4317)

If the Air cooler fan high vibration is detected (VS581), an alarm is generated and interlock 4317 is initiated.

5.4.1.6.14 AIR COOLER FAN Q02 VIBRATION (4318)

If the Air cooler fan high vibration is detected (VS582), an alarm is generated and interlock 4318 is initiated.

5.4.1.6.15 AIR COOLER FAN Q03 VIBRATION (4319)

If the Air cooler fan high vibration is detected (VS583), an alarm is generated and interlock 4319 is initiated.

5.4.1.6.16 AIR COOLER FAN Q04 VIBRATION (4320)

If the Air cooler fan high vibration is detected (VS584), an alarm is generated and interlock 4320 is initiated.

5.4.1.6.17 REFLUX DRUM LEVEL LOW-LOW (4321)

If the Reflux Drum low-low (LALL582) is active, an alarm is generated and interlock 4321 is initiated.

5.4.1.6.18 REFLUX DRUM LEVEL HIGH-HIGH (4322)

If the Reflux Drum level high-high (LAHH582) is activated, an alarm is generated and interlock 4322 is initiated.

5.4.1.6.19 REFLUX DRUM TEMPERATURE HIGH-HIGH (4325)

If the Reflux Drum temperature high-high (TAHH582) is activated, an alarm is generated and interlock 4325 is initiated.

5.4.1.6.20 FEED TANK T07 LOW LEVEL (4329)

If the feed tank T07 low level (LAL557) is activated, an alarm is generated and interlock 4329 is initiated.

5.4.1.6.21 FEED TANK T07 LOW LEVEL RECIRCULATION (4330)

If the feed tank T07 low level (LAL557) is activated, an alarm is generated and interlock 4330 is initiated.

5.4.1.6.22 FEED TANK T07 LEVEL HIGH-HIGH (4331)

If the feed tank T07 high-high level (LAHH557) is activated, an alarm is generated and interlock 4331 is initiated.

5.4.1.6.23 FEED TANK T08 LOW LEVEL (4332)

If the feed tank T08 low level (LAL558) is activated, an alarm is generated and interlock 4332 is initiated.

5.4.1.6.24 FEED TANK T08 LOW LEVEL RECIRCULATION (4333)

If the feed tank T08 low level (LAL558) is activated, an alarm is generated and interlock 4333 is initiated.

5.4.1.6.25 FEED TANK T08 LEVEL HIGH-HIGH (4334)

If the feed tank T08 high-high level (LAHH558) is activated, an alarm is generated and interlock 4334 is initiated.

5.4.1.6.26 PETROL PRODUCT TANK T05 LEVEL LOW-LOW (4335)

If the petrol product tank T05 low-low level (LALL555) is activated, an alarm is generated and interlock 4335 is initiated.

5.4.1.6.27 PETROL PRODUCT TANK T05 LEVEL HIGH-HIGH (4336)

If the petrol product tank T05 high-high level (LAHH555) is activated, an alarm is generated and interlock 4336 is initiated.

5.4.1.6.28 PETROL PRODUCT TANK T06 LEVEL LOW-LOW (4337)

If the petrol product tank T06 low-low level (LALL556) is activated, an alarm is generated and interlock 4337 is initiated.

5.4.1.6.29 PETROL PRODUCT TANK T06 LEVEL HIGH-HIGH (4338)

If the petrol product tank T06 high-high level (LAHH556) is activated, an alarm is generated and interlock 4338 is initiated.

5.4.1.6.30 DIESEL FUEL TANK T04 LEVEL LOW-LOW (4339)

If the Diesel fuel tank T04 low-low level (LALL554) is activated, an alarm is generated and interlock 4339 is initiated.

5.4.1.6.31 DIESEL PRODUCT TEMPERATURE HIGH (4341)

If the Diesel product temperature high (TAH573) is activated, an alarm is generated and interlock 4341 is initiated.

5.4.1.6.32 REBOILER/BOTTOM PUMP X03 BARRIER FLUID PRESSURE LOW (4344)

If the Reboiler/Bottom pump X03 barrier fluid pressure low (PAL577) is activated while the pump is running, an alarm is generated and interlock 4344 is initiated.

5.4.1.6.33 REBOILER/BOTTOM PUMP X04 BARRIER FLUID PRESSURE LOW (4345)

If the Reboiler/Bottom pump X04 barrier fluid pressure low (PAL578) is activated while the pump is running, an alarm is generated and interlock 4345 is initiated.

5.4.1.6.34 DIESEL FEED PUMPS LOW FLOW (4346)

If the Diesel feed pump low flow (FS553) is activated, an alarm is generated and interlock 4346 is initiated.

5.4.1.6.35 DIESEL PUMP X09 DISCHARGE PRESSURE LOW (4347)

If the Diesel feed pumps discharge pressure low (PAL551) is activated, an alarm is generated and interlock 4347 is initiated.

5.4.1.6.36 DIESEL PUMP X10 DISCHARGE PRESSURE LOW (4347)

If the Diesel feed pumps discharge pressure low (PAL551) is activated, an alarm is generated and interlock 4347 is initiated.

5.4.1.6.37 LOSS OF COMPRESSED AIR (4348)

If the compressed air pressure (PAL191) low is detected, an alarm is generated and interlock 4348 is initiated.

5.4.1.7 INTERLOCKING STRATEGIES

5.4.1.7.1 HARDWIRED INTERLOCKS

None.

5.4.1.7.2 PLC INTERLOCKS

5.4.1.7.2.1 COLUMN PRESSURE HIGH (4301)

The column pressure high (PAH571/2/3) will result in the following interlocks if there is any 2 of the 3 as a high alarm:

- Close feed flow control valve FCV571
- Close Petrol product flow control valve FCV582
- Close Diesel product flow control valve FCV573

Fired Heater Diesel Running:

- Close the Diesel fuel supply valves to the fired heater XV591 and XV592.
- Stop the Diesel fuel supply pumps to the fired heater (X09/10).

Fired Heater Main Gas Running:

- Close Main gas block valves XV597 and XV598, Open Main gas vent valve XV599

5.4.1.7.2.2 COLUMN TRAY 20 TEMPERATURE HIGH (4302)

The column tray 20 temperature high (TAH574) will result in the following interlocks:

- Close feed flow control valve FCV571
- Close Petrol product flow control valve FCV582
- Close Diesel product flow control valve FCV573

Fired Heater Diesel Running:

- Close the Diesel fuel supply valves to the fired heater XV591 and XV592.

Fired Heater Main Gas Running:

- Close Main gas block valves XV597 and XV598, Open Main gas vent valve XV599

5.4.1.7.2.3 COLUMN LEVEL HIGH (4303)

The column level high (LAH571) will result in the following interlocks:

- Close feed flow control valve FCV571
- Close Petrol product flow control valve FCV582

Fired Heater Diesel Running:

- Close the Diesel fuel supply valves to the fired heater XV591 and XV592.

Fired Heater Main Gas Running:

- Close Main gas block valves XV597 and XV598, Open Main gas vent valve XV599

5.4.1.7.2.4 COLUMN LEVEL LOW (4304)

The column level low (LAL571) will result in the following interlocks:

- Close Petrol product flow control valve FCV582
- Close Diesel product flow control valve FCV573

Fired Heater Diesel Running:

- Close the Diesel fuel supply valves to the fired heater XV591 and XV592.

Fired Heater Main Gas Running:

- Close Main gas block valves XV597 and XV598, Open Main gas vent valve XV599

5.4.1.7.2.5 FEED PUMP X01 LOW FLOW (4305)

The feed pump X01 low flow (FS551) will result in the following interlocks when X1A and X1E are open and X1F is closed:

- Stop X01
- Close feed flow control valve FCV571
- Close Petrol product flow control valve FCV582
- Close Diesel product flow control valve FCV573

5.4.1.7.2.6 FEED PUMP X02 LOW FLOW (4306)

The feed pump X02 low flow (FS552) will result in the following interlocks when X2A and X2E are open and X2F is closed:

- Stop X02
- Close feed flow control valve FCV571
- Close Petrol product flow control valve FCV582
- Close Diesel product flow control valve FCV573

5.4.1.7.2.7 FEED PUMP X01 LOW FLOW ñ RECYCLE (4307)

The feed pump X01 low flow (FS551) will result in the following interlocks when X1A and X1F are open and X1E is closed:

- Stop X01

5.4.1.7.2.8 FEED PUMP X02 LOW FLOW ñ RECYCLE (4308)

The feed pump X02 low flow (FS552) will result in the following interlocks when X2A and X2F are open and X2E is closed:

- Stop X02

5.4.1.7.2.9 REBOILER/BOTTOM PUMP X03 LOW FLOW (4309)

If the bottom total flow rate (FT591 and FT573) are low, the duty/standby controller will start the second pump if it is available. If the bottom total flow rate remains low for longer than configurable PLC time, will result in the following interlocks:

- Stop the Reboiler/Bottom pump X03
- Close FCV571, FCV573 and FCV582

Fired Heater Diesel Running:

- Close the Diesel fuel supply valves to the fired heater XV591 and XV592.
- Stop the Diesel fuel supply pumps to the fired heater (X09/10).

Fired Heater Main Gas Running:

- Close Main gas block valves XV597 and XV598, Open Main gas vent valve XV599

5.4.1.7.2.10 REBOILER/BOTTOM PUMP X04 LOW FLOW (4310)

If the bottom total flow rate (FT591 and FT573) are low, the duty/standby controller will start the second pump if it is available. If the bottom product flow rate remains low for longer than configurable PLC time, will result in the following interlocks:

- Stop the Reboiler/Bottom pump X04
- Close FCV571, FCV573 and FCV582

Fired Heater Diesel Running:

- Close the Diesel fuel supply valves to the fired heater XV591 and XV592.
- Stop the Diesel fuel supply pumps to the fired heater (X09/10).

Fired Heater Main Gas Running:

- Close Main gas block valves XV597 and XV598, Open Main gas vent valve XV599

5.4.1.7.2.11 REFLUX/OVERHEAD PUMP X05 LOW FLOW (4313)

If the Reflux/Overhead total flow rate (FT572 and FT582) remains low for longer than configurable PLC time, will result in the following interlocks:

- Stop the Reflux/Overhead pump X05
- Close FCV571, FCV573 and FCV582

Fired Heater Diesel Running:

- Close the Diesel fuel supply valves to the fired heater XV591 and XV592.
- Stop the Diesel fuel supply pumps to the fired heater (X09/10).

Fired Heater Main Gas Running:

- Close Main gas block valves XV597 and XV598, Open Main gas vent valve XV599

5.4.1.7.2.12 REFLUX/OVERHEAD PUMP X06 LOW FLOW (4314)

If the Reflux/Overhead total flow rate (FT572 and FT582) remains low for longer than configurable PLC time, will result in the following interlocks:

- Stop the Reflux/Overhead pump X06
- Close FCV571, FCV573 and FCV582

Fired Heater Diesel Running:

- Close the Diesel fuel supply valves to the fired heater XV591 and XV592.
- Stop the Diesel fuel supply pumps to the fired heater (X09/10).

Fired Heater Main Gas Running:

- Close Main gas block valves XV597 and XV598, Open Main gas vent valve XV599

5.4.1.7.2.13 PETROL PRODUCT PUMP LOW FLOW (4315)

If the petrol flow rate (FT551) remains low for longer than configurable PLC time, will result in the following interlocks:

- Close Petrol product flow control valve (FCV551)
- Stop the petrol product pump X07

5.4.1.7.2.14 DIESEL PRODUCT PUMP LOW FLOW (4316)

If the Diesel flow rate (FT552) remains low for longer than configurable PLC time, will result in the following interlocks:

- Close Petrol product flow control valve (FCV552)
- Stop the Diesel product pump X08

5.4.1.7.2.15 AIR COOLER FAN Q01 VIBRATION (4317)

If the Air cooler fan high vibration is detected (VS581), the following interlocks will result:

- Stop Air cooler fan Q01

5.4.1.7.2.16 AIR COOLER FAN Q02 VIBRATION (4318)

If the Air cooler fan high vibration is detected (VS582), the following interlocks will result:

- Stop Air cooler fan Q02

5.4.1.7.2.17 AIR COOLER FAN Q03 VIBRATION (4319)

If the Air cooler fan high vibration is detected (VS583), the following interlocks will result:

- Stop Air cooler fan Q03

5.4.1.7.2.18 AIR COOLER FAN Q04 VIBRATION (4320)

If the Air cooler fan high vibration is detected (VS584), the following interlocks will result:

- Stop Air cooler fan Q04

5.4.1.7.2.19 REFLUX DRUM LEVEL LOW-LOW (4321)

The reflux drum low-low (LALL582) will result in the following interlocks:

- Close feed flow control valve FCV571
- Close Petrol product flow control valve FCV582
- Close Diesel product flow control valve FCV573
- Stop Reflux pumps X05/6

Fired Heater Diesel Running:

- Close the Diesel fuel supply valves to the fired heater XV591 and XV592

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Fired Heater Main Gas Running:

- Close Main gas block valves XV597 and XV598, Open Main gas vent valve XV599

5.4.1.7.2.20 REFLUX DRUM LEVEL HIGH-HIGH (4322)

The Reflux Drum level high-high (LAHH582) will result in the following interlocks:

- Close feed flow control valve FCV571
- Close Diesel product flow control valve FCV573

Fired Heater Diesel Running:

- Close the Diesel fuel supply valves to the fired heater XV591 and XV592.

Fired Heater Main Gas Running:

- Close Main gas block valves XV597 and XV598, Open Main gas vent valve XV599

5.4.1.7.2.21 REFLUX DRUM TEMPERATURE HIGH-HIGH (4325)

The Reflux Drum temperature high-high (TAHH582) will result in the following interlocks:

- Close feed flow control valve FCV571
- Close Petrol product flow control valve FCV582
- Close Diesel product flow control valve FCV573

Fired Heater Diesel Running:

- Close the Diesel fuel supply valves to the fired heater XV591 and XV592.

Fired Heater Main Gas Running:

- Close Main gas block valves XV597 and XV598, Open Main gas vent valve XV599

5.4.1.7.2.22 FEED TANK T07 LOW LEVEL (4329)

The feed tank T07 low level (LAL557) will result in the following interlocks if lined up to the column:

- Close feed flow control valve FCV571
- Close Petrol product flow control valve FCV582
- Close Diesel product flow control valve FCV573
- Stop feed pump X01

5.4.1.7.2.23 FEED TANK T07 LOW LEVEL RECIRCULATION (4330)

The feed tank T07 low level (LAL557) will result in the following interlocks:

- Stop feed pump X01

5.4.1.7.2.24 FEED TANK T07 LEVEL HIGH-HIGH (4331)

The feed tank T07 high-high level (LAHH557) will result in the following interlocks:

- Close tank inlet valve XVT7B

5.4.1.7.2.25 FEED TANK T08 LOW LEVEL (4332)

The feed tank T08 low level (LAL558) will result in the following interlocks if lined up to the column:

- Close feed flow control valve FCV571
- Close Petrol product flow control valve FCV582
- Close Diesel product flow control valve FCV573
- Stop feed pump X01/02

5.4.1.7.2.26 FEED TANK T08 LOW LEVEL RECIRCULATION (4333)

The feed tank T08 low level (LAL558) will result in the following interlocks:

- Stop feed pump X02

5.4.1.7.2.27 FEED TANK T08 LEVEL HIGH-HIGH (4334)

The feed tank T08 high-high level (LAHH558) will result in the following interlocks:

- Close tank inlet valve XVT8B

5.4.1.7.2.28 PETROL PRODUCT TANK T05 LEVEL LOW-LOW (4335)

The petrol product tank T05 low-low level (LALL555) will result in the following interlocks:

- Close Petrol product flow control valve (FCV551)
- Stop Petrol product pump X07

5.4.1.7.2.29 PETROL PRODUCT TANK T05 LEVEL HIGH-HIGH (4336)

The petrol product tank T05 high-high level (LAHH555) will result in the following interlocks:

- Close feed flow control valve FCV571
- Close Petrol product flow control valve FCV582
- Close Diesel product flow control valve FCV573
- Close petrol product tank inlet valve XVT5B

5.4.1.7.2.30 PETROL PRODUCT TANK T06 LEVEL LOW-LOW (4337)

The petrol product tank T06 low-low level (LALL556) will result in the following interlocks:

- Close Petrol product flow control valve (FCV552)
- Stop Petrol product pump X08

5.4.1.7.2.31 PETROL PRODUCT TANK T06 LEVEL HIGH-HIGH (4338)

The petrol product tank T06 high-high level (LAHH556) will result in the following interlocks:

- Close feed flow control valve FCV571
- Close Petrol product flow control valve FCV582
- Close Diesel product flow control valve FCV573
- Close petrol product tank inlet valve XVT6B

5.4.1.7.2.32 DIESEL FUEL TANK T04 LEVEL LOW-LOW (4339)

The Diesel fuel tank T04 low-low level (LALL554) will result in the following interlocks:

- Close feed flow control valve FCV571
- Close Petrol product flow control valve FCV582
- Close Diesel product flow control valve FCV573
- Close the Diesel fuel supply valves to the fired heater XV591 and XV592.
- Stop the Diesel fuel supply pumps to the fired heater (X09/10).

5.4.1.7.2.33 MAIN GAS LOW-LOW PRESSURE (4380)

The Main Gas low-low pressure (PT596) will result in the following interlocks:

- Close feed pressure control valve PCV596
- Close Petrol product flow control valve FCV582
- Close Diesel product flow control valve FCV573
- Close Main Gas block valves XV597 and XV598, Open Main Gas vent Valve XV599

5.4.1.7.2.34 DIESEL PRODUCT TEMPERATURE HIGH (4341)

The Diesel product temperature high (TAH573) will result in the following interlocks:

- Close feed flow control valve FCV571
- Close Petrol product flow control valve FCV582
- Close Diesel product flow control valve FCV573

5.4.1.7.2.35 REBOILER/BOTTOM PUMP NO FLOW (4342)

The Reboiler/Bottom pumps are controlled by a duty/standby controller typical. If the bottom total flow rate is low, the duty/standby controller will start the second pump if it is available. If the bottom total flow rate (FT591 + FT573) remains low for longer than configurable PLC time, interlock 4342 of the cause and effect chart will be activated. Interlock 4342 includes the following:

- Close feed flow control valve FCV571
- Stop the transfer of excess bottom product to the Diesel storage tank (Closing FCV573).
- Stop the transfer of excess overhead product to the Petrol storage tank (Closing FCV582).

Fired Heater Diesel Running:

- Close the Diesel fuel supply valves to the fired heater XV591 and XV592.
- Stop the Diesel fuel supply pumps to the fired heater (X09/10).

Fired Heater Main Gas Running:

- Close Main gas block valves XV597 and XV598, Open Main gas vent valve XV599

5.4.1.7.2.36 REFLUX/OVERHEAD PUMP NO FLOW (4343)

The Reflux/Overhead pumps are controlled by a duty/standby controller typical. If the reflux/overhead total flow rate is low, the duty/standby controller will start the second pump if it is available. If the total flow rate (FT572 + FT582) remains low for longer than configurable PLC time, interlock 4343 of the cause and effect chart will be activated. Interlock 4343 includes the following:

- Close feed flow control valve FCV571
- Stop the transfer of excess bottom product to the Diesel storage tank (Closing FCV573).
- Stop the transfer of excess overhead product to the Petrol storage tank (Closing FCV582).

Fired Heater Diesel Running:
- Close the Diesel fuel supply valves to the fired heater XV591 and XV592.
- Stop the Diesel fuel supply pumps to the fired heater (X09/10).

Fired Heater Main Gas Running:
- Close Main gas block valves XV597 and XV598, Open Main gas vent valve XV599

5.4.1.7.2.37 REBOILER/BOTTOM PUMP X03 BARRIER FLUID PRESSURE LOW (4344)

If the Reboiler/Bottom pump X03 barrier fluid pressure low (PAL577) is activated while the pump is running, the duty/standby controller will start the second pump if it is available. The following interlocks will then be applied:
- Stop Reboiler/Bottom pump X03

5.4.1.7.2.38 REBOILER/BOTTOM PUMP X04 BARRIER FLUID PRESSURE LOW (4345)

If the Reboiler/Bottom pump X04 barrier fluid pressure low (PAL578) is activated while the pump is running, the duty/standby controller will start the second pump if it is available. The following interlocks will then be applied:
- Stop Reboiler/Bottom pump X04

5.4.1.7.2.39 DIESEL FEED PUMPS LOW FLOW (4346)

The Diesel feed pump low flow (FS553) will result in the following interlocks:
- Stop the Diesel fuel supply pumps to the fired heater (X09/10).

5.4.1.7.2.40 DIESEL PUMP X09 DISCHARGE PRESSURE (4347)

If the Diesel feed pumps discharge pressure low (PAL551), the duty/standby controller will start the second pump if it is available. The following interlocks will then be applied:
- Stop Diesel Pump X09

5.4.1.7.2.41 DIESEL PUMP X10 DISCHARGE PRESSURE (4347)

If the Diesel feed pumps discharge pressure low (PAL551), the duty/standby controller will start the second pump if it is available. The following interlocks will then be applied:
- Stop Diesel Pump X10

5.4.1.7.2.42 LOSS OF COMPRESSED AIR (4348)

If the compressed air pressure (PAL191) low is detected, the following interlocks will apply:
- Close feed flow control valve FCV571
- Close Petrol product flow control valve FCV582

- Close Diesel product flow control valve FCV573

Fired Heater Diesel Running:
- Close the Diesel fuel supply valves to the fired heater XV591 and XV592.
- Stop the Diesel fuel supply pumps to the fired heater (X09/10).

Fired Heater Main Gas Running:
- Close Main gas block valves XV597 and XV598, Open Main gas vent valve XV599

5.4.1.7.2.43 EMERGENCY STOP

Emergency stop (ES571, ES597A, ES597B, or ES597C)
- Stop all pumps
- Close all valves
- Abort sequencer
- All PID controllers to off mode and closed.

5.4.1.7.2.44 X01

X01 is interlocked under the following conditions:

- The intermix feed pump is available (X01).
- The feed pump inlet valve is not open (ZVX1A)
- The feed pump discharge valve is not open (ZVX1E) and the feed pump jet mixing valve is not open (ZVX1F).
- The Intermix feed storage tank is not empty (T07).
- X01 and X02 are not both lined up to the column

5.4.1.7.2.45 X02

X02 is interlocked under the following conditions:

- The intermix feed pump is available (X02).
- The feed pump inlet valve is not open (ZVX2A)
- The feed pump discharge valve is not open (ZVX2E) and the feed pump jet mixing valve is not open (ZVX2F).
- The Intermix feed storage tank is not empty (T08).
- X01 and X02 are not both lined up to the column

5.5 IRP FIRED HEATER ROUTING GROUP

The fired heater heats the Reboiler/bottom product that is circulated through the bottom of the column. The column fired heater routing group includes the routing of diesel fuel, air, main gas and LP gas to the fired heater pilot and main burners.

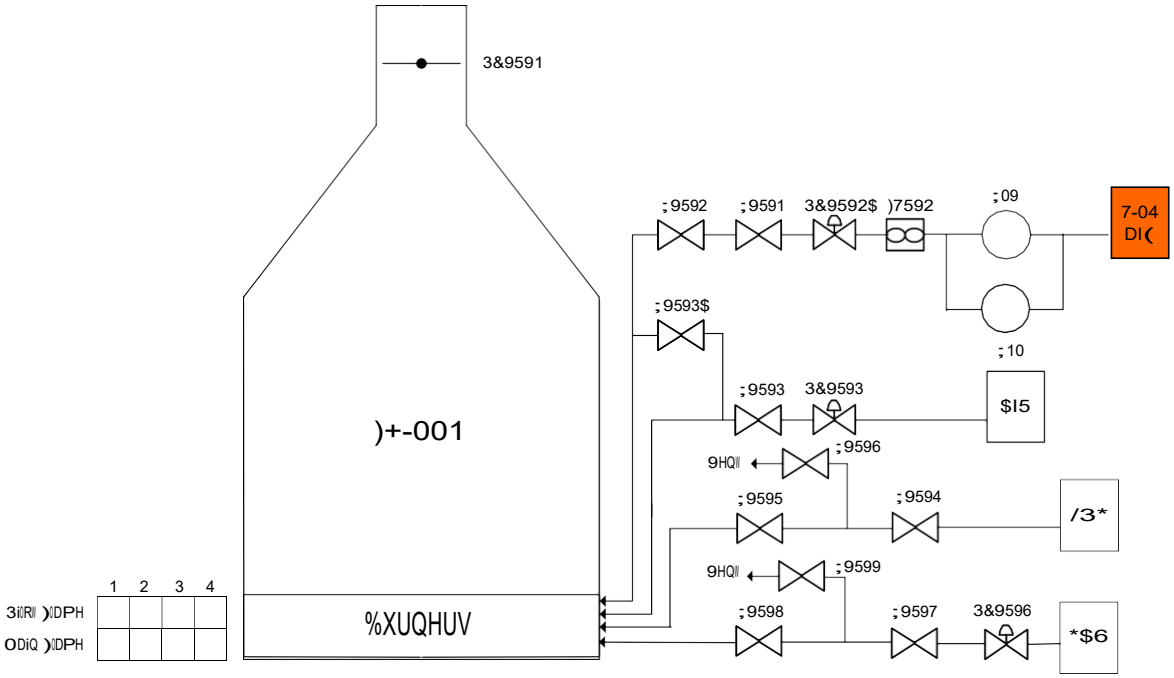

Figure 5.5: Column fired heater routing

5.5.1 GROUP DESCRIPTION

The fired heater field devices are to be terminated to SIL 3 rated Siemens I/O modules. Combined with the implementation of Siemens Safety Integrated Software, the Fired Heater system will comply with the requirements of TUV for up to SIL 2 applications.

Control and Monitoring functionality shall be achieved via interface to the following devices:

VALVES

Fired heater Diesel fuel primary block valve	XV591
Fired heater Diesel fuel secondary block valve	XV592
Fired heater Atomising air block valve	XV593
Fired heater pilot gas primary block valve	XV594
Fired heater pilot gas secondary block valve	XV595
Fired heater pilot gas vent valve	XV596
Fired heater main gas primary block valve	XV597
Fired heater main gas secondary block valve	XV598
Fired heater main gas vent valve	XV599
Fired heater Burner 1 Main gas line valve	XV595A
Fired heater Burner 2 Main gas line valve	XV595B
Fired heater Burner 3 Main gas line valve	XV595C
Fired heater Burner 4 Main gas line valve	XV595D

Fired heater Burner 1 Diesel line valve	XV596A
Fired heater Burner 2 Diesel line valve	XV596B
Fired heater Burner 3 Diesel line valve	XV596C
Fired heater Burner 4 Diesel line valve	XV596D
Fired heater Burner 1 Air line Diesel flushing valve	XV597A
Fired heater Burner 2 Air line Diesel flushing valve	XV597B
Fired heater Burner 3 Air line Diesel flushing valve	XV597C
Fired heater Burner 4 Air line Diesel flushing valve	XV597D
Fired heater Burner 1 Atomising line valve	XV598A
Fired heater Burner 2 Atomising line valve	XV598B
Fired heater Burner 3 Atomising line valve	XV598C
Fired heater Burner 4 Atomising line valve	XV598D
Fired heater Burner 1 Pilot Gas line valve	XV599A
Fired heater Burner 2 Pilot Gas line valve	XV599B
Fired heater Burner 3 Pilot Gas line valve	XV599C
Fired heater Burner 4 Pilot Gas line valve	XV599D

INSTRUMENTATION

Pilot Gas Burner 1 flame detector	BS592A
Pilot Gas Burner 2 flame detector	BS592B
Pilot Gas Burner 3 flame detector	BS592C
Pilot Gas Burner 4 flame detector	BS592D
Diesel Burner 1 flame detector	BS591A
Diesel Burner 2 flame detector	BS591B
Diesel Burner 3 flame detector	BS591C
Diesel Burner 4 flame detector	BS591D
Arch pressure	PT591
Diesel fuel flow meter	FT592
Diesel fuel pressure	PT592
Atomising air pressure	PT593
Pilot gas pressure	PT595
Main gas pressure	PT596
Main gas pressure	PT597
Main gas pressure	PT598
Inlet temperature 1st pass	TT592A
Inlet temperature 2nd pass	TT592B
Tube skin temperature shock-row pass A	TT593A
Tube skin temperature shock-row pass B	TT593B
Process temperature pass A cross over	TT594A
Process temperature pass B cross over	TT594B
Tube skin temperature pass A radiant tube	TT595A
Tube skin temperature pass B radiant tube	TT595B
Tube skin temperature pass A radiant outlet	TT596A
Tube skin temperature pass B radiant outlet	TT596B
Process outlet temperature pass A	TT597A
Process outlet temperature pass B	TT597B
Flue gas temperature stack base temp	TT598
Flue gas temperature at arch	TT599
Diesel fuel storage tank T04 level transmitter	LT554

PUMPS

Diesel fuel feed pump	X09
Diesel fuel feed pump	X10

IGNITERS

Pilot flame 1 ignition transformer	XI592A_BY
Pilot flame 2 ignition transformer	XI592B_BY
Pilot flame 3 ignition transformer	XI592C_BY
Pilot flame 4 ignition transformer	XI592D_BY

5.5.2 DEVICE GROUP OBJECT CONTROL

There is no standard device group control for this group.

5.5.3 MODES OF CONTROL

The fired heater Reboiler Device Group shall be controllable locally from the SCADA System installed at the IRP Fired Heater. Remote control from the Master Control Centre in Durban will not be possible, with the exception of total plant shutdown.

5.5.4 MODES OF OPERATION

Although the Burner has a local operator panel, all devices related to fired heater shall only be controlled in automatic mode of operation.

5.5.5 GROUP FUNCTIONALITY

5.5.5.1 PROCESS CONTROL SEQUENCE

The Fired heater sequence includes six phases, which are not active, purge, pilot light, burner light, running, and shutdown. The not active phase is when the sequence is not processing any steps or control functions. The purge phase includes steps 1 to 3, which are ready to purge(step1), purging (step2) and gas test(step3). The pilot light phase includes the ready to light pilot burners step (step 4). The burner light phase includes the burner permissive step(step5). The running phase of the sequence is when the fired heater is fully operational. The last phase of the sequence is the shutdown which includes the main burner shutdown, diesel fuel line shutdown, main gas shutdown, pilot standby, pilot shutdown, and ESD shutdown steps.

Step	Phase	Step description	Step end condition	Next step
0	No active	Not active	HS591 leading edge detection.	Step 1
1	Purge	Ready to purge	HS595 leading edge detection	Step 2, step 0 if fault
2		Purging	Time elapsed	Step 3 if successful purge, step 0 if purge failed
3		Gas test	HS596 leading edge detection	Step 4, step 0 if fault
4	Pilot Light	Ready to light pilot burners	Min 1 pilot flames are detected	Step 5 if successful, step 0 if failed to light
5	Burner Light	Main burner permissive	Fuel Selected: Diesel Fuel - Min 2 pilot burners, no ESD593, and time delay elapsed Main Gas - Min 3 pilot burners, no ESD593, and time delay elapsed Diesel Flushing – Min 4 pilot burners, no ESD593, and time delay elapsed	Step 6A if Diesel Fuel is selected, Step 6B if Main Gas is selected, Step 6C if Diesel Flushing is selected,if <1 pilot flames detected, go to step 0
6	Running	Fired heater Running	HS592 pressed or ESD activated	Step 7 if HS592, step 11 if ESD activated, step 0 if <1 pilot flames, step 7 if no process flow and TT599 >= 375˚C
7	Shutdown	Main Burner shutdown	No burner flames detected	Step 8
8		Fuel shutdown	No diesel flow	Step 9
9		Pilot standby	Operator shutdown request or start main burners request	Step 10 to shutdown, or step 5 to start Burners, or step 11 if <1 pilots detected
10		Pilot shutdown	No pilot flames detected	Step 0

11		ESD Shutdown	Burners stopped, Diesel line closed, Main gas line closed and pilot closed	Step 0

The sequence is started by:

- HS591 leading edge is detected

If a start request is issued, a check is undertaken to ascertain if the sequencer is ìReady". If ready, the fired heater start-up is initiated and step 1 is started. The sequencer will then proceed to step 2 once step 1 end condition has been met. The sequencer will execute all steps up to Main burner permissive(step5), at which point a fuel selection must be made (Diesel,Main Gas or Diesel Flushing). Depending on fuel selected the number of pilot flames (>=2 for Diesel, >=3 for Main Gas or ==4 for Diesel Flushing) required must be on before the sequence can continue up to a running phase (step 6).

The sequence is shutdown by:

- A Fired Heater local panel stop request (HS 592). The sequence will execute steps 7 to 9.
- An ESD is activated. The sequence will execute step 11 irrespective of the current phase and step.

Refer to the following flow diagrams for operation:
G52001-T4043-L100 – FH Sequence overview
G52001-T4043-L101 – FH Step 1 Ready to Purge
G52001-T4043-L102 – FH Step 2 Purging
G52001-T4043-L103 – FH Step 3 Gas Test
G52001-T4043-L104 – FH Step 4 Ready to light Pilot
G52001-T4043-L105 – FH Step 5 Main burner Permissive
G52001-T4043-L106 – FH Step 6A Diesel Running
G52001-T4043-L116 – FH Step 6B Main Gas Running
G52001-T4043-L126 – FH Step 6C Diesel Flushing
G52001-T4043-L107 – FH Step 7A Diesel Burner Shutdown
G52001-T4043-L117 – FH Step 7B Main Gas Burner Shutdown
G52001-T4043-L108 – FH Step 8A Diesel shutdown
G52001-T4043-L118 – FH Step 8B Main Gas shutdown
G52001-T4043-L110 – FH Step 10 Pilot shutdown
G52001-T4043-L111 – FH Step 11 FH Shutdown

5.5.5.1.1 DIESEL FUEL PUMP CONTROL

The two Diesel Fuel pumps (X09 and X10) are controlled according to the duty/standby controller typical.

Object controller

Signal	Alternative			
DUTY	X09 Duty	X10 Duty	X09 and X10 Duty	No Pump Duty
DUTY_CONTROL	Not Active	Active		

The PLC will keep track of the running hours of each pump. Automatic selection of duty and standby status of pumps is based on Run Hour differentials [Configurable in the PLC – Default 100 hours]. Note that each pump will run for a period of twice the set point, i.e. 200 hours. The pump with the lowest running hours is started first if available. Once a pump is running, no switching will occur due to run hours.

If the group is ready, the duty controller is started from a:

- Start sequence Request from the SCADA
- Start request from the Fired Heater control sequencer.

An indication ìcontrol active" is indicated on the SCADA. The duty controller is now activated and will start and stop the Diesel Fuel pumps accordingly. If the Diesel Fuel flow rate is low for a PLC configurable time delay, and the second Diesel Fuel pump is available, the second pump will be started.

The duty controller is stopped from a:

- Stop sequence Request from the SCADA
- Stop request from the Column control sequencer.

5.5.5.2 ATOMISING AIR COMPRESSORS

The PLC will keep track of the running hours of each pump.

5.5.5.3 SWITCHES AND INDICATING LAMPS

The local operator panel includes hand switches and lamps. The following hand switches have been included:

Common

- Lamp Test HS593
- Trip reset HS594
- Start Purge HS595
- Gas test complete HS596

Pilot Gas

- Start/Stop Pilot 1 HS599A
- Start/Stop Pilot 2 HS599B
- Start/Stop Pilot 3 HS599C
- Start/Stop Pilot 4 HS599D
-

Main Gas System

- Start/Stop Burner 1 HS599E
- Start/Stop Burner 2 HS599F
- Start/Stop Burner 3 HS599G
- Start/Stop Burner 4 HS599H

Diesel System

- Start/Stop Burner 1	HS598A
- Start/Stop Burner 2	HS598B
- Start/Stop Burner 3	HS598C
- Start/Stop Burner 4	HS598D
- Start (Reset)	HS591
- Stop	HS592

The following lamps have been included:

Common

- Ready to Purge	XI591A_XL
- Purging	XI592A_XL
- Purge Complete	XI593A_XL
- Purge Failure	XI594A_XL
- Ready to Light	XI595A_XL

Pilot Gas

- Pilot Gas Pressure High-High	XI595_PLHH
- Pilot Gas Pressure Low-Low	XI595_PLLL
- LP Gas primary block valve closed	XI594_XLC
- LP Gas primary block valve open	XI594_XLO
- LP Gas secondary block valve closed	XI595_XLC
- LP Gas secondary block valve open	XI595_XLO
- LP Gas bleed block valve closed	XI596_XLC
- LP Gas bleed block valve open	XI596_XLO

Main Gas

- Main Gas Pressure High-High	XI597_PLHH
- Main Gas Pressure Low-Low	XI597_PLLL
- Main Gas primary block valve closed	XI597_XLC
- Main Gas primary block valve open	XI597_XLO
- Main Gas secondary block valve closed	XI598_XLC
- Main Gas secondary block valve open	XI598_XLO
- Main Gas bleed block valve closed	XI599_XLC
- Main Gas bleed block valve open	XI599_XLO

Air System

- Air Pressure High-High	XI593_PLHH
- Air Pressure Low-Low	XI593_PLLL
- Air block valve closed	XI593_XLC
- Air block valve open	XI593_XLO

Diesel System

- Primary block valve closed	XI591_XLC
- Primary block valve open	XI591_XLO
- Secondary block valve closed	XI592_XLC
- Secondary block valve open	XI592_XLO
- Diesel Pressure High-High	XI594_PLHH
- Diesel Pressure Low-Low	XI594_PLLL

Flame Detection

- Main Flame Detection Trip	XI591_BL
- Burner 1	XI591A_BL
- Burner 2	XI591B_BL
- Burner 3	XI591C_BL
- Burner 4	XI591D_BL
- Pilot Flame Detection Trip	XI592_BL
- Pilot 1	XI592A_BL
- Pilot 2	XI592B_BL
- Pilot 3	XI592C_BL
- Pilot 4	XI592D_BL

Emergency

- General Plant Emergency Trip	ES571
- ES Shutdown Front of Panel	ES597A
- ES Shutdown Control Room	ES597B
- ES Suggested Field Shutdown	ES597C

5.5.5.4 INDICATING LAMP FUNCTIONALITY

Certain lamps are an indication of field device statuses. For these lamps, the following functionality applies:

Lamp Tag	Lamp Description	Conditions to activate lamp
PILOT GAS SYSTEM		
PLHH 595	High High Pilot Gas pressure	PT595 HH activated
PLLL 595	Low Low Pilot Gas pressure	PT595 LL activated
XLO 594	Pilot Gas primary block valve 594 open	XV 594 open feedback active
XLC 594	Pilot Gas primary block valve 594 closed	XV 594 closed feedback active
XLO 595	Pilot Gas secondary block valve 594 open	XV 595 open feedback active
XLC 595	Pilot Gas secondary block valve 594 closed	XV 595 closed feedback active
XLO 596	Pilot Gas bleed valve 596 open	XV 596 open feedback active
XLC 596	Pilot Gas bleed valve 596 closed	XV 596 closed feedback active
AIR SYSTEM		
PLHH 593	High High air pressure	PT593 HH activated
PLLL 593	Low Low air pressure	PT593 LL activated
XLO 593	Air primary block valve 593 open	XV 593 open feedback active
XLC 593	Air primary block valve 593 closed	XV 593 closed feedback active
DIESEL SYSTEM		
XLO 591	Diesel primary block valve 591 open	XV 591 open feedback active
XLC 591	Diesel primary block valve 591 closed	XV 591 closed feedback active
XLO 592	Diesel secondary block valve 592 open	XV 592 open feedback active
XLC 592	Diesel secondary block valve 592 closed	XV 592 closed feedback active
PLHH 594	High High Diesel pressure	PT594 HH activated
PLLL 594	Low Low Diesel pressure	PT594 LL activated
MAIN GAS SYSTEM		
XLO 597	Main Gas Primary Block Valve 597 Open	XV 597 Open Feedback Active
XLC 597	Main Gas Primary Block Valve 597 Closed	XV 597 Closed Feedback Active
XLO 598	Main Gas Secondary Block Valve 598 Open	XV 598 Open Feedback Active
XLC 598	Main Gas Secondary Block Valve 598 Closed	XV 598 Closed Feedback Active
XLO 599	Main Gas Vent Valve 599 Open	XV 599 Open Feedback Active
XLC 599	Main Gas Vent Valve 599 Closed	XV 599 Closed Feedback Active
PLHH 597	High High Main Gas Pressure	PT597 HH Activated
PLLL 597	Low Low Main Gas Pressure	PT597 LL Activated
FLAME DETECTION		
BL591	Main flame detection trip	<2 main flames detected
BL591A	Burner 1 flame detection	BS591A active
BL591B	Burner 2 flame detection	BS591B active
BL591C	Burner 3 flame detection	BS591C active
BL591D	Burner 4 flame detection	BS591D active
BL592	Pilot flame detection trip	
BL592A	Pilot 1 flame	BS592A active
BL592B	Pilot 2 flame	BS592B active
BL592C	Pilot 3 flame	BS592C active
BL592D	Pilot 4 flame	BS592D active

5.5.6 GROUP AVAILABILITY

Availability will be indicated on the Sequence button displaying either yellow (not available) or green (available). Availability is determined by the status of the following devices:

Diesel Fuel operation:

- Either Diesel Fuel feed pump is available (X09 / X10).
- Air pressure >= required pressure (PT192).
- The Diesel Fuel storage tank is not empty (LAL554).
- All valves (XVís) for the group must be available.

Main Gas operation:

- Air pressure >= required pressure (PT192).
- The Main Gas pressure is not low (PT596).
- All valves (XVís) for the group must be available.

5.5.7 ALARM STRATEGIES

5.5.7.1 NO FLOW PATH

A ìNo flow path" is activated if there is no delivery online. An online condition is if all the valves are either open or in wire-break condition.

5.5.7.2 TANK LOW LEVEL

If the Diesel Fuel storage tank low level switch is activated, an alarm shall be issued.

5.5.7.3 PILOT FLAME FAILURE

If the fired heater is running and is in steps 5 to 10, and there is less than 2 pilot flames detected, an alarm is generated and the indication lamp XI592_XL is activated.

5.5.7.4 MAIN BURNER FLAME FAILURE

If the fired heater is in the running phase and there is less than 2 burner flames detected, an alarm is generated and the indication lamp XI591_XL is activated.

5.5.7.5 MAIN GAS PRESURRE LOW

If the Main Gas pressure low is activated, an alarm shall be issued. (PT598)

5.5.8 INTERLOCKING STRATEGIES

5.5.8.1 HARDWIRED INTERLOCKS

5.5.8.2 PLC INTERLOCKS

5.5.8.2.1 PROCESS INTERLOCKS

5.5.8.2.1.1 PROCESS INLET TEMPERATURE HIGH (TT592A/B >327 ºC) INTERLOCK 4361

Fired Heater Diesel Running:

- If Burner 1 is active, open XV597A, close XV596A.
- If Burner 2 is active, open XV597B, close XV596B.
- If Burner 3 is active, open XV597C, close XV596C.
- If Burner 4 is active, open XV597D, close XV596D.
- Close XV591 and XV592

Fired Heater Main Gas Running:
- If Burner 1 is active, close XV595A.
- If Burner 2 is active, close XV595B.
- If Burner 3 is active, close XV595C.
- If Burner 4 is active, close XV595D.
- Close XV597 and XV598
- Open XV599

5.5.8.2.1.2 CONVECTION OUTLET TEMPERATURE HIGH (TT593A/B > 450 ºC) INTERLOCK 4362

Fired Heater Diesel Running:
- If Burner 1 is active, open XV597A, close XV596A.
- If Burner 2 is active, open XV597B, close XV596B.
- If Burner 3 is active, open XV597C, close XV596C.
- If Burner 4 is active, open XV597D, close XV596D.
- Close XV591 and XV592
- PCV591 manual mode, 0% open (Fail open valve)

Fired Heater Main Gas Running:
- If Burner 1 is active, close XV595A.
- If Burner 2 is active, close XV595B.
- If Burner 3 is active, close XV595C.
- If Burner 4 is active, close XV595D.
- Close XV597 and XV598
- Open XV599
- PCV591 manual mode, 0% open (Fail open valve)

5.5.8.2.1.3 RADIANT OUTLET TEMPERATURE HIGH (TT595A/B > 450 ºC) INTERLOCK 4363

Fired Heater Diesel Running:
- If Burner 1 is active, open XV597A, close XV596A.
- If Burner 2 is active, open XV597B, close XV596B.
- If Burner 3 is active, open XV597C, close XV596C.
- If Burner 4 is active, open XV597D, close XV596D.
- Close XV591 and XV592

Fired Heater Main Gas Running:
- If Burner 1 is active, close XV595A.
- If Burner 2 is active, close XV595B.
- If Burner 3 is active, close XV595C.
- If Burner 4 is active, close XV595D.
- Close XV597 and XV598
- Open XV599

5.5.8.2.1.4 RADIANT OUTLET TEMPERATURE HIGH (TT596A/B > 450 ºC) INTERLOCK 4364

Fired Heater Diesel Running:
- If Burner 1 is active, open XV597A, close XV596A.
- If Burner 2 is active, open XV597B, close XV596B.
- If Burner 3 is active, open XV597C, close XV596C.
- If Burner 4 is active, open XV597D, close XV596D.
- Close XV591 and XV592

Fired Heater Main Gas Running:
- If Burner 1 is active, close XV595A.
- If Burner 2 is active, close XV595B.
- If Burner 3 is active, close XV595C.
- If Burner 4 is active, close XV595D.
- Close XV597 and XV598
- Open XV599

5.5.8.2.1.5 FIRED HEATER DISCHARGE TEMPERATURE HIGH-HIGH (TT597A/B>327ºC) INTERLOCK 4327

Fired Heater Diesel Running:
- If Burner 1 is active, open XV597A, close XV596A.
- If Burner 2 is active, open XV597B, close XV596B.
- If Burner 3 is active, open XV597C, close XV596C.
- If Burner 4 is active, open XV597D, close XV596D
- Close XV591 and XV592.

Fired Heater Main Gas Running:
- If Burner 1 is active, close XV595A.
- If Burner 2 is active, close XV595B.
- If Burner 3 is active, close XV595C.
- If Burner 4 is active, close XV595D.
- Close XV597 and XV598
- Open XV599

5.5.8.2.1.6 STACK TEMPERATURE HIGH (TT598 > 450 ºC) INTERLOCK 4327

Fired Heater Diesel Running:
- If Burner 1 is active, open XV597A, close XV596A.
- If Burner 2 is active, open XV597B, close XV596B.
- If Burner 3 is active, open XV597C, close XV596C.
- If Burner 4 is active, open XV597D, close XV596D.
- Close XV591 and XV592

Fired Heater Main Gas Running:
- If Burner 1 is active, close XV595A.
- If Burner 2 is active, close XV595B.
- If Burner 3 is active, close XV595C.
- If Burner 4 is active, close XV595D.
- Close XV597 and XV598
- Open XV599

5.5.8.2.1.7 RADIANT SECTION TEMPERATURE HIGH (TT599 > 850 ºC) INTERLOCK 4366

Fired Heater Diesel Running:
- If Burner 1 is active, open XV597A, close XV596A.
- If Burner 2 is active, open XV597B, close XV596B.
- If Burner 3 is active, open XV597C, close XV596C.
- If Burner 4 is active, open XV597D, close XV596D.
- Close XV591 and XV592
- PCV591 manual mode, 0% open (Fail open valve)
-

Fired Heater Main Gas Running:
- If Burner 1 is active, close XV595A.
- If Burner 2 is active, close XV595B.
- If Burner 3 is active, close XV595C.
- If Burner 4 is active, close XV595D.
- Close XV597 and XV598
- Open XV599
- PCV591 manual mode, 0% open (Fail open valve)

5.5.8.2.1.8 RADIANT SECTION PRESSURE HIGH-HIGH (PT591A/B) INTERLOCK 4367

Fired Heater Diesel Running:
- If Burner 1 is active, open XV597A, close XV596A.
- If Burner 2 is active, open XV597B, close XV596B.
- If Burner 3 is active, open XV597C, close XV596C.
- If Burner 4 is active, open XV597D, close XV596D.
- Close XV591 and XV592
- PCV591 manual mode, 0% open (Fail open valve)

Fired Heater Main Gas Running:
- If Burner 1 is active, close XV595A.
- If Burner 2 is active, close XV595B.
- If Burner 3 is active, close XV595C.
- If Burner 4 is active, close XV595D.
- Close XV597 and XV598
- Open XV599
- PCV591 manual mode, 0% open (Fail open valve)

5.5.8.2.1.9 PROCESS INLET FLOW LOW (FT591B) INTERLOCK 4328

Fired Heater Diesel Running:
- If Burner 1 is active, close XV596A.
- If Burner 2 is active, close XV596B.
- If Burner 3 is active, close XV596C.
- If Burner 4 is active, close XV596D
- Close XV591 and XV592.

Fired Heater Main Gas Running:
- If Burner 1 is active, close XV595A.
- If Burner 2 is active, close XV595B.
- If Burner 3 is active, close XV595C.
- If Burner 4 is active, close XV595D.
- Close XV597 and XV598
- Open XV599

5.5.8.2.1.10 DIESEL FLOW HIGH-HIGH (FT592 > 17L/MIN) INTERLOCK 4368

- Close XV591 and XV592.

5.5.8.2.1.11 DIESEL PRESSURE HIGH-HIGH (PT592A > 580 KPA) INTERLOCK 4369

- Close XV591 and XV592.

5.5.8.2.1.12 ATOMISING AIR PRESSURE LOW-LOW (PT593 < 310 KPA) INTERLOCK 4370

- If Burner 1 is active, close XV596A
- If Burner 2 is active, close XV596B
- If Burner 3 is active, close XV596C.
- If Burner 4 is active, close XV596D.
- Close XV591 and XV592.
- Close XV593

5.5.8.2.1.13 ATOMISING AIR PRESSURE HIGH-HIGH (PT593 > 780 KPA) INTERLOCK 4371

- Close XV593

5.5.8.2.1.14 PILOT GAS PRESSURE LOW-LOW (PT595 < 20 KPA) INTERLOCK 4372

- Close XV594 and XV595
- Open XV596
- Close XV599 A-D

Fired Heater Diesel Running:
- Close XV591 and XV592
- If Burner 1 is active, close XV596A.
- If Burner 2 is active, close XV596B.
- If Burner 3 is active, close XV596C.
- If Burner 4 is active, close XV596D.

Fired Heater Main Gas Running:
- Close XV597 and XV598
- Open XV599
- If Burner 1 is active, close XV595A.
- If Burner 2 is active, close XV595B.
- If Burner 3 is active, close XV595C.
- If Burner 4 is active, close XV595D.

5.5.8.2.1.15 PILOT GAS PRESSURE HIGH-HIGH (PT595 > 100 KPA) INTERLOCK 4373

- Close XV594 and XV595
- Open XV596
- Close XV599 A-D

Fired Heater Diesel Running:
- Close XV591 and XV592
- If Burner 1 is active, close XV596A.
- If Burner 2 is active, close XV596B.
- If Burner 3 is active, close XV596C.
- If Burner 4 is active, close XV596D.

Fired Heater Main Gas Running:
- Close XV597 and XV598
- Open XV599

- If Burner 1 is active, close XV595A.
- If Burner 2 is active, close XV595B.
- If Burner 3 is active, close XV595C.
- If Burner 4 is active, close XV595D.

5.5.8.2.1.16 BURNER PILOT FLAME FAILURE (BE592A/B/C/D) INTERLOCK 4374

- Close XV599A/B/C/D

Fired Heater Diesel Running:
- Close XV596A/B/C/D
- Open XV597A/B/C/D
- Open XV598A/B/C/D

Fired Heater Main Gas Running:
- Close XV595A/B/C/D

5.5.8.2.1.17 BURNER MAIN FLAME FAILURE (BE591A/B/C/D) INTERLOCK 4375

- Open XV597A/B/C/D
- Open XV598A/B/C/D
- Close XV596A/B/C/D

5.5.8.2.1.18 PILOT FLAME NOT DETECTED

Main Burner flame 1
If pilot flame 1 (BS592A) is not detected, the following interlocks apply:
- Force close XV596A
- Force close XV597A
- Force close XV598A

Main Burner flame 2
If pilot flame 2 (BS592B) is not detected, the following interlocks apply:
- Force close XV596B
- Force close XV597B
- Force close XV598B

Main Burner flame 3
If pilot flame 3 (BS592C) is not detected, the following interlocks apply:
- Force close XV596C
- Force close XV597C
- Force close XV598C

Main Burner flame 4
If pilot flame 4 (BS592D) is not detected, the following interlocks apply:
- Force close XV596D
- Force close XV597D
- Force close XV598D

5.5.8.2.2 EMERGENCY STOP

Emergency stop (ES597A, ES597B, ES597C, or remote MCC shutdown) will shutdown the Fired Heater as indicated by the flow charts.

5.6 REBOILER FEED FLOW CONTROL

5.6.1 GROUP DESCRIPTION

The Reboiler feed flow control valve is used to control the Reboiler feed flow rate through the Fired Heater. Control and Monitoring functionality shall be achieved via interface to the following devices:

Valves
Reboiler feed flow control valve FCV591

5.6.2 MODES OF CONTROL

The flow Control Valve Device Group shall be controllable locally from the SCADA System installed at the IRP and not remotely from the Master Control Centre in Durban.

5.6.3 MODES OF OPERATION

All devices related to this Device Group shall have the following modes of Operation:

- Manual
- Automatic

5.6.4 GROUP FUNCTIONALITY

5.6.4.1 MODULATING POSITIONER

The control valve position is detected by the control valve position feedback (FZT591). The Reboiler feed flow control is achieved through the use of a PID controller (FIC591). The PID process variable is the actual reboiler feed flow rate (FT 591), which is manipulated by throttling bottom product flow control valve (FCV 591). The flow rate set point is a fixed parameter which is entered by the operator into the PID controller.

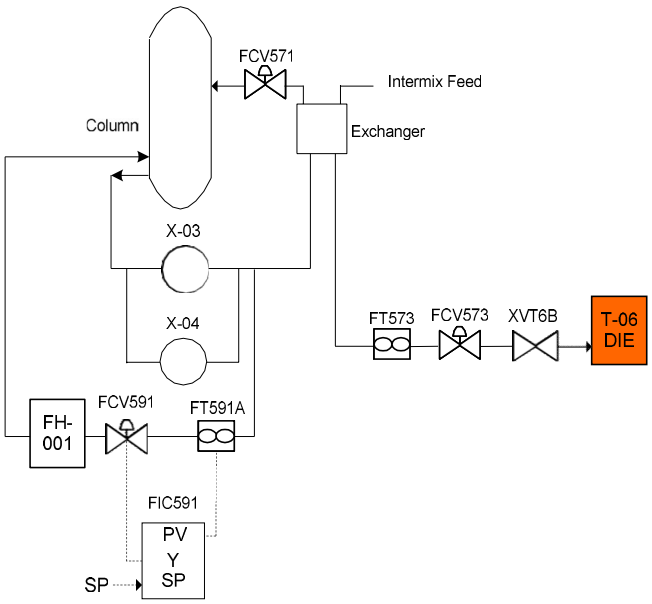

Figure 5.6: Column Reboiler/Bottom flow control

5.6.5 DEVICE GROUP AVAILABILITY

The Control valve availability is displayed as the group availability.

5.6.6 ALARM STRATEGIES

None.

5.6.7 INTERLOCKING STRATEGIES

The following interlocking strategies have been defined for the Flow Control Device Group:

5.6.7.1 HARD WIRED INTERLOCKS

None.

5.6.7.2 PLC INTERLOCKS

5.6.7.2.1 CONTROL VALVE INTERLOCK

The control valve is forced open if any of the Emergency stops are activated (ES571, ES597A, ES597B, ES597C or remote MCC shutdown). In addition, the flow control valve (FCV591) not open feedback (FZT591) and not wire-break condition, will force FCV591 open.

5.7 COLUMN LEVEL CONTROL

5.7.1 GROUP DESCRIPTION

The column level control is achieved using a cascade level-flow controller. Control and Monitoring functionality shall be achieved via interface to the following devices:

Valves
Diesel product to storage tank flow control valve FCV573

5.7.2 MODES OF CONTROL

The flow Control Valve Device Group shall be controllable locally from the SCADA System installed at the IRP and not remotely from the Master Control Centre in Durban.

5.7.3 MODES OF OPERATION

All devices related to this Device Group shall have the following modes of Operation:

- Manual
- Automatic

5.7.4 GROUP FUNCTIONALITY

5.7.4.1 MODULATING POSITIONER

The distillation column level is to be maintained by regulating the bottom product flow to the Diesel storage tank. This will be achieved through the use of a level controller and a flow controller in cascade mode. This cascade controller will ensure that when the column level rises above the level set point, the flow rate of diesel to the storage tank will increase, and vice versa. The distillation column level PID controller (LIC 573) process variable will be the column bottom level (LT 573) and the controller will have a fixed level set point. The output from the level controller will be the set point to the transfer to Diesel storage tank flow controller. The transfer to Diesel storage tank flow controller will measure the actual flow rate to the Diesel storage tank (FT573) and manipulate the flow rate using the transfer to Diesel storage tank control valve (FCV573). Refer to figure 5.7.

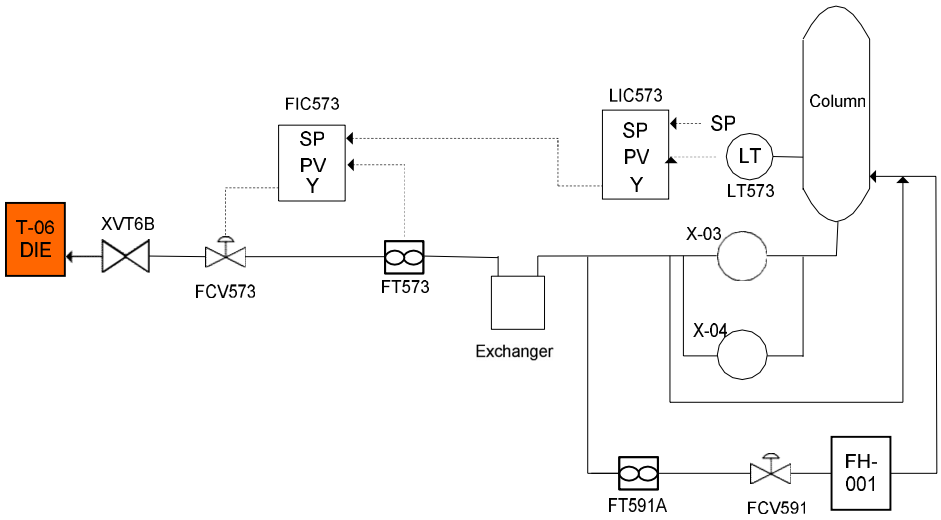

Figure 5.7: Column level-flow cascade control

5.7.5 DEVICE GROUP AVAILABILITY

The Control valve availability is displayed as the group availability.

5.7.6 ALARM STRATEGIES

None.

5.7.7 INTERLOCKING STRATEGIES

The following interlocking strategies have been defined for the Flow Control Device Group:

5.7.7.1 HARD WIRED INTERLOCKS

None.

5.7.7.2 PLC INTERLOCKS

5.7.7.2.1 CONTROL VALVE INTERLOCK

The control valve is forced closed if any of the Emergency stops are activated (ES571, ES597A, ES597B, ES597C, or a remote MCC shutdown). In addition, the flow control valve (FCV573) not open feedback (FZT573) and not wire-break condition, will force FCV573 closed.

5.8 HOT VAPOUR BYPASS DIFFERENTIAL PRESSURE CONTROL

5.8.1 GROUP DESCRIPTION

The hot vapour bypass differential pressure control is achieved using a PID controller. Control and Monitoring functionality shall be achieved via interface to the following devices:

Valves
Hot vapour bypass differential pressure control valve PDCV581

5.8.2 MODES OF CONTROL

The Pressure Control Valve Device Group shall be controllable locally from the SCADA System installed at the IRP and not remotely from the Master Control Centre in Durban.

5.8.3 MODES OF OPERATION

All devices related to this Device Group shall have the following modes of Operation:

- Manual
- Automatic

5.8.4 GROUP FUNCTIONALITY

5.8.4.1 MODULATING POSITIONER

The pressure controller controls the differential pressure (PDIC581) to achieve the pressure in the reflux drum.

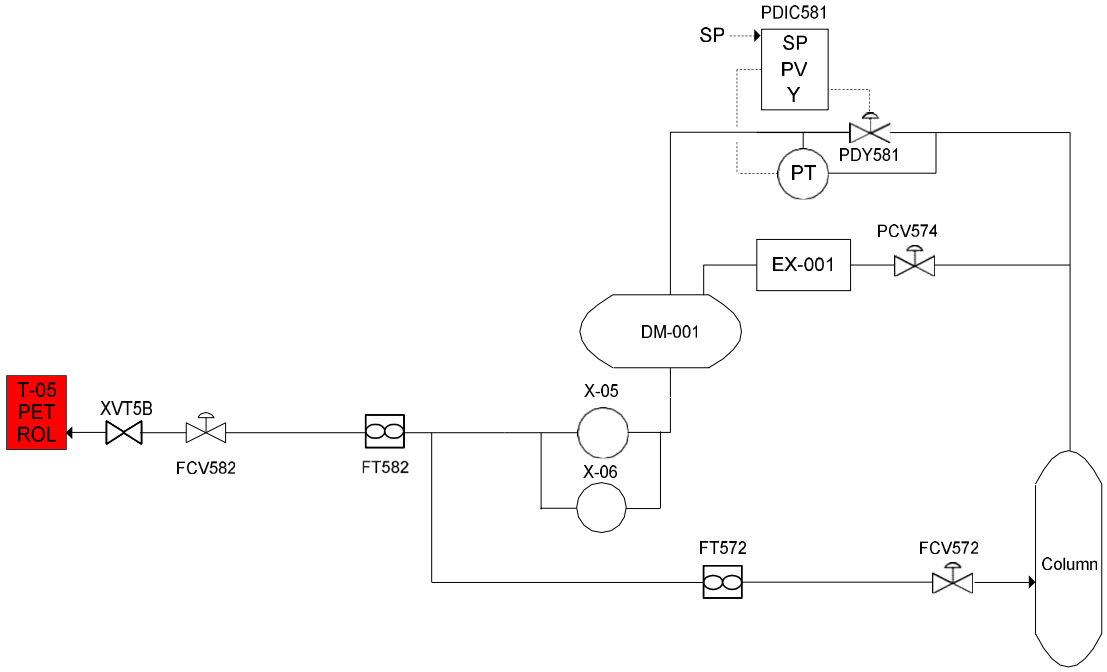

Figure 5.8: Column differential pressure control

5.8.5 DEVICE GROUP AVAILABILITY

The Control valve availability is displayed as the group availability.

5.8.6 ALARM STRATEGIES

None.

5.8.7 INTERLOCKING STRATEGIES

The following interlocking strategies have been defined for the differential pressure controller device Group:

5.8.7.1 HARD WIRED INTERLOCKS

None.

5.8.7.2 PLC INTERLOCKS

5.8.7.2.1 CONTROL VALVE INTERLOCK

The control valve is forced closed if any of the Emergency stops are activated (ES571, ES597A, ES597B, ES597C, or a MCC shutdown). In addition, the pressure control valve (PDCV581) not open feedback (PDZT581) and not wire-break condition, will force PDCV581 closed.

5.9 OVERHEAD CONDENSER PRESSURE CONTROL

5.9.1 GROUP DESCRIPTION

The overhead condenser pressure control is achieved using a PID controller. Control and Monitoring functionality shall be achieved via interface to the following devices:

Valves
Overhead condenser pressure control valve PCV574

5.9.2 MODES OF CONTROL

The overhead condenser Pressure Control Valve Device Group shall be controllable locally from the SCADA System installed at the IRP and not remotely from the Master Control Centre in Durban.

5.9.3 MODES OF OPERATION

All devices related to this Device Group shall have the following modes of Operation:

- Manual
- Automatic

5.9.4 GROUP FUNCTIONALITY

5.9.4.1 MODULATING POSITIONER

The pressure controller controls the pressure between the overhead cooler and the column to achieve the desired pressure.

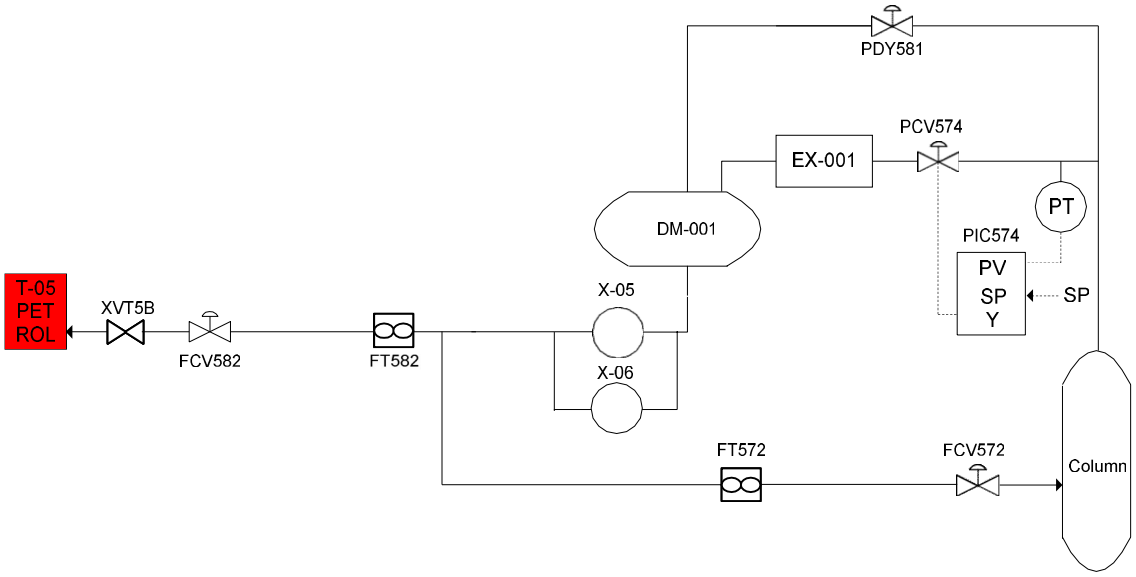

Figure 5.9: Column pressure control

5.9.5 DEVICE GROUP AVAILABILITY

The Control valve availability is displayed as the group availability.

5.9.6 ALARM STRATEGIES

None.

5.9.7 INTERLOCKING STRATEGIES

The following interlocking strategies have been defined for the column pressure controller device Group:

5.9.7.1 HARD WIRED INTERLOCKS

None.

5.9.7.2 PLC INTERLOCKS

5.9.7.2.1 CONTROL VALVE INTERLOCK

The control valve is forced open if any of the Emergency stops are activated (ES571, ES597A, ES597B, ES597C, or a MCC shutdown). In addition, the pressure control valve (PCV574) not open feedback (PZT574) and not wire-break condition, will force PCV574 open.

5.10 COLUMN REFLUX/OVERHEAD FLOW CONTROL

5.10.1 GROUP DESCRIPTION

The column Reflux/overhead flow control is achieved using a PID controller. Control and Monitoring functionality shall be achieved via interface to the following devices:

Valves
Column reflux/overhead flow control valve FCV572

5.10.2 MODES OF CONTROL

The reflux/overhead flow Control Valve Device Group shall be controllable locally from the SCADA System installed at the IRP and not remotely from the Master Control Centre in Durban.

5.10.3 MODES OF OPERATION

All devices related to this Device Group shall have the following modes of Operation:

- Manual
- Automatic

5.10.4 GROUP FUNCTIONALITY

5.10.4.1 MODULATING POSITIONER

The column Reflux/overhead flow controller controls the Reflux flow to the column. The flow rate is a fixed set point entered by the operator.

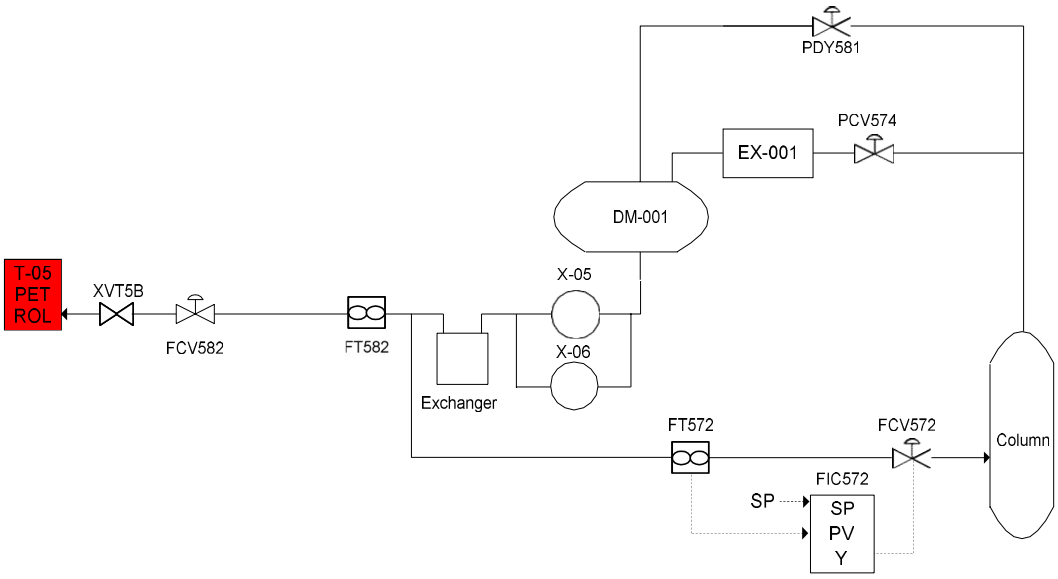

Figure 5.10: Column Reflux/Overhead flow control

5.10.5 DEVICE GROUP AVAILABILITY

The Control valve availability is displayed as the group availability.

5.10.6 ALARM STRATEGIES

None.

5.10.7 INTERLOCKING STRATEGIES

The following interlocking strategies have been defined for the column pressure controller device Group:

5.10.7.1 HARD WIRED INTERLOCKS

None.

5.10.7.2 PLC INTERLOCKS

5.10.7.2.1 CONTROL VALVE INTERLOCK

The control valve is forced open if any of the Emergency stops are activated (ES571, ES597A, ES597B, ES597C, or a MCC shutdown). In addition, the flow control valve (FCV572) not open feedback (FZT572) and not wire-break condition, will force FCV572 open.

5.11 COLUMN DRUM LEVEL CONTROL

5.11.1 GROUP DESCRIPTION

The column drum level control is achieved using a cascade level-flow PID controller. Control and Monitoring functionality shall be achieved via interface to the following devices:

Valves
Petrol product storage flow control valve FCV582

5.11.2 MODES OF CONTROL

The Petrol product storage flow Control Valve Device Group shall be controllable locally from the SCADA System installed at the IRP and not remotely from the Master Control Centre in Durban.

5.11.3 MODES OF OPERATION

All devices related to this Device Group shall have the following modes of Operation:

- Manual
- Automatic

5.11.4 GROUP FUNCTIONALITY

5.11.4.1 MODULATING POSITIONER

The reflux drum level is controlled by cascaded level-flow controllers. The level controller (LIC582) measures the drum level (LT582) and manipulates the set point to the petrol product flow controller based upon the desired drum level set point. The overhead flow controller measures the actual flow rate and manipulates the flow using the petrol product flow control valve (FCV582) to achieve the desired flow rate that is requested by the level controller. Additionally, the overhead product temperature high alarm (TAH582) will limit the flow controller output to zero, thereby shutting of the flow to the petrol storage tank and preventing hot (>50˚C) petrol from being transferred to the petrol storage tank.

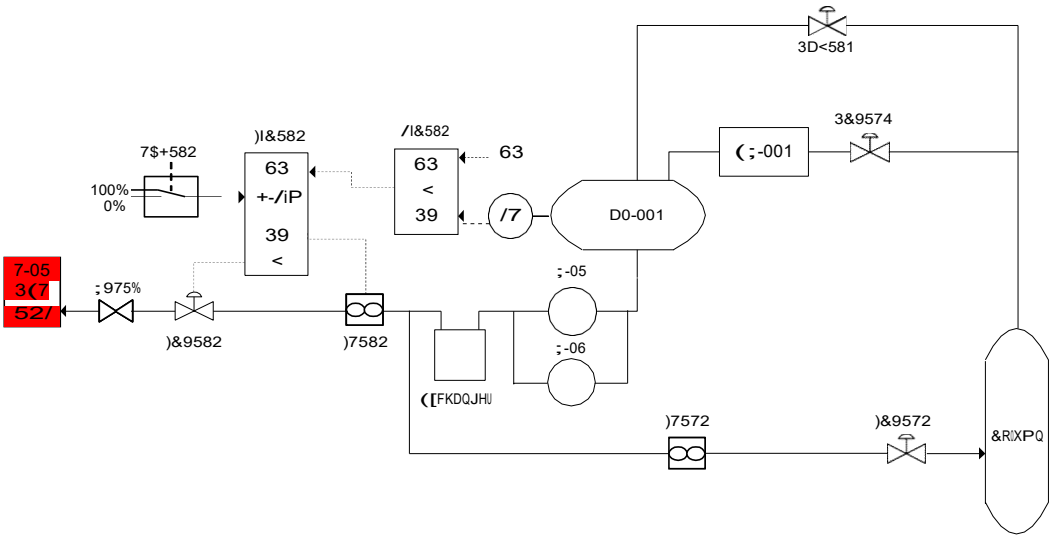

Figure 5.11: Column drum level cascade control

5.11.5 DEVICE GROUP AVAILABILITY

The Control valve availability is displayed as the group availability.

5.11.6 ALARM STRATEGIES

None.

5.11.7 INTERLOCKING STRATEGIES

The following interlocking strategies have been defined for the column pressure controller device Group:

5.11.7.1 HARD WIRED INTERLOCKS

None.

5.11.7.2 PLC INTERLOCKS

5.11.7.2.1 CONTROL VALVE INTERLOCK

The control valve is forced closed if any of the Emergency stops are activated (ES571, ES597A, ES597B, ES597C, or a MCC shutdown). In addition, the pressure control valve (FCV582) not open feedback (FZT582) and not wire-break condition, will force FCV582 closed.

5.12 COLUMN INTERMIX FEED FLOW CONTROL

5.12.1 GROUP DESCRIPTION

The column intermix feed flow control is achieved using a flow PID controller. Control and Monitoring functionality shall be achieved via interface to the following devices:

Valves
Column intermix feed flow control valve FCV571

5.12.2 MODES OF CONTROL

The Pressure Control Valve Device Group shall be controllable locally from the SCADA System installed at the IRP and not remotely from the Master Control Centre in Durban.

5.12.3 MODES OF OPERATION

All devices related to this Device Group shall have the following modes of Operation:

- Manual
- Automatic

5.12.4 GROUP FUNCTIONALITY

5.12.4.1 MODULATING POSITIONER

The intermix feed flow control is achieved through the use of a PID controller. The PID process variable is the actual intermix feed flow rate (FT 571), which is manipulated by throttling the Intermix feed flow control valve (FCV 571). The flow rate set point is a fixed parameter which is supplied to the PID controller entered by the operator.

In order to reduce product temperature fluctuations, the rate of change of the flow rate should not vary more than 10%. This is to be implemented through the rate of change of the PID output valve.

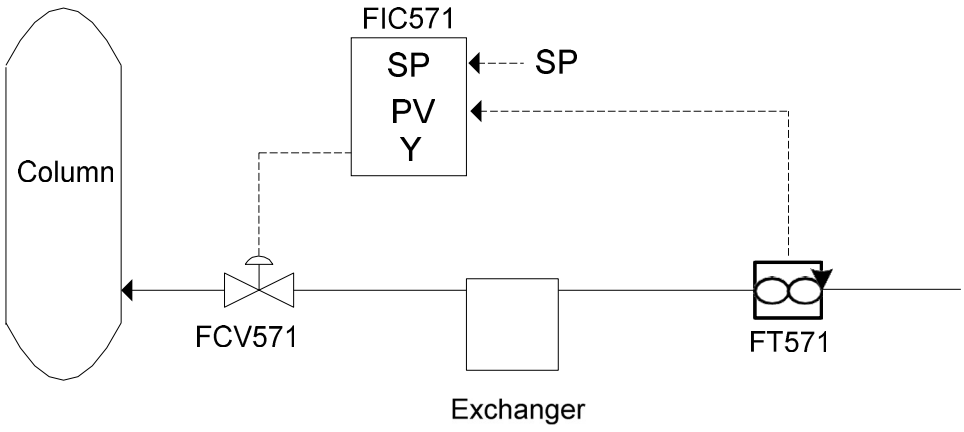

Figure 5.12: Column intermix feed flow control

5.12.5 DEVICE GROUP AVAILABILITY

The Control valve availability is displayed as the group availability.

5.12.6 ALARM STRATEGIES

None.

5.12.7 INTERLOCKING STRATEGIES

The following interlocking strategies have been defined for the column pressure controller device Group:

5.12.7.1 HARD WIRED INTERLOCKS

None.

5.12.7.2 PLC INTERLOCKS

5.12.7.2.1 CONTROL VALVE INTERLOCK

The control valve is forced closed if any of the Emergency stops are activated (ES571, ES597A, ES597B, ES597C, or a MCC shutdown). In addition, the pressure control valve (FCV571) not open feedback (FZT571) and not wire-break condition, will force FCV571 closed.

5.13 FIRED HEATER DIESEL FUEL PRESSURE CONTROLLER

5.13.1 GROUP DESCRIPTION

The pressure control valve is used for Diesel fuel line pressure control and indirectly the column temperature. Control and Monitoring functionality shall be achieved via interface to the following devices:

Valves
Diesel fuel pressure control valve PCV592A

5.13.2 MODES OF CONTROL

The Pressure Control Valve Device Group shall be controllable locally from the SCADA System installed at the IRP and not remotely from the Master Control Centre in Durban.

5.13.3 MODES OF OPERATION

All devices related to this Device Group shall have the following modes of Operation:

- Manual
- Automatic

5.13.4 GROUP FUNCTIONALITY

5.13.4.1 MODULATING POSITIONER

The control valve position is detected by the control valve position feedback (PZT592A). The Diesel fuel pressure will be controller using two cascaded PID controllers, as illustrated in figure 5.13. The first PID controller is a flow controller with the process variable being the actual Diesel fuel flow rate and the set point been calculated from a flow set point and the column temperature (TT591). The second controller is the Diesel Fuel pressure controller which controls the line pressure to achieve the desired flow rate.

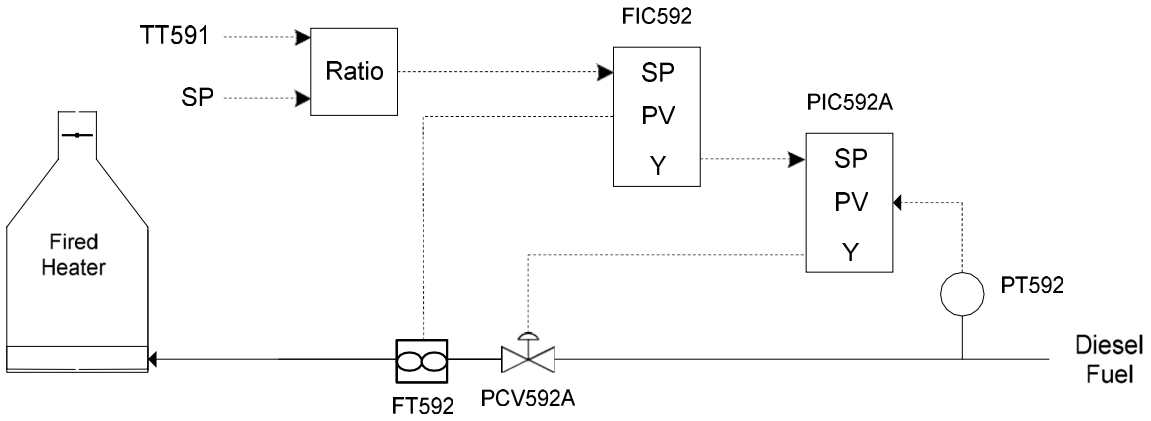

Figure 5.13: Fired heater Diesel Fuel Pressure control

5.13.5 DEVICE GROUP AVAILABILITY

The Control valve availability is displayed as the group availability.

5.13.6 ALARM STRATEGIES

None.

5.13.7 INTERLOCKING STRATEGIES

The following interlocking strategies have been defined for the Flow Control Device Group:

5.13.7.1 HARD WIRED INTERLOCKS

None.

5.13.7.2 PLC INTERLOCKS

5.13.7.2.1 CONTROL VALVE INTERLOCK

The control valve is forced closed if any of the Emergency stops are activated (ES571, ES597A, ES597B, ES597C, or a MCC shutdown). In addition, the pressure control valve (PCV592A) not open feedback (PZT592A) and not wire-break condition, will force PCV592A closed.

5.14 FIRED HEATER MAIN GAS PRESSURE CONTROLLER

5.14.1 GROUP DESCRIPTION

The pressure control valve is used for Main Gas pressure control and indirectly the column temperature. Control and Monitoring functionality shall be achieved via interface to the following devices:

Valves
Main Gas pressure control valve PCV596

5.14.2 MODES OF CONTROL

The Pressure Control Valve Device Group shall be controllable locally from the SCADA System installed at the IRP and not remotely from the Master Control Centre in Durban.

5.14.3 MODES OF OPERATION

All devices related to this Device Group shall have the following modes of Operation:

- Manual
- Automatic

5.14.4 GROUP FUNCTIONALITY

5.14.4.1 MODULATING POSITIONER

The control valve position is detected by the control valve position feedback (PZT596). The Main Gas pressure will be controlled using a PID controllers, as illustrated in figure 5.14. The PID controller is a pressure controller with the process variable being the actual Main Gas pressure and the set point been calculated from an ratio with the column temperature (TT591).

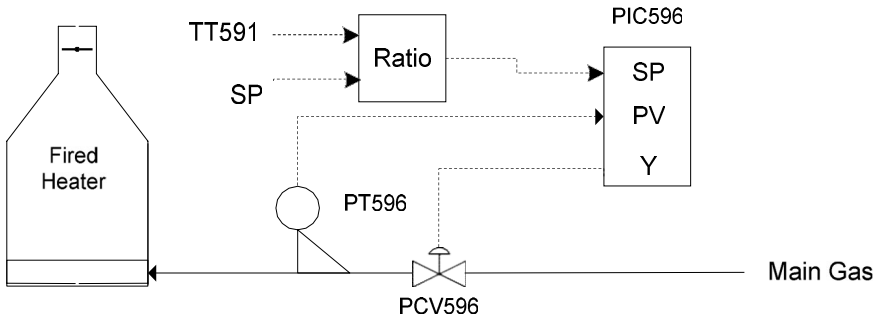

Figure 5.14: Fired heater Main Gas Pressure control

5.14.5 DEVICE GROUP AVAILABILITY

The Control valve availability is displayed as the group availability.

5.14.6 ALARM STRATEGIES

None.

5.14.7 INTERLOCKING STRATEGIES

The following interlocking strategies have been defined for the Pressure Control Device Group:

5.14.7.1 HARD WIRED INTERLOCKS

None.

5.14.7.2 PLC INTERLOCKS

5.14.7.2.1 CONTROL VALVE INTERLOCK

The control valve is forced closed if any of the Emergency stops are activated (ES571, ES597A, ES597B, ES597C, or a MCC shutdown). In addition, the pressure control valve (PCV596) not open feedback (PZT596) and not wire-break condition, will force PCV596 closed.

5.15 FIRED HEATER ATOMISING AIR PRESSURE CONTROLLER

5.15.1 GROUP DESCRIPTION

The pressure control valve is used for line pressure control. Control and Monitoring functionality shall be achieved via interface to the following devices:

Valves
Atomising Air pressure control valve PCV593

5.15.2 MODES OF CONTROL

The Pressure Control Valve Device Group shall be controllable locally from the SCADA System installed at the IRP and not remotely from the Master Control Centre in Durban.

5.15.3 MODES OF OPERATION

All devices related to this Device Group shall have the following modes of Operation:

- Manual
- Automatic

5.15.4 GROUP FUNCTIONALITY

5.15.4.1 MODULATING POSITIONER

The control valve position is detected by the control valve position feedback (PZT593). The atomising air pressure will be controller using a PID controller, as illustrated in figure 5.15. The set point for the Atomising air pressure controller is determined by an offset (typically 2Bar) from the Diesel fuel pressure and the desired atomising air pressure.

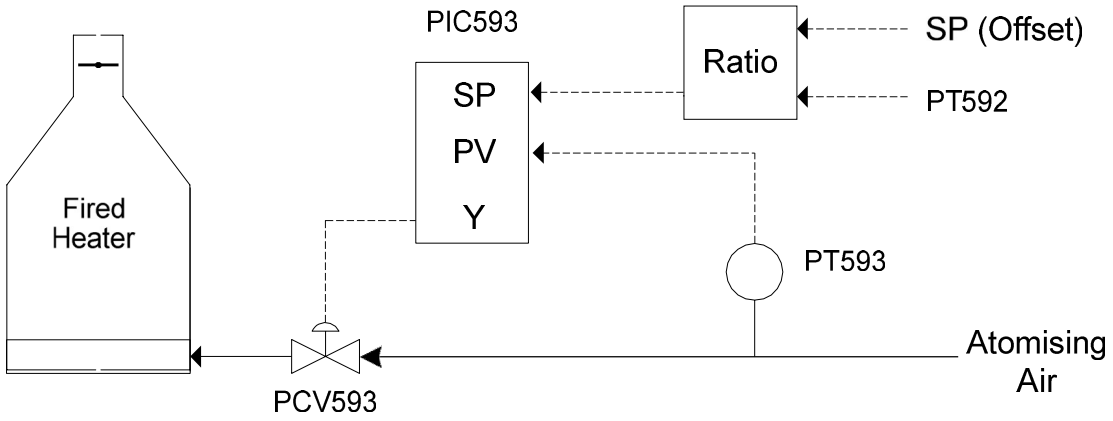

Figure 5.15: Fired heater Atomising Air Pressure control

5.15.5 DEVICE GROUP AVAILABILITY

The Control valve availability is displayed as the group availability.

5.15.6 ALARM STRATEGIES

None.

5.15.7 INTERLOCKING STRATEGIES

The following interlocking strategies have been defined for the Flow Control Device Group:

5.15.7.1 HARD WIRED INTERLOCKS

None.

5.15.7.2 PLC INTERLOCKS

5.15.7.2.1 CONTROL VALVE INTERLOCK

The control valve is forced open if any of the Emergency stops are activated (ES571, ES597A, ES597B, ES597C, or a MCC shutdown). In addition, the pressure control valve (PCV593) not open feedback (PZT593) and not wire-break condition, will force PCV593 open.

5.16 FIRED HEATER DRAFT PRESSURE CONTROLLER

5.16.1 GROUP DESCRIPTION

The pressure control valve is used for line pressure control. Control and Monitoring functionality shall be achieved via interface to the following devices:

Valves	Tag
Fired Heater damper control valve	PCV591

5.16.2 MODES OF CONTROL

The Fired Heater damper Control Valve Device Group shall be controllable locally from the SCADA System installed at the IRP and not remotely from the Master Control Centre in Durban.

5.16.3 MODES OF OPERATION

All devices related to this Device Group shall have the following modes of Operation:

- Manual
- Automatic

5.16.4 GROUP FUNCTIONALITY

5.16.4.1 MODULATING POSITIONER

The control valve position is detected by the control valve position feedback (PZT591). The Fired Heater draft pressure will be controller using a PID controller, as illustrated in figure 5.16.

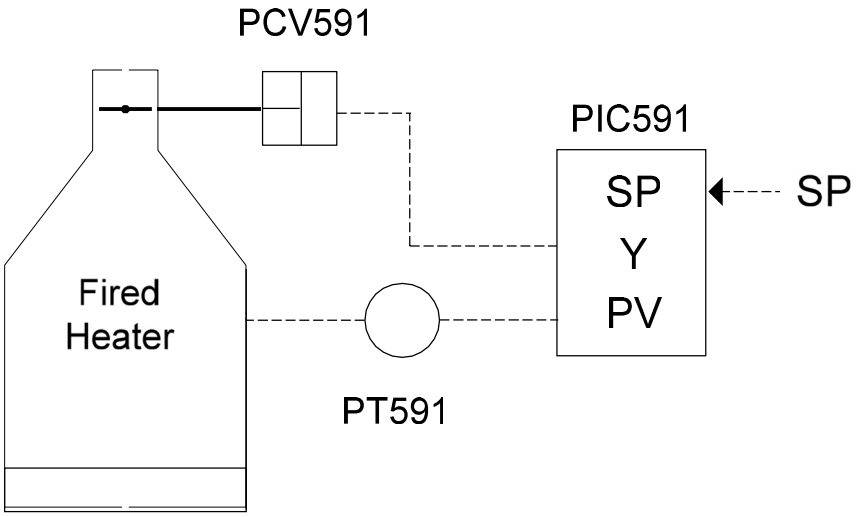

Figure 5.16: Fired heater Draft Pressure control

5.16.5 DEVICE GROUP AVAILABILITY

The Control valve availability is displayed as the group availability.

5.16.6 ALARM STRATEGIES

None.

5.16.7 INTERLOCKING STRATEGIES

The following interlocking strategies have been defined for the Flow Control Device Group:

5.16.7.1 HARD WIRED INTERLOCKS

None.

5.16.7.2 PLC INTERLOCKS

5.16.7.2.1 CONTROL VALVE INTERLOCK

The control valve is forced open if any of the Emergency stops are activated (ES571, ES597A, ES597B, ES597C, or a MCC shutdown). In addition, the pressure control valve (PCV591) not open feedback (PZT591) and not wire-break condition, will force PCV591 open.

5.17 PETROL STORAGE FLOW CONTROLLER

5.17.1 GROUP DESCRIPTION

The flow control valve is used to control the flow of petrol to Tarlton. Control and Monitoring functionality shall be achieved via interface to the following devices:

Valves
Petrol storage flow control valve FCV551

5.17.2 MODES OF CONTROL

The flow Control Valve Device Group shall be controllable locally from the SCADA System installed at the IRP and not remotely from the Master Control Centre in Durban.

5.17.3 MODES OF OPERATION

All devices related to this Device Group shall have the following modes of Operation:

- Manual
- Automatic

5.17.4 GROUP FUNCTIONALITY

5.17.4.1 MODULATING POSITIONER

The control valve position is detected by the control valve position feedback (FZT551). The petrol storage flow will be controller using a PID controller, as illustrated in figure 5.17.

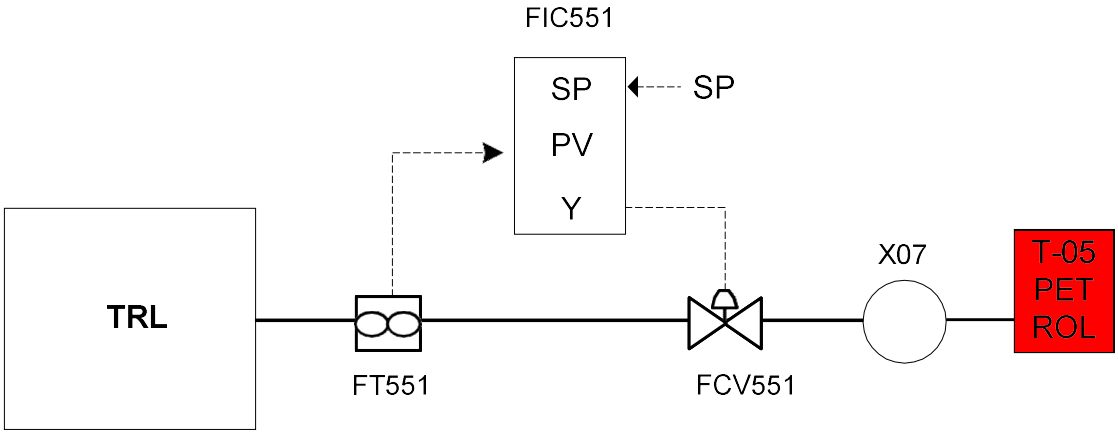

Figure 5.17: Petrol delivery flow control

5.17.5 DEVICE GROUP AVAILABILITY

The Control valve availability is displayed as the group availability.

5.17.6 ALARM STRATEGIES

None.

5.17.7 INTERLOCKING STRATEGIES

The following interlocking strategies have been defined for the Flow Control Device Group:

5.17.7.1 HARD WIRED INTERLOCKS

None.

5.17.7.2 PLC INTERLOCKS

5.17.7.2.1 CONTROL VALVE INTERLOCK

The control valve is forced closed if any of the Emergency stops are activated (ES571, ES597A, ES597B, ES597C, or a MCC shutdown). In addition, the pressure control valve (FCV551) not open feedback (FZT551) and not wire-break condition, will force FCV551 closed.

5.18 DIESEL STORAGE FLOW CONTROLLER

5.18.1 GROUP DESCRIPTION

The flow control valve is used to control the flow of Diesel to Tarlton. Control and Monitoring functionality shall be achieved via interface to the following devices:

Valves
Diesel storage flow control valve FCV552

5.18.2 MODES OF CONTROL

The flow Control Valve Device Group shall be controllable locally from the SCADA System installed at the IRP and not remotely from the Master Control Centre in Durban.

5.18.3 MODES OF OPERATION

All devices related to this Device Group shall have the following modes of Operation:

- Manual
- Automatic

5.18.4 GROUP FUNCTIONALITY

5.18.4.1 MODULATING POSITIONER

The control valve position is detected by the control valve position feedback (FZT552). The Diesel storage flow will be controller using a PID controller, as illustrated in figure 5.18.

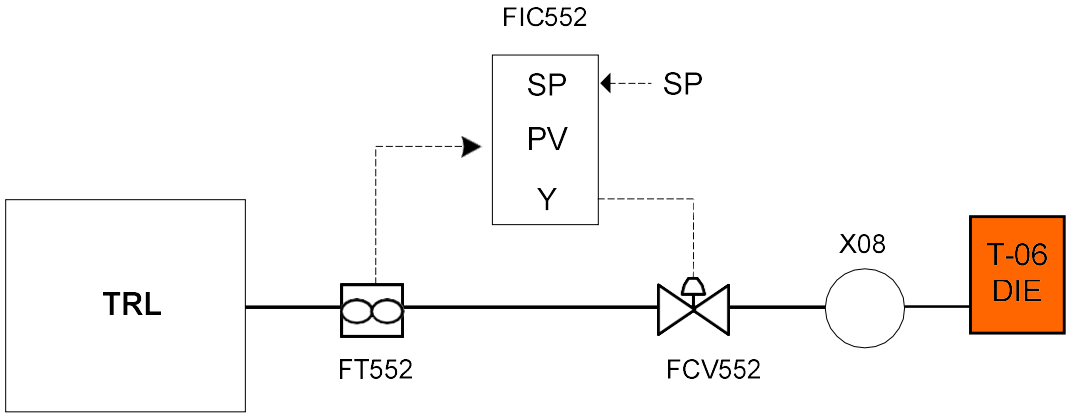

Figure 5.18: Diesel delivery flow control

5.18.5 DEVICE GROUP AVAILABILITY

The Control valve availability is displayed as the group availability.

5.18.6 ALARM STRATEGIES

None.

5.18.7 INTERLOCKING STRATEGIES

The following interlocking strategies have been defined for the Flow Control Device Group:

5.18.7.1 HARD WIRED INTERLOCKS

None.

5.18.7.2 PLC INTERLOCKS

5.18.7.2.1 CONTROL VALVE INTERLOCK

The control valve is forced closed if any of the Emergency stops are activated (ES571, ES597A, ES597B, ES597C, or a MCC shutdown). In addition, the pressure control valve (FCV552) not open feedback (FZT552) and not wire-break condition, will force FCV552 closed.

5.19 IRP DELIVERY ROUTING GROUP

5.19.1 GROUP DESCRIPTION

The IRP delivery routing group consists of two products namely Diesel and Petrol. The delivery of product is from the IRP to Tarlton accumulators. Refer to figure 5.18. The delivery of product to Tarlton is metered on the Tarlton LP manifold using Flowboss S600 metering. The routing and proving of product on the Tarlton LP manifold is monitored and controlled by the Tarlton control system as described in the Tarlton EDS.

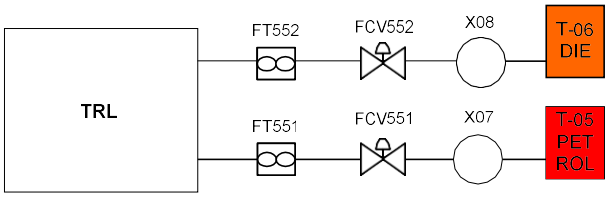

Figure 5.18: IRP delivery routing

Control and Monitoring functionality shall be achieved via interface to the following devices:

Valves	
Product pump X07 suction valve	ZVX7A
Product pump X07 discharge valve	ZVX7E
Product pump X08 suction valve	ZVX8A
Product pump X08 discharge valve	ZVX8E
Instrumentation	
Petrol delivery flow meter	FT551
Diesel delivery flow meter	FT552
Intermix feed storage tank T5 level transmitter	LT555
Intermix feed storage tank T6 level transmitter	LT556
T05 Fire foam bursting disc switch	PSE191
T06 Fire foam bursting disc switch	PSE192
Pumps	
Petrol delivery pump	X07
Diesel delivery pump	X08

5.19.1.1 GROUP FUNCTIONALITY

The transfer of intermix from IRP to Tarlton will be controlled by the Tarlton control system. The IRP routing will be performed manually by the operator.

5.19.2 ALARM STRATEGIES

5.19.2.1.1 TANK LOW LEVEL

If tank T05 low level (LAL555) is activated, an alarm shall be issued.
If tank T06 low level (LAL556) is activated, an alarm shall be issued.

5.19.2.1.2 PETROL PUMP NO FLOW

In the event that X07 is running and low flow is detected through FAL551 an alarm is generated.

5.19.2.1.3 DIESEL PUMP NO FLOW

In the event that X08 is running and low flow is detected through FAL552 an alarm is generated.

5.19.3 INTERLOCKING STRATEGIES

The following interlocking strategies have been defined for this Device Group:

5.19.3.1 PLC INTERLOCKS

If the tank status is not available, the tank is not available for Delivery.

5.19.3.1.1 PETROL PUMP NO FLOW

X07 is interlocked if FAL551 is active for a PLC configurable time when the pump is running.

5.19.3.1.2 DIESEL PUMP NO FLOW

X08 is interlocked if FAL552 is active for a PLC configurable time when the pump is running.

5.20 UTILITIES

The utilities group includes the air compressors which are controlled by an independent duty/standby controller.

5.20.1 GROUP DESCRIPTION

Control and Monitoring functionality shall be achieved via interface to the following devices:

Pumps	
Air Compressor 1 common alarm	COM1_FA
Air Compressor 1 running	COM1_PON
Air Compressor 1 trip alarm	COM1_TRP
Air Compressor 1 remote start/stop	COM1_IRT
Air Compressor 2 common alarm	COM2_FA
Air Compressor 2 running	COM2_PON
Air Compressor 2 trip alarm	COM2_TRP
Air Compressor 2 remote start/stop	COM2_IRT

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