CONTROL NARRATIVE UNIT 60

Contract No:	22640	Client Contract No	280815/FEED/BSR-AFW		
Client's Name:	Binh Son Refining and Petrochemical Company Ltd.				
Project Title:	Dung Quat Refinery Upgrading and Expansion Project				
Project Location:	Quang Ngai Province, Vietnam				
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APP. BY	NAP	NAP	NAP	NAP	NAP	NAP

CONFIDENTIAL PROPRIETARY INFORMATION FOR DUNG QUAT REFINERY UPGRADING & EXPANSION PROJECT USE ONLY

THIS DOCUMENT HAS BEEN DEVELOPED FROM 8474L-600-SP-1511-101 REV.3 CHANGES FROM THE ORIGINAL DOCUMENT ARE INDICATED IN RED TEXT

EPC CONTRACTOR TO CONFIRM THE SCOPE OF REVAMP MODIFICATION AND NEW DESIGN (PROCESS CONTROL/EMERGENCY SHUTDOWN) BASED ON INFORMATION RECEIVED FROM LICENSORS, VENDORS AND DESIGN DEVELOPMENT IN EPC PHASE AND UPDATE THIS DOCUMENT ACCORDINGLY

CONTENTS

1. GENERAL

This document provides information that is required in addition to the Project P&IDs to facilitate the configuration of the Distributed Control System (DCS) for the Unit 060 "Crude Tankage" of the Dung Quat Refinery Upgrading and Expansion (DQRE) Project.

These Control Narratives support and are to be read in conjunction with document 'DCS Configuration Typicals' number 8474L-000-JSS-1513-001.

2. REFERENCES

Design & Engineering Information for Control & Instrumentation	8474L-000-JSD-1510-001
Distributed Control System Technical Specification	000-JSS-1511-001
Emergency Shutdown Systems Standard	000-JSS-1515-001
Human-Machine Interface	8474L-000-JSS-1512-001
DCS configuration typicals	8474L-000-JSS-1513-001
System I/O list – Unit 060	8474L-600-NM-1511-001
Crude Tank Farm – Control and Shutdown Philosophy	15001-060-CN-0008-001
Crude Tank Farm – Cause and Effect Chart	15001-060-DW-1514-201
Control Narratives – Interconnecting Units	8474L-000-SP-1511-101
Control Narratives – Unit 011 CDU	15001-011-SP-1511-101
Instrument Index (060-Crude Tankage Unit)	15001-060-NM-1551-001

3. ABBREVIATIONS

C&E	–	Cause & Effect (Diagrams)
DCS	–	Distributed Control System
EMCS	–	Electrical Monitoring and Control System
ESD	–	Emergency Shutdown System
F&G	–	Fire and Gas System
HART	–	Highway Addressable Remote Transducer
I/O	–	Input / Output
HMI	–	Human Machine Interface
MCC	–	Motor Control Centre
MCS	–	MOV Control System
MMS	–	Machine Monitoring System
MOS	–	Maintenance Override Switch
MOV	–	Motor Operated Valve

MV	–	Measured Variable
N/A	–	Not applicable
OMS	–	Oil Movement System
OOS	–	Operation Override Switch
P&ID	–	Piping & Instrument Diagram
PID	–	Proportional, Integral, Derivative controller
PLC	–	Programmable Logic Controller
PV	–	Process Variable
SP	–	Set Point
VSDS	–	Variable Speed Drive System

4.   GENERAL RULES

4.1   Control Valve Failure Position

Analog output to FO valve

- 4 mA represents 0 % output = valve fully open
- 20 mA represents 100 % output = valve fully closed

Analog output to FC valve

- 4 mA represents 0 % output = valve fully closed
- 20 mA represents 100 % output = valve fully open

VDU display
On VDU displays, independently of failure position of the control valve, 0% output shall mean the valve is to close and 100% output shall mean the valve is to open.

4.2   Control Loops

- PID equation form should be on the form in which the derivate action is only based on the change in process variable. Those forms of PID equation in which the derivate action is based on the change in error (and derivative is used) cause the controller output to spike when the operators change the output.

- Controller set-points should track their respective process variables while in manual mode. For cascade loops, the output of each Master controller should track the set-point of its respective Slave controller when the Slave controller is not in cascade mode. All Master controllers should also revert to manual or inhibit mode when their associated Slave controllers are not in cascade mode. This allows the controller output tracking to take effect, thereby facilitating bumpless transfer when cascade is re-established. Proper configuration of tracking allows operators to change the mode of any controller from manual to automatic or from local automatic to cascade without causing a process disturbance.

- In case of two PID controllers, or split ranges, multiplier functions, acting on the same output through an automatic selector (e.g. low selector taking the lowest of two controller output to the valve), the controller shall be provided with anti reset wind-up feature and the integral action of each loop shall be calculated on the actual output of the valve.

- For complex or advanced schemes, selector and/or dedicated views shall be implemented so that the operator can manage the different modes (Cascade, Auto or Manual) with proper resetting.

4.3   Transmitter Failure

For control loops, in case of bad value of the measurement, the controller will be forced to manual mode, with an alarm to inform operator, with its output left unchanged at the last correct value, at switching over, unless specified otherwise in the narrative.

4.4   Loss of Controller Output

Loss of Controller Output, such as open circuit, will result in 'controller output open' alarm with controller switching to manual, unless specified otherwise in the narrative.

4.5   Control Valve Failure

Control valve failure may result in a measurement change. If the measurement change is significant, an alarm shall be initiated to inform operator. Default value will be 5% deviation between Set Point and Process value to be adjusted during commissioning unless particular requirement.

## 5.   CRUDE TO CDU / CDF – FLOW CONTROL

5.1   Objective

Flow controller 060-FIC-103 is to control the ESPO Crude flow to CDU / CDF by acting on 060-FV-103.

Flow controller 060-FIC-107 is to control the Murban / Arab Light Crudes flow to CDU / CDF by acting on 060-FV-107.

5.2   Document reference

Process P&ID   : 15001-060-PID-0021-239
              : 15001-060-PID-0021-240
              : 15001-011-PID-0021-105

5.3   Functional Description
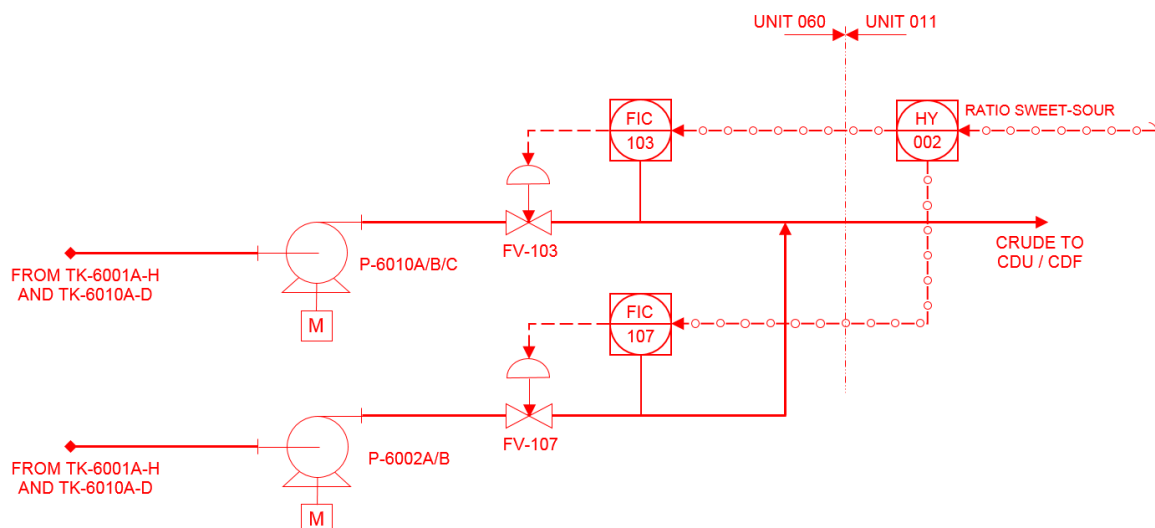
- **Controller 060-FIC-103**

  - Controller action: REVERSE

  - Input: 060-FT-103

  - Output: 060-FV-103

  - Remote Set Point from: 011-HY-002, % Ratio for P-6010A/B/C ESPO crude charge pumps

- **Controller 060-FIC-107**

  - Controller action: REVERSE

  - Input: 060-FT-107

  - Output: 060-FV-107

  - Remote Set Point from: 011-HY-002, % Ratio for P-6002A/B Murban/Arab Light crude charge pumps

For complete functional detail please refer to section "Desalters Pressure Control and Crude Feed Rate", doc. no. 15001-011-SP-1511-101.

6.   CRUDE TO CDU / CDF – TEMPERATURE CONTROL

6.1   Objective

Temperature control of mixed crude to CDU / CDF from Crude Pre-heater E-6001.

6.2   Document reference

Process P&ID   : 15001-060-PID-0021-241

6.3   Functional Description
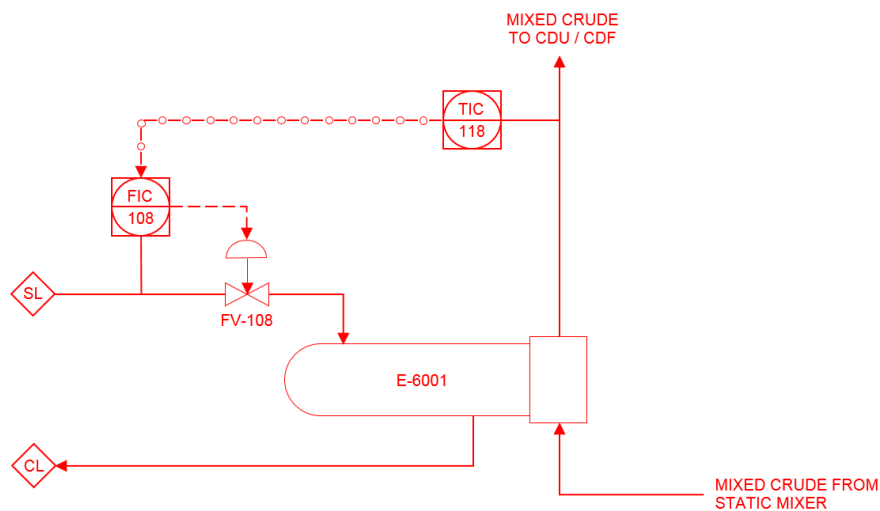
060-TIC-118 controls the temperature of the mixed crude from the Crude Pre-heater E-6001, as Master controller cascaded with the LP Steam flow controller 060-FIC-108 (Slave).

- **Controller 060-TIC-118**
    - Controller Algorithm: proportional, integral, derivative.
    - Controller action: REVERSE
    - Input: 060-TT-118
    - Output: 060-FIC-108
- **Controller 060-FIC-108**
    - Controller Algorithm: proportional, integral.
    - Controller action: REVERSE
    - Input: 060-FT-108
    - Output: 060-FV-108
    - Remote Set Point from: 060-TIC-118

7. OILY WATER TREATMENT – TANKS (TK-6002, TK-6003, TK-6004 AND TK-6005) LEVEL CONTROL AND PUMPS OPERATION

7.1 Objective

The level in TK-6002 is controlled by gap controller 060-LIC-006 by starting/stopping of pump P-6005A/B.
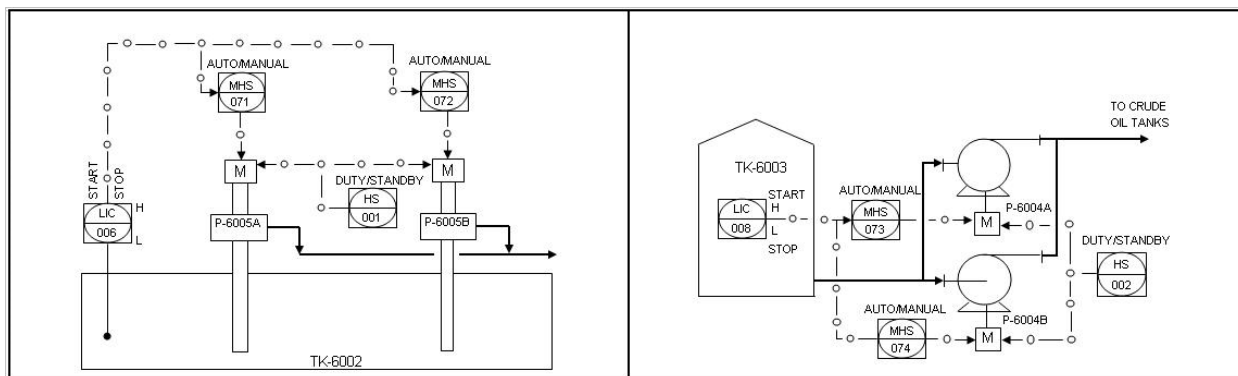
Similar configuration is applicable for TK-6003, TK-6004 and TK-6005 level control scheme.

7.2 Document reference

Process P&ID : 8474L-060-PID-0021-013
              : 8474L-060-PID-0021-014

7.3 Functional Description

EQUIPMENT	PUMP NO.	MHS- AUTO/MANUAL	HS- DUTY/STANDBY	CONTROLLER	LAL	PUMP STOP	PUMP START	LAH
TK-6002	P-6005A	071	001	LIC-006	10%	15%	75%	80%
	P-6005B	072						
TK-6004	P-6007A	075	003	LIC-007	10%	15%	75%	80%
	P-6007B	076						
TK-6003	P-6004A	073	002	LIC-008	15.4%	17.98%	75%	82%
	P-6004B	074						
TK-6005	P-6006A	077	004	LIC-009	15.4%	17.98%	75%	82%
	P-6006B	078						

In auto mode, the duty pump (P-6005A or P-6005B) will be started automatically at "pump start" level and automatically stop at "pump stop" level within the High and Low level alarm set point band. In the event where the duty pump did not start automatically, the standby pump will start after a certain time delay. The pumps shall not start when the level is Low-Low even on local mode.

Corresponding DCS Configuration Typicals are U0001 and U0003.

Controller 060-LIC-006

- Controller Algorithm: Gap Control

- Controller action: DIRECT

This controller is based on the typical Xxx40. However it functions as a differential gap controller for On/Off service.

8. OILY WATER TREATMENT – TANKS (TK-6011 AND TK-6013) LEVEL CONTROL AND PUMPS OPERATION

8.1 Objective

The level in TK-6011 is controlled by gap controller 060-LIC-108 by starting/stopping of pump P-6012A/B.
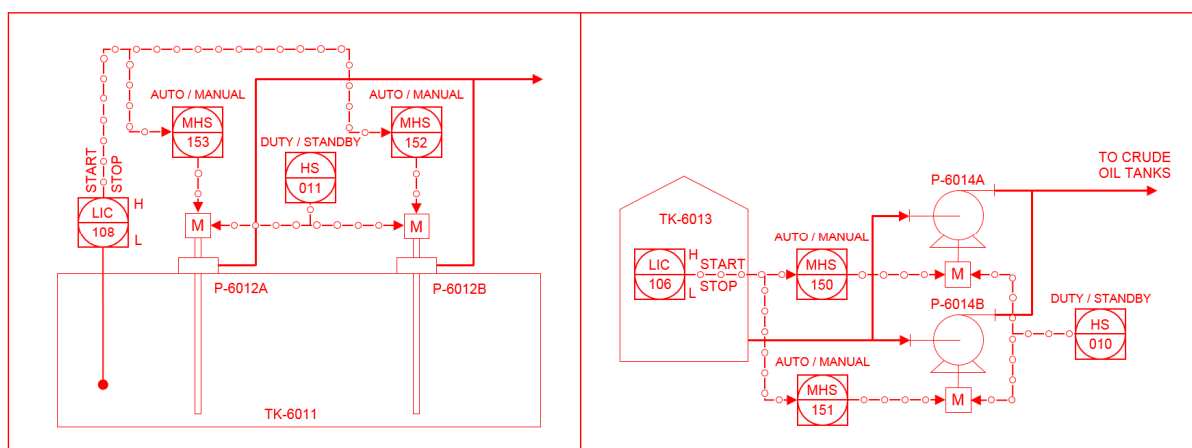
Similar configuration is applicable for TK-6013 level control scheme.

8.2 Document reference

Process P&ID   : 15001-060-PID-0021-242

: 15001-060-PID-0021-243

8.3 Functional Description

EQUIPMENT	PUMP NO.	MHS-AUTO/MANUAL	HS-DUTY/STANDBY	CONTROLLER	LAL	PUMP STOP	PUMP START	LAH
TK-6011	P-6012A	153	011	LIC-108	10%	15%	75%	80%
	P-6012B	154						
TK-6013	P-6014A	150	010	LIC-106	15.4%	17.98%	75%	82%
	P-6014B	151						

In auto mode, the duty pump (P-6012A or P-6012B) will be started automatically at "pump start" level and automatically stop at "pump stop" level within the High and Low level alarm set point band. In the event where the duty pump did not start automatically, the standby pump will start after a certain time delay. The pumps shall not start when the level is Low-Low even on local mode.

Controller 060-LIC-108

- Controller Algorithm: Gap Control
- Controller action: DIRECT

The same control configuration is applicable for pump P-6014A/B and controller 060-LIC-106.

9.   COMPENSATED FLOW MEASUREMENT
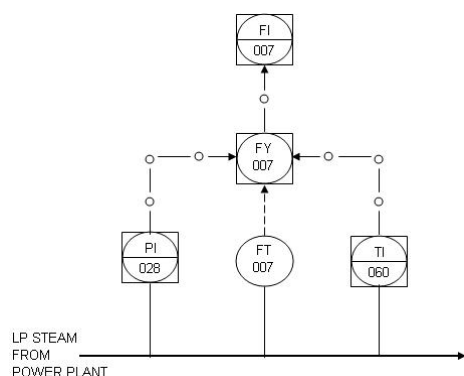
9.1   Objective

The Flow measurement shall be compensated by the Pressure and Temperature measurement.

9.2   Document reference

Process P&ID   : 15001-060-PID-0031-301

9.3   Functional Description

The Flow measurement will be compensated by Pressure and Temperature measurement in accordance with DCS Configuration Typicals 8474L-000-JSS-1513-001, Paragraph 10.4, Flow Compensation Formulas.

Tag	F	Equation	Flow	Flow Meas.	Pressure	Temperature	Fluid	P&ID Number
FY-007	FI-007	E	FT-007	Sqrt. signal	P = PI-028 P_0 = 3.6 kg/cm^2 P_g = 3.6 kg/cm^2	T = TI-060 T_0 = 160 ºC T_g = 160 ºC	LP Steam	060-PID-0031-301

Note: All instrument tag numbers in above table have 060 as prefix.

10.   OMS – CONTROL

Other than the data sent to OMS from various equipment (MOVs, Pumps, etc. as detailed in database, elsewhere) below are the equipment that will be controlled by OMS as a minimum.

i)   P-6010A, P-6010B, P-6010C, P-6002A, P-6002B and P-6003
When the respective Auto/Manual selector is put on "Auto" mode, pumps start/stop order is from OMS.

ii)   MOVs shall be as per Typical M6170
When the respective Auto/Manual selector is put on "Auto" mode, the following MOVs open/close order is from OMS.
060-MOV-001, 060-MOV-002, 060-MOV-003, 060-MOV-004, 060-MOV-005, 060-MOV-006, 060-MOV-007, 060-MOV-011, 060-MOV-012, 060-MOV-013, 060-MOV-014, 060-MOV-015, 060-MOV-016, 060-MOV-017, 060-MOV-021, 060-MOV-022, 060-MOV-023, 060-MOV-024, 060-MOV-025, 060-MOV-026, 060-MOV-027, 060-MOV-031, 060-MOV-032, 060-MOV-033, 060-MOV-034, 060-MOV-035, 060-MOV-036, 060-MOV-037, 060-MOV-041, 060-MOV-042, 060-MOV-043, 060-MOV-044, 060-MOV-045, 060-MOV-046, 060-MOV-047, 060-MOV-051, 060-MOV-052, 060-MOV-053, 060-MOV-054, 060-MOV-055, 060-MOV-056 and 060-MOV-057.

060-MOV-109, 060-MOV-110, 060-MOV-111, 060-MOV-112, 060-MOV-113, 060-MOV-114, 060-MOV-116, 060-MOV-117, 060-MOV-118, 060-MOV-119, 060-MOV-120, 060-MOV-121, 060-MOV-123, 060-MOV-124, 060-MOV-125, 060-MOV-126, 060-MOV-127, 060-MOV-128, 060-MOV-130, 060-MOV-131, 060-MOV-132, 060-MOV-133, 060-MOV-134, 060-MOV-135, 060-MOV-155, 060-MOV-156, 060-MOV-157, 060-MOV-158, 060-MOV-190, 060-MOV-191, 060-MOV-192, 060-MOV-193 and 060-MOV-194.

10.1   Document reference

Process P&ID   : 15001-060-PID-0021-202
               : 15001-060-PID-0021-204
               : 15001-060-PID-0021-207
               : 15001-060-PID-0021-209
               : 15001-060-PID-0021-234
               : 15001-060-PID-0021-235
               : 15001-060-PID-0021-239
               : 15001-060-PID-0021-240

11.   STANDARD CONTROLLERS & INDICATORS

11.1   Standard Controllers and Indicators

The standard simple closed control loops are detailed out in the System I/O List doc. No.: 8474L-600-NM-1511-001, with respective DCS Configuration Typicals reference.

12.   **US BLOCKS TO BE IMPLEMENTED IN DCS**

   a)   Auto Shutdown functionalities

   060-US-101, 060-US-111, 060-US-121, 060-US-131, 060-US-141, 060-US-151
   060-US-102, 060-US-112, 060-US-122, 060-US-132, 060-US-142, 060-US-152
   060-US-161, 060-US-162, 060-US-163, 060-US-164, 060-US-165, 060-US-166
   060-US-167, 060-US-106, 060-US-107

   060-US-212, 060-US-213, 060-US-214, 060-US-215, 060-US-219, 060-US-220
   and 060-US-221

   b)   Alarms functionalities

   060-US-105

   For details of US blocks, refer to Crude Tank Farm Control & Shutdown Philosophy, doc. no.
   15001-060-CN-0008-001

13.   **CONTROLLERS ACTIVATED BY US BLOCK.**

The following controllers shall be switched to manual mode when activated by the US block.

Initiator	Controller	Action	P&ID Number
060-US-165	060-FIC-004	0% output (060-FV-004 valve fully closed)	060-PID-0021-015
060-US-101	060-TIC-002	0% output (060-TV-002 valve fully closed)	060-PID-0021-003
060-US-111	060-TIC-012	0% output (060-TV-012 valve fully closed)	060-PID-0021-003
060-US-121	060-TIC-022	0% output (060-TV-022 valve fully closed)	060-PID-0021-006
060-US-131	060-TIC-032	0% output (060-TV-032 valve fully closed)	060-PID-0021-006
060-US-141	060-TIC-042	0% output (060-TV-042 valve fully closed)	060-PID-0021-008
060-US-151	060-TIC-052	0% output (060-TV-052 valve fully closed)	060-PID-0021-008
060-US-166	060-TIC-006	0% output (060-TV-006 valve fully closed)	060-PID-0021-013
060-US-167	060-TIC-007	0% output (060-TV-007 valve fully closed)	060-PID-0021-014

14.   **MEASUREMENT COMPARISON**

14.1   **List of corresponding ESD and DCS Transmitter.**

Following table lists ESD initiator transmitter tags and corresponding DCS transmitter tags between which measurement comparison shall be performed to generate discrepancy alarm when the difference of value between transmitters exceed x % (Preset value is 3%).

DCS / ESD Discrepancy alarm	ESD Initiator Transmitter	DCS Transmitter	P&ID Number
060-LZA-002	060-LT-002	060-LT-001	060-PID-0021-003
060-LZA-012	060-LT-012	060-LT-011	060-PID-0021-003
060-LZA-022	060-LT-022	060-LT-021	060-PID-0021-006
060-LZA-032	060-LT-032	060-LT-031	060-PID-0021-006
060-LZA-042	060-LT-042	060-LT-041	060-PID-0021-008
060-LZA-052	060-LT-052	060-LT-051	060-PID-0021-008
060-LZA-123	060-LT-123	060-LT-100	060-PID-0021-236
060-LZA-124	060-LT-124	060-LT-101	060-PID-0021-236
060-LZA-125	060-LT-125	060-LT-102	060-PID-0021-237
060-LZA-116	060-LT-116	060-LT-103	060-PID-0021-237

14.2   List of corresponding DCS Shutdown Transmitter and DCS Control/Monitoring Transmitter.

Following table lists DCS shutdown initiator transmitter tags and corresponding DCS control /monitoring transmitter tags between which measurement comparison shall be performed to generate discrepancy alarm when the difference of value between transmitters exceed x % (Preset value is 3%).

DCS Discrepancy alarm	DCS Shutdown Transmitter	DCS Control/Monitoring Transmitter	P&ID Number
060-LZA-054	060-LIT-054	060-LIT-006	060-PID-0021-013
060-LZA-055	060-LT-055	060-LT-008	060-PID-0021-013
060-LZA-056	060-LIT-056	060-LIT-007	060-PID-0021-014
060-LZA-057	060-LT-057	060-LT-009	060-PID-0021-014
060-TZA-054	060-TT-054	060-TIT-002	060-PID-0021-003
060-TZA-055	060-TT-055	060-TIT-012	060-PID-0021-003
060-TZA-056	060-TT-056	060-TIT-022	060-PID-0021-006
060-TZA-057	060-TT-057	060-TIT-032	060-PID-0021-006
060-TZA-058	060-TT-058	060-TIT-042	060-PID-0021-008
060-TZA-059	060-TT-059	060-TIT-052	060-PID-0021-008
060-TZA-063	060-TT-063	060-TT-006	060-PID-0021-013
060-TZA-064	060-TT-064	060-TT-007	060-PID-0021-014
060-LZA-107	060-LIT-107	060-LIT-108	060-PID-0021-243
060-LZA-120	060-LT-120	060-LT-106	060-PID-0021-242

15.   OTHER ALARMS

Refer to Control & Shutdown Philosophy, doc. no. 15001-060-CN-0008-001, Clause 5 for details.