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INTER TERMINALS IMMINGHAM LTD

EAST TERMINAL

GASOLINE OVERFILL PROTECTION

SAFETY INSTRUMENT SYSTEM IMMEAS-SIS1

DESIGN MANUAL

Rev	Date	By	Checked	Approved	Description	Client Ref.
A	14.03.17	D. Smith	DBF	DBF	Original Issue	
						Document No. **SI483001_MNL**

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P & I Design Ltd. *Drawing Register*

CLIENT:
Inter Terminals Immingham Ltd
East Terminal

ISSUE	DATE	BY	CHKD	APPD
A	14.03.17	DS	DBF	DBF

CLIENT REF.
IMMEAS-SIS1
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SI483021_DWG	B	XV56101 – Tank 561 Import / Export Valve Loop Sheet
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SI483005_SCH	B	JB4/198 Tank Level J/B Connection Schedule
SI483006_SCH	B	JB4/199 Tank Valve J/B Connection Schedule
SI483007_SCH	B	JB4/200 Tank Valve J/B Connection Schedule
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P & I Design Ltd. *Report Register*

CLIENT:	ISSUE	DATE	BY	CHKD	APPD	CLIENT REF.
Inter Terminals Immingham Ltd East Terminal	A	14.03.17	DS	DBF	DBF	IMMEAS-SIS1 **P & I REF.** SI483002_REG **SHT** 1 **OF** 1

REPORT NO	REV	DESCRIPTION
SI277010_RPT	G	Safety Requirement Specification
SI277001_RPT	F	SIS Design
SI483005_RPT	A	Factory Acceptance Test Procedure
SI483017_RPT	A	Document Verification Procedure
SI483018_RPT	A	Shutdown Conditions Proof Testing Procedure
SI483019_RPT	A	Equipment Failure Proof Testing Procedure

P & I Design Ltd

Specification Register

CLIENT:
Inter Terminals Immingham Ltd
East Terminal

ISSUE	DATE	BY	CHKD	APPD
A	14.03.17	DS	DBF	DBF

CLIENT REF
IMMEAS-SIS1
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P&I REF.	REV	SUPPLIER	TAG No.	ITEM
SI277015_SPC	B	TBC	JB4/199	Tank Valve Junction Box
SI277016_SPC	B	TBC	JB4/200	Tank Valve Junction Box
SI277017_SPC	B	TBC	JB4/197	Tank Level Junction Box
SI277018_SPC	B	TBC	JB4/198	Tank Level Junction Box
SI483001_SPC	A	Endress & Hauser	LE56101	Tank 561 Independent High High Level Probe
SI483002_SPC	A	Endress & Hauser	LE56401	Tank 564 Independent High High Level Probe
SI483003_SPC	A	Endress & Hauser	LE56801	Tank 568 Independent High High Level Probe

P & I Design Ltd. *Calculation Register*

CLIENT:	**ISSUE**	**DATE**	**BY**	**CHKD**	**APPD**	**CLIENT REF.**
Inter Terminals Immingham Ltd East Terminal	A	14.03.17	DS	DBF	DBF	IMMEAS-SIS1 **P & I REF.** SI483004_REG **SHT** 1 **OF** 1

CALC NO	**REV**	**DESCRIPTION**
SI483001_CAL	A	IS Calculation
SI483002_CAL	A	IS Calculation
SI483003_CAL	A	IS Calculation

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IMMINGHAM STORAGE Co LTD

IMMINGHAM EAST TERMINAL

IME-SIS1

SAFETY INSTRUMENT SYSTEM

SAFETY REQUIREMENT SPECIFICATION

Rev	Date	By	Checked	Approved	Description	Client Ref.
A	27.07.10	D.S. Regan	MM	DRR	Original Issue	
B	03.12.10	D.S. Regan	PJP	DRR	Revised as per discussions with client	Document No. **SI277010_RPT**
C	20.12.10	D.S. Regan	PJP	Client	Post FSA Stage 1	
D	22.02.11	D.S. Regan	MM	Client	Revised following SIS Design	
E	29.06.12	D.S. Regan	MM	Client	Revised following FSA Stage 3	
F	19.06.13	D.B.Faulkner	DSR	Client	XV56701 Installed	
G	31.10.14	D.B.Faulkner	DSR	ISCo	Scope Reduced to Tanks 561, 564 & 568	

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Contents

1 REVISION HISTORY

Rev	Description
A	Original Issue
B	Revised as per discussions with client
C	Post FSA Stage 1
D	Revised following SIS Design
E	Re-written for the declassification of pipeline import line actuated valves on the No. 4 East series tanks. Tank side valves installed on all tanks on SIS duty.
F	XV56701 Installed. Final element response times modified in line with pipeline surge calculations.
G	Scope reduced to gasoline Tanks 561, 564 & 568

2.0 INTRODUCTION

This document has been prepared for the Safety Instrumented System IME-SIS1 to reflect the life cycle of the SIS in accordance with BS EN 61508 & BS EN 61511 and to be a working document throughout the life cycle of the SIS.

SCOPE

Client / Company	-	Immingham Storage Co Ltd
Location / Facility	-	ISCo East Terminal
Plant Unit	-	Tanks 561, 564 & 568
Service	-	No4 East Storage Tank Overfill Protection
SIS Tag No	-	IME-SIS1
SIF's Tag No's	-	TK561-SIF1, TK564-SIF1 & TK568-SIF1
SIL	-	2

2.1 Overview of System

A LOPA Risk Assessment was conducted on a Gasoline Import and storage facility on 31st January 2007, it was revisited in February, August 2007, July 2010 and June 2011. The outcome of the assessment showed a shortfall in protection of SIL 2.

Document SI057001_RPT details this assessment.

Tanks 561, 564 and 568 are allocated to store gasoline.

There are however a number of other tanks that have not yet had LOPA assessments but have had SIS infrastructure to SIL2 installed for the purpose of contractual flexibility should they be required to store gasoline in the future. LOPA of these tanks will be required should they be brought into gasoline service and the designed infrastructure confirmed to be suitable. All tanks will be maintained and proof tested in accordance with BS EN 61511 for the purpose of collating historical proven in use data. These tanks are :-
No. 4 East tanks 552, 553, 554, 557, 558, 562, 563, 565, 566, 567, 569, 570, 571, 572.

4 East Tanks

The SIS logic solver will be configured for all in scope gasoline tanks, future tanks will be located in the ROSOV logic panel. Cabling infrastructure will be installed for all tanks to allow the installation of a tank side valve and relocation to the SIS logic solver should the tank be required for gasoline duty. The SIS logic solver to be allocated with space and infrastructure for 7 additional gasoline storage tanks. Each tank on SIS duty will have an individual tank-side import / export valve that will close on the activation of the independent high high level switch on that tank or on activation of an individual tank isolation pushbutton located at the exit of the bund.
All valves will also close on activation of the 4 East Crash Stop.

2.2 Operation

The Safety Instrument Functions are to prevent overfill of the storage tanks.

The No. 4 East tanks will have actuated import/export valves which again will automatically close on the activation of the independent high high level switch for that particular tank. The following valves are included in the design:

XV56101 - Tank 561 Import/Export Valve
XV56401 - Tank 564 Import/Export Valve
XV56801 - Tank 568 Import/Export Valve

2.2.1 No. 4 East Tanks

There are six possible import routes. Although there are six pipelines, a batch import process to any particular tank will only use a single pipeline. As there is no process control system which confirms the route, this design will operate by closing the tank-side import/export valve on the tank independent high high alarm activation.

For the No.4 East tanks, on detection of a tank independent high high level, fault or power supply failure, the output will be removed to the actuator on that tank's import/export valve, resulting in the ball valve closing. The valve cannot be re-opened until the independent high high level, fault or power supply failure are returned to a healthy state. Then on operation of a momentary reset pushbutton (one on the SIS logic solver panel plus facility for remote operation) the actuated ball valve will open (if selected to open at local pneumatic control station).

There is no requirement to override this SIF in the event of an activation of the independent high high level switch as there is a dedicated export route using hoses under management procedures which will allow for product to be removed from the tank. Management controlled use of this is described elsewhere.
The valves will be operated, cycled, periodically on a monthly basis. This will provide a form of regular stroke testing. Taking this into consideration, and the fact that only one valve will be open to allow import to any one tank, the SIS shall be designed as a 1oo1 system throughout, providing all clauses of BS EN 61511 are satisfied.

2.2.2 General

The Safety Instrument function will operate as a demand mode system with demands placed on the SIS of no greater than one event in ten years. This demand rate has been conservatively determined from the calculations in the LOPA and is backed up by site experience in the operation of existing high high alarms, where existing records demonstrate the frequency as conservative.

The Safety Instrument System will be a hardwired logic system utilising analogue and digital switches and safety relays.

As the import process is performed on a batch basis, no specific requirements requiring 1oo2, 2oo2 systems or specific requirements regarding nuisance tripping are considered necessary.

Immingham Storage Co Ltd will confirm the acceptability of the calculated spurious trip rate after the SIS PFD is calculated.

Common cause failure is not normally a consideration on non-redundant systems with the valves operated periodically. However, failures that could conceivably lead to a dangerous state would be the tank side import/export valves failing to close in the event of a independent high high level switch activation. Each valve is a simple valve actuated with a pneumatic spring return actuator. A common cause failure of electrical power or air supply would lead to all valves closing. Further failures which could lead to the valve failing to danger is air which is saturated with water with the possibility of freezing in the exhaust of the actuator vent restrictor or dirt clogging up the solenoid vent.

In this design, there will be no conceivable individually safe process states which, when occurring concurrently, create a separate hazard apart from damage to ship, pipelines, hoses or jetty arms occurring on the fast closing of the valves. Valves will be fitted with restrictors to ensure slow closing.

The functional test will be an end to end test with a simulated independent high high level derived from the level switch. The switches cannot be fixed in the override position.

On activation of a independent high high switch, the operating procedures will ensure that the transfer is terminated before carrying out a check on the system. An assessment of the human response time, to check that on an SIS trip the correct action has occurred, is required to be carried out during commissioning.

New procedures will be developed with auditable actions to ensure that on activation of the SIS, the import from ship or pipeline is immediately stopped. It will also be necessary to check that the correct valves have closed, and flow has ceased as required by the Safety Instrument System

At present a mean time to repair of 72 hours will be assumed. If site conditions detect that this is not feasible, the calculation of the SIS will be reviewed.

2.2.3 Environmental Considerations

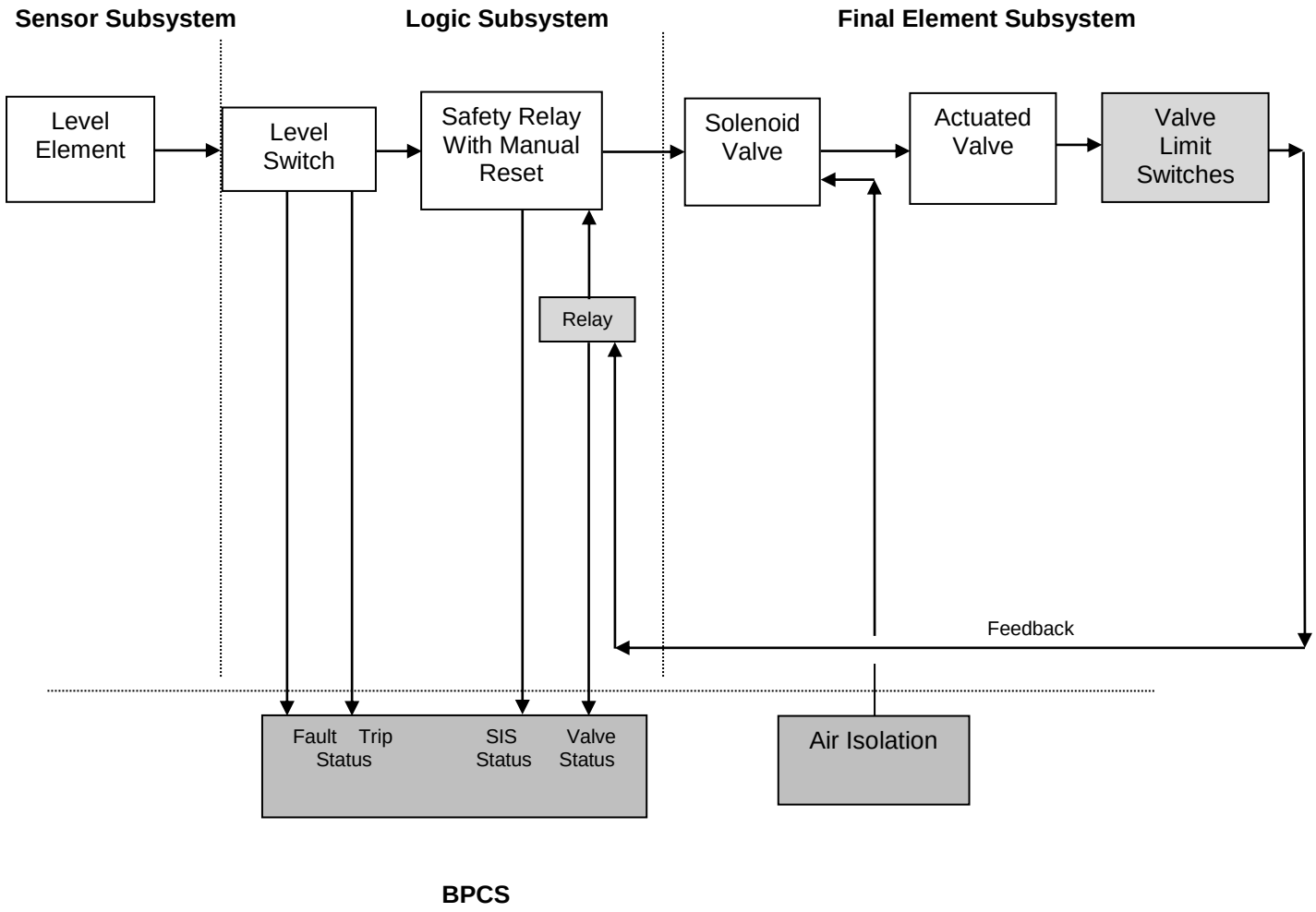
The system will be installed in mainland UK where it will not be subjected to extremes of temperature or humidity. The site is liable to flooding. The individual elements of the system are suitable for the duty and the site electrical area classification.

All valves will be specified as fire-safe. All elements will fail safe.

2.3 System Structure

2.3.1 System Model – No. 4 East Tanks

Tanks 561, 564 & 568.
The SIF is based upon a 1oo1 (single) sensor, 1oo1 (single) logic solver and 1oo1 final element with no redundancy.



Note 1: Shaded areas do not affect safety function
Note 2: New System models will be developed for future phases of the SIS

2.4 Definitions and Abbreviations

The following details the definitions and abbreviations used in this document.

BPCS	Basic Process Control System – Existing tank gauging system
Final Element	Part of the SIS which implements the action necessary to achieve a safe state, e.g. shut off valve
G.R.	General Requirements of the SRS (See Section 2)
LOPA	Layers of Protection Analysis
Logic Solver	Part of the SIS that performs one or more logic functions, e.g. safety relay, trip amplifier
Proof Test	Periodic testing to detect failures in a safety instrumented system
Protection Layer	A mechanism that reduces risk by control, prevention or mitigation
Sensor	Part of the SIS which measures the process condition
SIF	Safety instrumented function – An E/E/PE function with a specified safety integrity level which is necessary to achieve functional safety
SIL	Safety integrity level – A numerical number, 1 to 4 stipulating the level of integrity the system shall perform to, 1 being the lowest 4 the highest
SIS	Safety Instrument System – A SIS comprises of sensors, logic solvers and final elements
1ooN	SIS made up of N independent channels, which are so connected, that any single channel is sufficient to perform the correct safety instrumented function
2ooN	SIS made up of N independent channels, which are so connected, that any two of the channels are required to perform the correct safety instrumented function
MTBF	Mean Time Between Failures
PFD	Probability of Failing on Demand

3.0 General Requirements

The following are general requirements specific to this SIS for prevention of tank overfill.

All safety Instrument functions shall be designed as follows:

- De-energise to trip.
- Shall operate as a low demand mode system with demands placed on the system from operations no more frequently than once every 10 years.
- Generally in accordance with all the requirements laid down in the standard BS EN 61511.
- The response time shall be determined for each storage tank with consideration given to the import rate and air supply pressure as well as surge pressures created by the closing of the valves.
- There shall be no conceivable individually safe process states which, when occurring concurrently, can create a separate hazard.
- Auto Reset, after high high level activation, of the final element shall not be possible.
- The level sensors shall have diagnostics and fault detection on all tanks.
- Dominant failure modes of any device shall be to the safe state. The safe state is with the import valves closed and no flow into the storage tank.
- To carry out its design function on loss of electric power or air.
- Mean time to repair shall be 72 hours or less.
- Valves and actuators will be designed for the following:
    - Adequate margin of safety factor shall be provided for actuators on valves (torque need to be high enough), nominally 50% over sizing.
    - Import isolation valves do not need to be tight shut off, but be adequate to stop dangerous flow as well as conforming to antistatic and fire safe requirements.

This system will be installed in mainland UK where it will not be subjected to extremes of temperature or humidity. We do not consider that *grounding, electromagnetic interference/radiofrequency interference (EMI/RFI), shock, vibration, electrostatic discharge, flooding or lightning* will have a detrimental effect on the SIS. The system is designed to fail safe on any loss of electrical power. The individual elements of the system shall be designed for the process and operating conditions, the environment and the site electrical area classification. Specifically, all wetted parts should be suitable for Petroleum Spirit.

4.0 Functional Requirements

4.1 No. 4 East Tanks

4.1.1 SIS Inputs

1. Tank Level Switch Elements
    a. LE56101 - Tank 561 High High Level Switch
    b. LE56401 - Tank 564 High High Level Switch
    c. LE56801 - Tank 568 High High Level Switch

2. Valve closed position – Diagnostic feedback and reset permissive.
    a. ZSC56101 - Tank 561 XV56101 Import/Export Valve Closed Limit
    b. ZSC56401 - Tank 564 XV56401 Import/Export Valve Closed Limit
    c. ZSC56801 - Tank 568 XV56801 Import/Export Valve Closed Limit

3. Valve open position – Diagnostic feedback.
    a. ZSC56101 - Tank 561 XV56101 Import/Export Valve Closed Limit
    b. ZSC56401 - Tank 564 XV56401 Import/Export Valve Closed Limit
    c. ZSC56801 - Tank 568 XV56801 Import/Export Valve Closed Limit

4. Manual Shutdown Inputs
    a. Site ESD
    b. Tank 561
    c. Tank 564
    d. Tank 568

5. Manual Reset Pushbutton/Remote Input
    a. Common reset relays operated by a panel pushbutton or remote input

4.1.2 SIS Logic Solvers

a) Safety Relay with feedback verification before reset.
    a. Tank 561 Safety Relay
    b. Tank 564 Safety Relay
    c. Tank 568 Safety Relay

4.1.3 SIS Outputs

1. Solenoid valves
    a. SOV56101 - Tank 561 XV56101 Import/Export Solenoid Valve
    b. SOV56401 - Tank 564 XV56401 Import/Export Solenoid Valve
    c. SOV56801 - Tank 568 XV56801 Import/Export Solenoid Valve

2. Ball valve with air fail closed, spring return actuator
    a. XV56101 - Tank 561 Import/Export Valve
    b. XV56401 - Tank 564 Import/Export Valve
    c. XV56801 - Tank 568 Import/Export Valve

4.2 Interface between the SIS and BPCS

There is no existing control system. In future a control system including PLC control of valve operation and SCADA display and monitoring may be installed. The SIS will be totally independent from any future BPCS. The SIS will be designed to provide any future BPCS with the following to advise status and for external diagnostics of the SIS. They have no impact on the SIS and are for information and alarm only.

1. Status of safety relays – volt free contact closed on system healthy.
2. Valve position – volt free contacts for closed and open status.

There are locally mounted pneumatic switches used for opening and closing the tank-side actuated valves for the No. 4 East Tanks however, the solenoid valve connected to the Safety Instrument System allows the air supply to all actuated valves to be vented, on a independent high high level or on activation of the 4 East Crash stop, regardless of the position of the locally mounted pneumatic switch.

There is a possibility for future operation of the valves from the BPCS, but this will not impair the safety function of the valve, nor will it increase the demand rate of the SIF as the valve will only be operated prior to and at the end of a transfer.

5.0 SIF Requirements

5.1 Tank 561 High High Level

ID:	TK561 -SIF1	Service: LE56101 Independent High High Level in Tank 561 shuts down: XV56101 Tank-side Import/Export valve
Reference:	Tank 561	
Required SIL:	2	
Proof Test Interval:	1 year	
Response Time:	Sensor and Logic Solver < 2seconds Final Element – Trip initiation to valve closed < 180 Seconds, Valve traveling Time > 90 Seconds	
Activation Method:	De-energise to trip (See G.R.)	
Manual reset:	Manual Reset on the SIS panel (See G.R.)	
Nuisance Trip Requirements:	ISCo to approve	Safe State: Import to tank 561 stopped, XV56101 Tank-side Import/Export valve closed
Diagnostics:	Required, at Nivotester within the SIS monitoring panel	
Manual Shutdown:	At the valve, remotely outside bund and via 4 East Crash Stop	
Regulatory Reqs:	BS-EN61511	
Process Setpoint:	>5 minutes before Overflow at Max fill rate	

5.2 Tank 564 High High Level

ID:	TK564-SIF1	Service: LE56401 Independent High High Level in Tank 564 shuts down: XV56401 Tank-side Import/Export valve
Reference:	Tank 564	
Required SIL:	2	
Proof Test Interval:	1 year	
Response Time:	Sensor and Logic Solver < 2seconds Final Element – Trip initiation to valve closed < 180 Seconds, Valve traveling Time > 90 Seconds	
Activation Method:	De-energise to trip (See G.R.)	
Manual reset:	Manual Reset on the SIS panel (See G.R.)	
Nuisance Trip Requirements:	ISCo to approve	Safe State: Import to tank 564 stopped, XV56401 Tank-side Import/Export valve closed
Diagnostics:	Required, at Nivotester within the SIS monitoring panel	
Manual Shutdown:	At the valve, remotely outside bund and via 4 East Crash Stop	
Regulatory Reqs:	BS-EN61511	
Process Setpoint:	>5 minutes before Overflow at Max fill rate	

5.3 Tank 568 High High Level

ID:	SIF-013	Service: LE56801 Independent High High Level in Tank 568 shuts down: XV56801 Tank-side Import/Export valve
Reference:	Tank 568	
Required SIL:	2	
Proof Test Interval:	1 year	
Response Time:	Sensor and Logic Solver < 2seconds Final Element – Trip initiation to valve closed < 180 Seconds, Valve traveling Time > 90 Seconds	
Activation Method:	De-energise to trip (See G.R.)	
Manual reset:	Manual Reset on the SIS panel (See G.R.)	
Nuisance Trip Requirements:	ISCo to approve	Safe State: Import to tank 568 stopped, XV56801 Tank-side Import/Export valve closed
Diagnostics:	Required, at Nivotester within the SIS monitoring panel	
Manual Shutdown:	At the valve, remotely outside bund and via 4 East Crash Stop	
Regulatory Reqs:	BS-EN61511	
Process Setpoint:	>5 minutes before Overflow at Max fill rate	

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IMMINGHAM STORAGE Co LTD

IMMINGHAM EAST TERMINAL

IME-SIS1

SAFETY INSTRUMENT SYSTEM

Rev	Date	By	Checked	Approved	Description	Client Ref.
A	16.11.08	D.S.Regan	DRR	DRR	Original Issue	
B	18.02.09	D.S.Regan	DRR	DRR	Revised with extra tanks	
C	24.02.11	D.S.Regan	MM	PJP	Tank 709 removed, SIS modified following client discussions	
D	29.06.12	D.S.Regan	DBF	DSR	Following Stage 3 FSA	Document No. **SI277001_RPT**
E	19.06.13	D.B.Faulkner	DSR	DSR	XV56701 Installed	
F	31.10.14	D.B.Faulkner	DSR	ISCo	Scope reduced to Tanks 561, 564 & 568	

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Contents

Appendices

1 REVISION HISTORY

Rev	Description
A	Original Issue – Modification requested, assessed and initiated
B	Revised with extra tanks
C	Tank 709 removed, SIS modified following client discussions
D	Following Stage 3 FSA Pipeline Valves Declassified as SIS
E	Tank-side Valve XV56701 Installed

2 SCOPE

This document has been prepared for the Safety Instrumented System IME-SIS1 to reflect the life cycle of the SIS in accordance with BS EN 61508 & BS EN 61511 and to be a working document throughout the life cycle of the SIS.

SCOPE

Client / Company	-	Immingham Storage Co Ltd
Location / Facility	-	ISCo East Terminal
Plant Unit	-	Tanks 561, 564 & 568
Service	-	No4 East Storage Tank Overfill Protection
SIS Tag No	-	IME-SIS1
SIF's Tag No's	-	TK561-SIF1, TK564-SIF1 & TK568-SIF1
SIL	-	2

3 DEFINITIONS AND ABBREVIATIONS

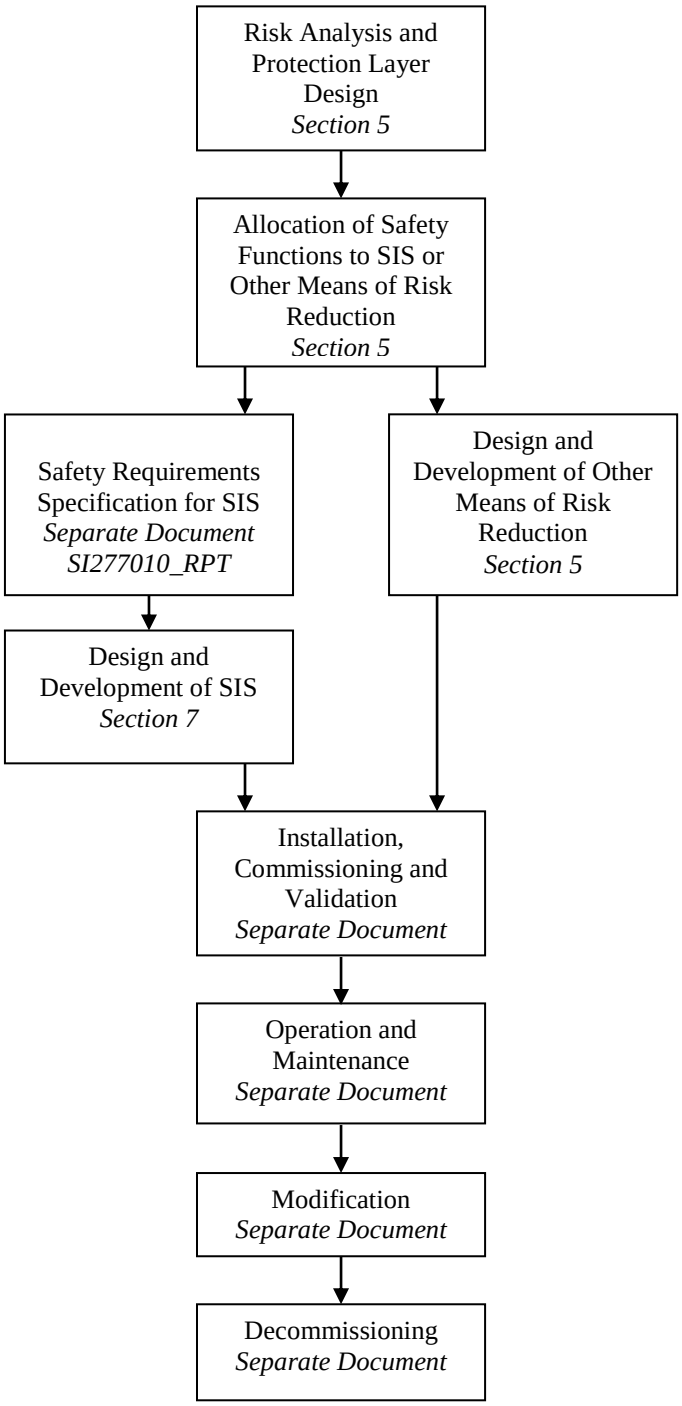
The following details the definitions and abbreviations used in this document.

BPCS	Basic Process Control System
Final Element	Part of the SIS which implements the action necessary to achieve a safe state, e.g. shut off valve
HAZOP	Hazard and Operability Study
Logic Solver	Part of the SIS that performs one or more logic functions, e.g. safety relay, trip amplifier
Proof Test	Periodic testing to detect failures in a safety instrumented system
Protection Layer	A mechanism that reduces risk by control, prevention or mitigation
Sensor	Part of the SIS which measures the process condition
SIF	Safety instrumented function – An E/E/PE function with a specified safety integrity level which is necessary to achieve functional safety
SIL	Safety integrity level – A numerical number, 1 to 4 stipulating the level of integrity the system shall perform to, 1 being the lowest 4 the highest
SIS	Safety Instrument System – A SIS comprises of sensors, logic solvers and final elements
1ooN	SIS made up of N independent channels, which are so connected, that any single channel is sufficient to perform the correct safety instrumented function
2ooN	SIS made up of N independent channels, which are so connected, that any two of the channels are required to perform the correct safety instrumented function
MTBF	Mean Time Between Failures
PFD	Probability of Failing on Demand

4 SAFETY LIFE CYCLE

A SIS requires to be auditable throughout each stage of its cycle. It is necessary not just at the conceptual and design stage but also at operational and maintenance stages.

The following figure details the life cycle, the section numbers in italics relate to this document:



5 RISK ANALYSIS AND ALLOCATION OF SAFETY FUNCTIONS

A LOPA Risk Assessment was conducted on a possible, future Gasoline Import and storage facility on 31st January 2007, it was revisited in February, August 2007 and July 2010. The outcome of the assessment showed a shortfall in protection of SIL1. It was decided however, due to commonality throughout the ISCo sites, to incorporate a mid-range SIL 2 Safety Instrumented System.

Document SI057001_RPT details this assessment.

Following the issue of the PSLG guidelines on LOPA, it was decided that there was no point in revisiting the LOPA and revising it in accordance with PSLG, as it would not be possible to provide the data in sufficient detail as the facility currently does not store gasoline. However, as part of a terminal upgrade in overfill protection, it was decided to design, procure and install all instrument equipment/items on their ability to demonstrate suitability for a SIL2 system design.

5.1 Interpretation of SIL Levels

The following figure provides an interpretation of SIL levels with reference to Probability of Failing on Demand, availability and risk reduction factors.

Safety Integrity Level	Probability of failure on demand	Availability %	Non Availability Continuous Demand	Risk Reduction Factor
SIL 1	**0.1 to 0.01**	**90 to 99%**	**876 to 87.6 hours/year**	**10 – 100**
SIL 2	**0.01 to 0.001**	**99 to 99.9%**	**87.6 to 8.76 hours/year**	**100 - 1000**
SIL 3	**0.001 to 0.0001**	**99.9 to 99.99%**	**8.76 to 0.876 hours/year**	**1000 - 10000**
SIL 4	**0.0001 to 0.00001**	**99.99 to 99.999%**	**52 to 5.2 minutes/year**	**>10000**

6 SPECIFICATION OF SAFETY INSTRUMENT SYSTEM

6.1 Safety Instrumented Function

The Safety Instrument Functions are to prevent overfill of the storage tanks. See Safety Requirement Specification SI227010_RPT.

The fixed roof tanks (No. 4 East) will have actuated import or import/export valves which will automatically close on the activation of the high level switch for that particular tank. The following valves are included in the design:

XV56101	Tank 561 Import/Export Valve
XV56401	Tank 564 Import/Export Valve
XV56801	Tank 568 Import/Export Valve

The No. 4 East tanks are designated as 561, 564 & 568.

All tank-side actuated valves will also close on activation of the 4 East Crash Stop, on activation of that tank's high high level switch or on activation of an individual tank isolation pushbutton for any of the above tanks, installed outside the bunds.

There will be an SIS monitoring panel installed in a new switchroom. The SIS monitoring panel will be designed for all phases of the complete SIS installation. Alarm and Status data has been allowed for transmission to the control room in the future.

The Safety Instrument function will operate as a demand mode system with demands placed on the SIS of no greater than one event in ten years. This demand rate has been conservatively determined from the calculations in the LOPA and is backed up by site experience in the operation of existing high high alarms, where existing records demonstrate the frequency as conservative.

The Safety Instrument System will be a hardwired logic system utilising analogue and digital switches and safety relays.

As the import process is performed on a batch basis, no specific requirements requiring 1oo2, 2oo2 systems or specific requirements regarding nuisance tripping are considered necessary.

Immingham Storage Company will confirm the acceptability of the calculated spurious trip rate after the SIS PFD is calculated.

Common cause failure is not normally a consideration on non-redundant systems with the valves operated periodically. However, failures that could conceivably lead to a dangerous state would be the pipeline import valves failing to close in the event of a high high level switch activation. Each valve is a simple valve actuated with a pneumatic spring return actuator. A common cause failure of electrical power or air supply would lead to all valves closing. Further failures which could lead to the valve failing to danger is air which is saturated with water with the possibility of freezing in the exhaust of the actuator vent restrictor or dirt clogging up the solenoid vent.

In this design, there will be no conceivable individually safe process states which, when occurring concurrently, create a separate hazard apart from damage to ship, pipelines, hoses or jetty arms occurring on the fast closing of the valves. Valves will be fitted with restrictors to ensure slow closing.

The functional test will be an end to end test with a simulated high level derived from the level switch. The switches cannot be fixed in the override position.

On activation of a high high switch, the operating procedures will ensure that the transfer is terminated before carrying out a check on the system. An assessment of the human response time, to check that on an SIS trip the correct action has occurred, is required to be carried out during commissioning.

New procedures will be developed with auditable actions to ensure that on activation of the SIS, the import from ship or pipeline is immediately stopped. It will also be necessary to check that the correct valves have closed, and flow has ceased as required by the Safety Instrument System

At present a mean time to repair of 72 hours will be assumed. If site conditions detect that this is not feasible, the calculation of the SIS will be reviewed.

6.1.1 Environmental Considerations

The system will be installed in mainland UK where it will not be subjected to extremes of temperature or humidity. The site is liable to flooding. The individual elements of the system are suitable for the duty and the site electrical area classification.
All valves will be specified as fire-safe. All elements will fail safe.

6.2 Interface between the SIS and BPCS

There is no existing control system. In future a control system including PLC control of valve operation and SCADA display and monitoring may be installed. The SIS will be totally independent from any future BPCS. The SIS will be designed to provide any future BPCS with the following to advise status and for external diagnostics of the SIS. They have no impact on the SIS and are for information and alarm only.

1. Status of safety relays – volt free contact closed on system healthy.
2. Valve position – volt free contacts for closed and open status.

There are locally mounted pneumatic switches used for opening and closing the tank-side actuated valves for the No. 4 East Tanks however, the solenoid valve connected to the High Level Safety Instrument System allows the air supply to all of the actuated valves to be vented, closing the valves on a high high level or on activation of the 4 East Crash stop, regardless of the position of the locally mounted pneumatic switch.
There is a possibility for future operation of the valves from the BPCS, but this will not impair the safety function of the valve, nor will it increase the demand rate of the SIF as the valve will only be operated prior to and at the end of a transfer.

6.3 Operation

The Safety Instrument Functions (SIF) are to prevent overfill of the storage tanks.

6.3.1 No. 4 East Tanks

There are six possible import routes. Although there are six pipelines, a batch import process to any particular tank will only use a single pipeline. As there is no process control system which confirms the route, this design will operate by closing the tank-side import valve on the tank high high alarm activation.

For the No.4 East tanks, on detection of a tank high high level, fault or power supply failure, the output will be removed to the actuator on that tank's import valve, resulting in the ball valve closing. The valve cannot be re-opened until the high high level, fault or power supply failure are returned to a healthy state. Then on operation of a momentary reset pushbutton (one on the SIS panel plus facility for remote operation) the actuated ball valve will open (if selected to open at local pneumatic control station).

There is no requirement to override this SIF in the event of an activation of the high high level switch as there is a dedicated export route using hoses under management procedures which will allow for product to be removed from the tank. Management controlled use of this is described elsewhere.

The valves will be operated, cycled, periodically on a monthly basis. This will provide a form of regular stroke testing. Taking this into consideration, and the fact that only one valve will be open to allow import to any one tank, the SIS shall be designed as a 1oo1 system throughout, providing all clauses of BS EN 61511 are satisfied.

6.4 Functional Requirements - No. 4 East Tanks (Fixed Roof)

6.4.1 SIS Inputs

1. Tank Level Switch Elements
    a. LE561 Tank 561 High High Level Switch
    b. LE564 Tank 564 High High Level Switch
    c. LE568 Tank 568 High High Level Switch

2. Valve closed position – Permissive only for feedback purposes.
    a. ZSC56101 Tank 561 Import/Export Valve
    b. ZSC56401 Tank 564 Import/Export Valve
    c. ZSC56801 Tank 568 Import/Export Valve

3. Manual Reset Pushbutton/Remote Input
   Common reset relays operated by a panel pushbutton or remote input

6.4.2 SIS Logic Solvers

a) Safety Relay with feedback verification before reset.
    a. R250 :- Reference Drawing SI483009_DWG
    b. R330 :- Reference Drawing SI483010_DWG
    c. R410 :- Reference Drawing SI483011_DWG

6.4.3 SIS Outputs

1. Solenoid valves
    a. SOV56101 Tank 561 Import/Export Solenoid Valve
    b. SOV56401 Tank 564 Import/Export Solenoid Valve
    c. SOV56801 Tank 568 Import/Export Solenoid Valve

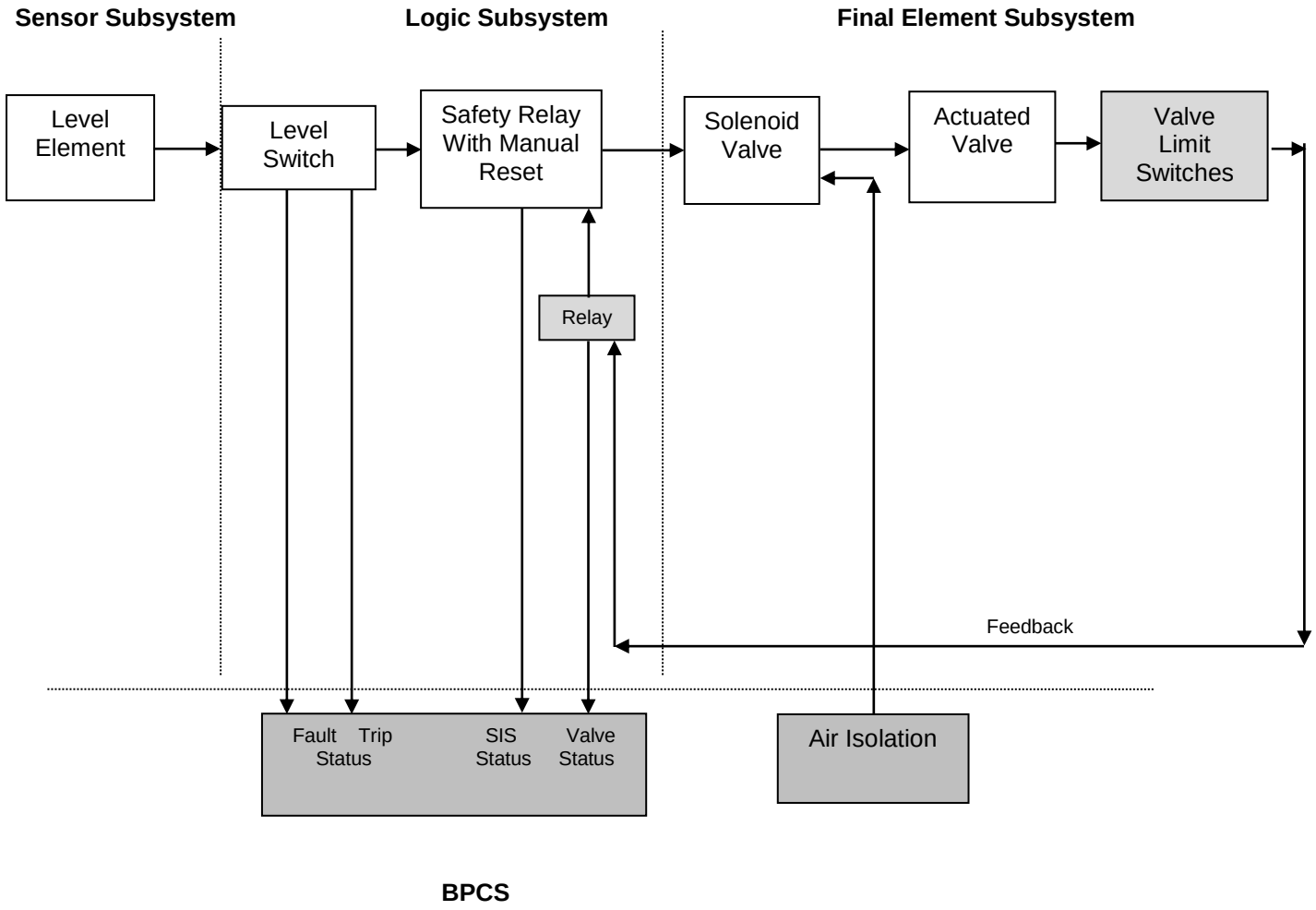
2. Ball valve with closed air fail, spring return actuator
    a. XV56101 Tank 561 Import/Export Valve
    b. XV56401 Tank 564 Import/Export Valve
    c. XV56801 Tank 568 Import/Export Valve

7 DESIGN & DEVELOPMENT OF SIS

7.1 System Structure

7.1.1 System Model – No. 4 East Tanks

Tanks 561, 564 & 568.
The SIF is based upon a 1oo1 (single) sensor, 1oo1 (single) logic solver and 1oo1 final element with no redundancy (note only one valve is routed to the import).



Note 1: Shaded areas do not affect safety function
Note 2: New System models will be developed for future phases of the SIS

7.2 Safety Instrumented Function – No 4 East Tanks

7.2.1 Sensor Sub-System

The Sensor sub-system comprises of an Endress & Hauser FTL51 Liquiphant with FEL57 2 wire PFM electronic insert. The instrument is ATEX certified II1/2G EExia IIC T6 and has been subjected to approval to BS EN61508 for use in SIL1/2 applications.

7.2.1.1 Sensor Suitability

The tanks contain Gasoline at atmospheric conditions. The materials of construction of the level probe and process flange is 316L stainless steel, of which Gasoline has no chemical effect. The level element is flanged 150lb top mounted so there is no risk of product release from the instrument tapping.
When the level element is fitted with the FEL57 electronic insert communicating with a safe area mounted Nivotester FTL325P then the system is self checking for line monitoring through to the sensor, corrosion monitoring on the tuning fork and power failure to the Nivotester. On detection of any of the above conditions the output contacts fail open, hence providing a fail safe output to the logic solver and the alarm contacts fail close, providing indication to the BPCS diagnostics

7.2.1.2 Sensor Subsystem PFD

For 1oo1 Architecture including 3 channel Nivotester and Liquiphant - Max mode and Density setting 0.7, Endress and Hauser supply the following figures:

Configuration 4 – FEL 57 with Nivotester FTL325P as three channel device in single channel mode

$\lambda_{SD} = 1.37 \times 10^{-7}$
$\lambda_{SU} = 4.57 \times 10^{-7}$
$\lambda_{DD} = 3.38 \times 10^{-10}$
$\lambda_{DU} = 5.57 \times 10^{-8}$

Safe fail fraction 91%
MTTR 72 hours
Functional Test with test key – Annually
Complete function test. e.g. by approaching level – Not required within normal life

Source: E & H Functional Safety Manual SD231F/00/en/ See Appendix 1

Calculated value of PFD of 2.48×10^{-4} meets the requirements of SIL2.

7.2.1.3 Sensor Subsystem Hardware Fault Tolerance

BS EN 61511-1:2003 Section 11.4 requires a minimum hardware fault tolerance.

Table 6 of the standard is reproduced below:

SIL	Minimum hardware fault tolerance (see 11.4.3 and 11.4.4)
1	0
2	1
3	2
4	Special requirements apply

BS EN 61511-1:2003 Section 11.4.3 states that the fault tolerance in the above table should be increased by 1, unless the dominant failure mode is to the safe state or dangerous failures are detected.

In this application the logic solver (Nivotester) provides a continuous check of these events and will cause the system to fail safe. Therefore, the fault tolerance has not been increased by 1.

BS EN 61511-1:2003 Section 11.4.4 states that the fault tolerance in the above table can be reduced by 1 if the hardware complies with the following:

- The hardware of the device is selected on the basis of prior use
- The device allows adjustment of process related parameters only. i.e. measuring range, upscale and downscale failures.
- The adjustment of the process related parameters is protected either by jumper or password.
- The function has a SIL requirement of less than 4.

In this application the above requirements are true for each sensor subsystem and a reduction of 1 applies.

As a cross check, the clause of hardware fault tolerance from BS EN 61508 has been applied. BS EN 61508-2:2010 Section 7.4.3 requires architectural constraints on hardware safety integrity.

Table 3 of the standard is reproduced below:

Table 3 – Hardware safety integrity: architectural constraints on type B safety-related subsystems

Safe fail Fraction	Hardware fault tolerance		
	0	1	2
< 60 %	Not allowed	SIL 1	SIL 2
>60 % < 90 %	SIL 1	SIL 2	SIL 3
90 % - < 99 %	SIL 2	SIL 3	SIL 4
≥99 %	SIL 3	SIL 4	SIL 4

NOTE 1: This table, in association with 7.4.4.2.1 and 7.4.4.2.2 is used for the for the determination of the maximum SIL that can be claimed for a subsystem given the fault tolerance of the subsystem and the SFF to the elements used.

i. For general application to any subsystems see 7.4.4.2.1

ii. For application to subsystems comprising elements that meet the specific requirements of 7.4.4.2.2. To claim that a subsystem meets a combined SIL directly from this table it will be necessary to meet all the requirements in 7.4.4.2.2

NOTE 2: This table, in association with 7.4.4.2.1 and 7.4.4.2.2 can also be used:

i. For the determination of the hardware fault tolerance requirements for a subsystem given the required SIL of the safety function and the SFFs of the elements to be used.

ii. For the determination of the SFF requirements for elements given the required SIL of the safety function and the hardware fault tolerance of the subsystem.

NOTE 3: The requirements in 7.4.4.2.3 and 7.4.4.2.4 are based on the data specified in this table and Table 2.

NOTE 4: See Annex C for details of how to calculate safe failure fraction.

NOTE 5: When using 7.4.4.2.1 for the combination of type B elements, with a hardware fault tolerance of 1, in which both elements have a safe fail fraction of less than 60%, the maximum allowable safety integrity level for a safety function carried out by the combination is SIL 1.

The above references in table 3 refer to BS EN 61508-2:2010

This level device is classified as a type B Device with a safe fail fraction of 91% (See Appendix 1).

Thus for a SFF of >90% and a hardware fault tolerance of 0 allows for this single sensor to be used as a 1oo1 sensor for a SIL2 application.

7.2.1.4 Sensor Subsystem Summary

From the enclosed calculations and fault tolerance checks the sub-system meets the requirements of > SIL 1 with a PFD_{AV} of 2.48×10^{-4}

Proof Test interval via operation of Nivotester Test Key – Annually
It is also advised although not required (according to manufacturer) to perform a functional check by immersing the liquiphant in product at an interval probably in line with vessel inspections.

Document SI277003.RPT details Testing Procedures.

7.2.2 Logic Solver

The Logic Solver function is performed in combination via the output of the Endress & Hauser Nivotester and the PILZ safety relay.

The inputs and outputs have been detailed in Section 6.

There are no Input or Output overrides to the system and reset is manual following feedback confirmation that the inlet valve is proved closed.

As the Liquiphant and Nivotester are certified together, the calculation of functional safety for the Nivotester has been included in the sensor sub-system.

7.2.2.1 Safety Relay

The chosen relay is PNOZ S2 which has the following safety requirements:

- The circuit is redundant with built in self monitoring.
- The safety function remains effective in the case of component failure.
- The correct opening and closing of the safety function is tested automatically in each on-off cycle.
- Electronic fuse.

The relay has the following features:

- 3 positively guided normally open safety contacts.
- Status indicators.
- Feedback control loop for monitoring of external switches.
- Feedback control loop in series with reset circuit.

The relay is also fail safe on power failure i.e. safety contacts normally open.

From the Pilz Safety Relay Type PNOZ S2 Internal safety Integrity Details, the PFD is taken as 4.0×10^{-6}.

7.2.2.2 Logic Solver Function

The Endress & Hauser Nivotester monitors the signal from the Endress & Hauser level element and on detection of a high level or fault open circuits the output contact. This contact is wired into the input circuit of the safety relay, which continually monitors the status of the input. Upon open circuit the safety relay de-energises its safety contacts, hence removing the signal to the final element.

Once the level has fallen below the level element the Nivotester will automatically make its output contact. However, in order to reset the safety relay it is necessary that the feedback circuit is closed (valve closed limit switch made), if it is, then operation of the manual reset facility will cause the safety relay to re-energise its outputs, providing a signal to the solenoid valve. Operation of the reset without the feedback circuit being closed will not allow the safety relay to re-energise.

7.2.2.3 Logic Solver Subsystem Hardware Fault Tolerance

BS EN 61511-1:2003 Section 11.4 requires a minimum hardware fault tolerance.

Table 6 of the standard is reproduced below:

SIL	Minimum hardware fault tolerance (see 11.4.3 and 11.4.4)
1	0
2	1
3	2
4	Special requirements apply

BS EN 61511-1:2003 Section 11.4.3 states that the fault tolerance in the above table should be increased by 1, unless the dominant failure mode is to the safe state or dangerous failures are detected.

The Safe fail Fraction of the Relay is 95% thus the dominant failure mode is to the safe state. Therefore, the fault tolerance has not been increased by 1

BS EN 61511-1:2003 Section 11.4.4 states that the fault tolerance in the above table can be reduced by 1 if the hardware complies with the following:

- The hardware of the device is selected on the basis of prior use
- The device allows adjustment of process related parameters only. i.e. measuring range, upscale and downscale failures.
- The adjustment of the process related parameters are protected either by jumper or password.
- The function has a SIL requirement of less than 4.

In this application the above requirements are true and a reduction of 1 applies thus a single device can be used.

Comparatively, BS IEC 61508-2:2010 Section 7.4.3 requires architectural constraints on hardware safety integrity.

Table 2 of the standard is reproduced below:

Table 2 – Hardware safety integrity: architectural constraints on type A safety-related subsystems

Safe fail Fraction	Hardware fault tolerance		
	0	1	2
< 60 %	SIL 1	SIL 2	SIL 3
>60 % < 90 %	SIL 2	SIL 3	SIL 4
90 % - < 99 %	SIL 3	SIL 4	SIL 4
≥99 %	SIL 3	SIL 4	SIL 4

NOTE 1: This table, in association with 7.4.4.2.1 and 7.4.4.2.2 is used for the for the determination of the maximum SIL that can be claimed for a subsystem: given the fault tolerance of the subsystem and the SFF to the elements used.

i. For general application to any subsystems see 7.4.4.2.1

ii. For application to subsystems comprising elements that meet the specific requirements of 7.4.4.2.2. To claim that a subsystem meets a combined SIL directly from this table it will be necessary to meet all the requirements in 7.4.4.2.2

NOTE 2: This table, in association with 7.4.4.2.1 and 7.4.4.2.2 can also be used:

i. For the determination of the hardware fault tolerance requirements for a subsystem given the required SIL of the safety function and the SFFs of the elements to be used.

ii. For the determination of the SFF requirements for elements given the required SIL of the safety function and the hardware fault tolerance of the subsystem.

NOTE 3: The requirements in 7.4.4.2.3 and 7.4.4.2.4 are based on the data specified in this table and Table 2.

NOTE 4: See Annex C for details of how to calculate safe failure fraction.

The above references in table 2 refer to BS EN 61508-2:2010

The Pilz relay is considered to be a type A Device with safe fail fraction of 95% (See Appendix 2).

Thus this satisfies the requirements of BS EN 61511 and BS EN 61508 fault tolerance criteria for a 1oo1 configuration for a SIL2 application.

7.2.3 Final Element Subsystem

The final element sub-system comprises an electrically operated, spring return solenoid valve and a air operated spring return pneumatic actuator mounted onto a 90° ball valve. Failure mode is that the valve will close on loss of electric or pneumatic signal. The solenoid is EExd certified.

The tanks may contain gasoline at atmospheric conditions. The materials of construction of the valve is carbon steel with 316L stainless steel ball, on which the stored product has no chemical effect. The range of specific gravities for the materials to be stored in the tanks is from 0.798 to 1.2.

The system is a 1oo1 configuration and currently the valve is not utilised as part of the BPCS.

7.2.3.1 Solenoid Valves

The solenoid valves utilised are manufactured by Seitz certified to AK-7/SIL 4.

For a 1oo1 configuration, from the attached calculation (Section 7.2.3.6) it can be seen that a typical value for the PFD, with a proof test interval of 365 days and a MTTR of 72 hours, for a seitz CP 0632….oH solenoid valve is 1.02×10^{-6}. The safe fail fraction for the solenoid valve is 99%

This value provides a safety integrity level of > SIL 2.

The valve components have been proven to have a very high reliability. However a concern of failure is the requirement of a clean, water free Air supply to ensure no freezing or debris enters the valve, and as such it is recommended to install individual filters with automatic drains to the solenoid valve.

7.2.3.2 Actuated Import Valves

The valves are fitted with open and closed limit switches and the logic solver checks that the valves have completely closed following each operation prior to system reset.

The valves utilised are standard, full bore ball valves manufactured to internationally recognised standards. Valves from different manufacturers have been used reliably for many years at the terminal. The valves supplied for this SIS are trunnion ball valve type. As this valve is to be utilised in a SIS it has been specified with an oversize actuator to ensure effective closing.

The actuator is fitted with a vent restrictor for slow closing, this is important, as if the valve slammed shut, the consequences to the import line and ship could be considerable. It must be ensured that the slow closing restrictor is protected against un-authorised adjustment, resulting in the valve being unable to vent and therefore not closing.

The speed of closing the valve is to be set such that following operation of the high level SIF, the product entering the tank, during the closing time, cannot overspill.

Maximum Import flow rate 500 m^3/hr
Slow closing time of valve : 3 minutes (based on surge calculations requirement of 75 seconds minimum, therefore desired closing time to be set at 90 seconds plus allowance for actuator venting time before valve starts to move)
Max additional capacity imported during 3 minutes : 25 m^3

Tank 561

	Capacity(m^3)	Level(mm)
Maximum Capacity	3229	7145
Level switch operation :97% of tank capacity	3139	6931
Capacity remaining in tank after high high level activated	90	
Time to overfill after high high level activated	10.8 minutes	

Tank 564

	Capacity(m^3)	Level(mm)
Maximum Capacity	5513	8950
Level switch operation :97% of tank capacity	5348	8682
Capacity remaining in tank after high high level activated	165	
Time to overfill after high high level activated	19.8 minutes	

Tank 568

	Capacity(m^3)	Level(mm)
Maximum Capacity	5500	8930
Level switch operation :97% of tank capacity	5335	8662
Capacity remaining in tank after high high level activated	165	
Time to overfill after high high level activated	19.8 minutes	

PFD and MTBF data is available from a number of valve manufacturers and is tabulated in Appendix 4. Data relating to the failure of these valves has been provided, however no 3rd party approval for SIL rating has been carried out.

For a 1oo1 configuration, from the attached calculation (Section 7.2.3.6) it can be seen that a typical value for the PFD (based on Pekos Valves), with a proof test interval of 365 days and a MTTR of 72 hours, for a Floating Ball valve with soft seat (up to 8") with partial stroke testing in a 1oo1 configuration is 1.33×10^{-3} . The safe fail fraction for the ball valve is 81%. This is conservative compared with the data supplied by Neway (PFD = 4.67×10^{-5})

The Ball Valve section of the sub system meets the requirements of SIL2 with a PFD of $1.33 \times 10^{-3.}$

PFD and MTBF data is available from a number of actuator manufacturers and is tabulated in Appendix 5. The actuators used for this SIS on these tanks were manufactured Actreg who have provided SIL certification.
For a 1oo1 configuration, from the attached calculation (section 7.2.3.6) it can be seen that a typical value for the PFD (based on Emerson Actuators which is more conservative than the Actreg data), with a proof test interval of 365 days and a MTTR of 72 hours, for a spring return, pneumatic actuator with partial stroke testing is 7.09×10^{-4}. The safe fail fraction for the actuator is 73%. This figure will be used in the calculation

The actuator section of the sub system meets the requirements of SIL2 with a PFD of 7.09×10^{-4}.

The valves will be operated, cycled, periodically on a monthly basis. This will provide a form of regular stroke testing. The operations to open and close the valves will not affect the SIS and will not prevent the activation of the SIS.

7.2.3.3 Final Element Subsystem Hardware Fault Tolerance

BS EN 61511-1:2003 Section 11.4 requires a minimum hardware fault tolerance.

Table 6 of the standard is reproduced below:

SIL	Minimum hardware fault tolerance (see 11.4.3 and 11.4.4)
1	0
2	1
3	2
4	Special requirements apply

BS EN 61511-1:2003 Section 11.4.3 states that the fault tolerance in the above table should be increased by 1, unless the dominant failure mode is to the safe state or dangerous failures are detected.

In this application, for the valve, the dominant failure mode is to the safe state (Safe Fail Fraction = 81%). Therefore, the fault tolerance has not been increased by 1.

In this application, for the actuator, the dominant failure mode is to the safe state (Safe Fail Fraction = 73%). Therefore, the fault tolerance has not been increased by 1.

In this application, for the solenoid valve, the dominant failure mode is to the safe state (Safe Fail Fraction = 99%). Therefore, the fault tolerance has not been increased by 1.

BS EN 61511-1:2003 Section 11.4.4 states that the fault tolerance in the above table can be reduced by 1 if the hardware complies with the following:

- The hardware of the device is selected on the basis of prior use
- The device allows adjustment of process related parameters only. i.e. measuring range, upscale and downscale failures.
- The adjustment of the process related parameters is protected either by jumper or password.
- The function has a SIL requirement of less than 4.

In this application the above requirements are true for each final element subsystem and a reduction of 1 applies.

Comparatively, BS EN 61508-2:2010 Section 7.4.3 requires architectural constraints on hardware safety integrity.

Tables 2 & 3 of the standard are reproduced below:

Table 2 – Hardware safety integrity: architectural constraints on type A safety-related subsystems

Safe fail Fraction	Hardware fault tolerance		
	0	1	2
< 60 %	SIL 1	SIL 2	SIL 3
>60 % < 90 %	SIL 2	SIL 3	SIL 4
90 % - < 99 %	SIL 3	SIL 4	SIL 4
≥99 %	SIL 3	SIL 4	SIL 4

NOTE 1: This table, in association with 7.4.4.2.1 and 7.4.4.2.2 is used for the for the determination of the maximum SIL that can be claimed for a subsystem: given the fault tolerance of the subsystem and the SFF to the elements used.

iii. For general application to any subsystems see 7.4.4.2.1

iv. For application to subsystems comprising elements that meet the specific requirements of 7.4.4.2.2. To claim that a subsystem meets a combined SIL directly from this table it will be necessary to meet all the requirements in 7.4.4.2.2

NOTE 2: This table, in association with 7.4.4.2.1 and 7.4.4.2.2 can also be used:

iii. For the determination of the hardware fault tolerance requirements for a subsystem given the required SIL of the safety function and the SFFs of the elements to be used.

iv. For the determination of the SFF requirements for elements given the required SIL of the safety function and the hardware fault tolerance of the subsystem.

NOTE 3: The requirements in 7.4.4.2.3 and 7.4.4.2.4 are based on the data specified in this table and Table 2.

NOTE 4: See Annex C for details of how to calculate safe failure fraction.

The above references in table 2 refer to BS EN 61508-2:2010

The ball valve is considered to be a type A Device with safe fail fraction of 81% (See Appendix 4).

Thus this satisfies the requirements of BS EN 61511 and BS EN 61508 fault tolerance criteria for a 1oo1 configuration for a SIL2 application.

The actuator is considered to be a type A Device with safe fail fraction of 73% (See Appendix 5).

Thus, this satisfies the requirements of BS EN 61511 and BS EN 61508 fault tolerance criteria for a 1oo1 configuration for a SIL2 application.

Table 3 – Hardware safety integrity: architectural constraints on type B safety-related subsystems

Safe fail Fraction	Hardware fault tolerance		
	0	1	2
< 60 %	Not allowed	SIL 1	SIL 2
>60 % < 90 %	SIL 1	SIL 2	SIL 3
90 % - < 99 %	SIL 2	SIL 3	SIL 4
≥99 %	SIL 3	SIL 4	SIL 4

NOTE 1: This table, in association with 7.4.4.2.1 and 7.4.4.2.2 is used for the for the determination of the maximum SIL that can be claimed for a subsystem given the fault tolerance of the subsystem and the SFF to the elements used.

iii. For general application to any subsystems see 7.4.4.2.1

iv. For application to subsystems comprising elements that meet the specific requirements of 7.4.4.2.2. To claim that a subsystem meets a combined SIL directly from this table it will be necessary to meet all the requirements in 7.4.4.2.2

NOTE 2: This table, in association with 7.4.4.2.1 and 7.4.4.2.2 can also be used:

iii. For the determination of the hardware fault tolerance requirements for a subsystem given the required SIL of the safety function and the SFFs of the elements to be used.

iv. For the determination of the SFF requirements for elements given the required SIL of the safety function and the hardware fault tolerance of the subsystem.

NOTE 3: The requirements in 7.4.4.2.3 and 7.4.4.2.4 are based on the data specified in this table and Table 2.

NOTE 4: See Annex C for details of how to calculate safe failure fraction.

NOTE 5: When using 7.4.4.2.1 for the combination of type B elements, with a hardware fault tolerance of 1, in which both elements have a safe fail fraction of less than 60%, the maximum allowable safety integrity level for a safety function carried out by the combination is SIL 1.

The above references in table 3 refer to BS EN 61508-2:2010

The Solenoid valve is classified as a type B Device with a safe fail fraction of 99% (See Appendix 3).

Thus for a SFF of >90% and a hardware fault tolerance of 0 allows for this single solenoid valve to be used as a 1oo1 sensor for a SIL2 application.

7.2.3.4 Final Element (ESD Valves) Subsystem Summary

The combined PFD for the final element sub-system is $1.02 \times 10^{-6} + 7.09 \times 10^{-4} + 1.33 \times 10^{-3}$

From the enclosed calculations and fault tolerance checks (as detailed in Section 7.2.3.6) the sub-system and each individual element of the sub-system meet the requirements of >SIL 2 with a PFD_G of 2.04×10^{-3}

7.2.3.5 Overall System Summary

System PFD = Sensor Sub-System PFD+Logic Solver PFD+Final Element Sub-System PFD

System PFD = $(2.48 \times 10^{-4}) + (4.0 \times 10^{-6}) + (2.04 \times 10^{-3})$

System PFD = 2.3×10^{-3}

System Checks – each sub-system individually satisfies the requirements of > SIL 2 together with the combined PFD of 2.3×10^{-3} providing a combined > SIL 2.

7.2.3.6 PFD System Calculations – Spreadsheet Programme

P & I Design Ltd ***Probability of Failure on Demand (PFD) Summary***

www.pidesign.co.uk Version 5.6

Project:	Immingham East	Originator:	PP
Client:	Simon Storage	Checked:	DRR
Client Ref:	No.4 East Tanks	Approved:	DRR
Document:	SI277001.CAL	Issue:	C
SIS Number:		Date:	24/02/2011

SAFETY INTEGRITY LEVEL REQUIRED

SIL 2

SAFETY INTEGRITY LEVEL ACHIEVED

Valid

CALCULATION SUMMARY

$PFD_{(SYS)}$	=	$PFD_{(S)}$		$PFD_{(L)}$		$PFD_{(FE)}$	
2.30E-03	=	2.48E-04	Valid	4.00E-06	Valid	1.02E-06	Valid
		0.00E+00	n/a	0.00E+00	n/a	7.09E-04	Valid
		0.00E+00	n/a	0.00E+00	n/a	1.33E-03	Valid
Valid		2.48E-04	Valid	4.00E-06	Valid	2.04E-03	Valid

SPURIOUS TRIP SUMMARY

$S.Trip_{(SYS)}$	=	$S.Trip_{(S)}$		$S.Trip_{(L)}$		$S.Trip_{(FE)}$	
50.5 Years	=	192	Years	13158	Years	5051	Years
		n/a	Years	n/a	Years	278	Years
		n/a	Years	n/a	Years	93	Years

P & I Design Ltd — **PFD - Sensor Subsystem Calculation Sheet 1**

www.pidesign.co.uk — Sheet Title:- E&H Liquiphant Level Switch — Version 5.6

Project:	Immingham East	Originator:	PP
Client:	Simon Storage	Checked:	DRR
Client Ref:	No.4 East Tanks	Approved:	DRR
Document:	SI277001.CAL	Issue:	C
SIS Number:		Date:	24/02/2011

Key:: Data Input Cell | Calculation Cell | Results Cell

System Architecture: 1oo1

Data Type: 2 — Failure Rate/hr (λ)

Sub System Item	Level Switch
FAILURE DATA	
Failures - Safe, Detected (λSD)	1.37E-07
Failures - Safe, Undetected (λSU)	4.57E-07
Failures - Dangerous, Detected (λDD)	3.38E-10
Failures - Dangerous, Undetected (λDU)	5.57E-08
MTBF all failure modes (hours)	
Safe split fraction (0 to 1.0)	
Diagnostic Coverage	
PFD Value (From Certificate)	

FAILURE CALCULATIONS	
Total Failures (λ)	6.50E-07
Safe Fail Fraction	0.91
Total Dangerous Failures (λ_D)	5.60E-08
Calculated Diagnostic Coverage (%)	0.60

SUB-SYSTEM DATA	
Mean Time to Repair (hrs)	72
Proof Test Interval (days)	365
Fraction of detected failures that have common cause (βD)	0.0

CALCULATED DATA	
Total System Dangerous Failure ($\lambda_{D(group)}$)	5.60E-08
Total System Dangerous Detected Failure ($\lambda_{DD(group)}$)	3.38E-10
Total System Dangerous Undetected Failure ($\lambda_{DU(group)}$)	5.57E-08
Fraction of undetected failures that have a common cause (β)	0
Channel Downtime (t_{CE})	4425.6
Voted Group Downtime (t_{GE})	n/a
Mean Diagnostic Coverage	0.6

LOOP CRITERIA ACHIEVED	
PFD Total	**2.48E-04**
SIL achieved (Including Fault Tolerance)	**Valid**
Spurious Trip Rate (years)	**192**

FAULT TOLERANCE CHECK
Conforms to Note 1: YES
Note 1: In order to reduce the fault tolerance by 1, for sensors, final elements and non-programmable logic solvers, the following must be satisfied:
1. the hardware is selected on the basis of proven technology (prior use)
2. adjustment, of process related parameters only, allowed to the user.
3. adjustment, of process related parameters, is protected by password or removeable programming link.
4. system function has SIL requirement of <4

P & I Design Ltd — **Logic Solver Calculation Sheet 1**

www.pidesign.co.uk — Sheet Title:- Safety Relay PNOZ S2 — Version 5.6

Project:	Immingham East	Originator:	PP
Client:	Simon Storage	Checked:	DRR
Client Ref:	No.4 East Tanks	Approved:	DRR
Document:	SI277001.CAL	Issue:	C
SIS Number:		Date:	24/02/2011

Key: Data Input Cell | Calculation Cell | Results Cell

System Architecture: 1oo1

Data Type: 3 — PFD Value Certified

Sub System Item	Safety Relay
FAILURE DATA	
Failures - Safe, Detected (λSD)	
Failures - Safe, Undetected (λSU)	
Failures - Dangerous, Detected (λDD)	
Failures - Dangerous, Undetected (λDU)	
MTBF all failure modes (hours)	
Safe split fraction (0 to 1.0)	0.95
Diagnostic Coverage	
PFD Value (From Certificate)	4.00E-06

FAILURE CALCULATIONS	
Total Failures (λ)	n/a
Safe Fail Fraction	n/a
Total Dangerous Failures (λ_D)	n/a
Calculated Diagnostic Coverage	n/a

CALCULATED DATA	
Total System Dangerous Failure ($\lambda_{D(group)}$)	n/a
Total System Dangerous Detected Failure ($\lambda_{DD(group)}$)	n/a
Total System Dangerous Undetected Failure ($\lambda_{DU(group)}$)	n/a
Fraction of undetected failures that have a common cause (β)	n/a
Channel Downtime (t_{CE})	n/a
Voted Group Downtime (t_{GE})	n/a
Mean Diagnostic Coverage	n/a

LOOP CRITERIA ACHIEVED	
PFD Total	**4.00E-06**
SIL achieved (Including Fault Tolerance)	**Valid**
Spurious Trip Rate (years)	**13158**

FAULT TOLERANCE CHECK — Non-Programmable

Programmable	Non Programmable
SFF>90%	Conforms to Note 1: YES

Note 1: In order to reduce the fault tolerance by 1, for sensors, final elements and non-programmable logic solvers, the following must be satisfied:

1. the hardware is selected on the basis of proven technology (prior use)
2. adjustment, of process related parameters only, allowed to the user.
3. adjustment, of process related parameters, is protected by password or removeable programming link.
4. system function has SIL requirement of <4

P & I Design Ltd — ***Final Element Calculation Sheet 1***

www.pidesign.co.uk — Sheet Title:- Seitz Solenoid Valve — Version 5.6

Project:	Immingham East	Originator:	PP
Client:	Simon Storage	Checked:	DRR
Client Ref:	No.4 East Tanks	Approved:	DRR
Document:	SI277001.CAL	Issue:	C
SIS Number:		Date:	24/02/2011

Key:: Data Input Cell | Calculation Cell | Results Cell

System Architecture: 1oo1

Data Type: 2 — Failure Rate/hr (λ)

Sub System Item	Safety Solenoid Valve
FAILURE DATA	
Failures - Safe, Detected (λSD)	
Failures - Safe, Undetected (λSU)	2.26E-08
Failures - Dangerous, Detected (λDD)	
Failures - Dangerous, Undetected (λDU)	2.28E-10
MTBF all failure modes (hours)	
Safe split fraction (0 to 1.0)	
Diagnostic Coverage	
PFD Value (From Certificate)	

FAILURE CALCULATIONS	
Total Failures (λ)	2.28E-08
Safe Fail Fraction	0.99
Total Dangerous Failures (λ_D)	2.28E-10
Calculated Diagnostic Coverage	0.00

SUB-SYSTEM DATA	
Mean Time to Repair	72
Proof Test Interval (days)	365
Fraction of detected failures that have common cause (βD)	0.0

CALCULATED DATA	
Total System Dangerous Failure ($\lambda_{D(group)}$)	2.28E-10
Total System Dangerous Detected Failure ($\lambda_{DD(group)}$)	0.00E+00
Total System Dangerous Undetected Failure ($\lambda_{DU(group)}$)	2.28E-10
Fraction of undetected failures that have a common cause (β)	0
Channel Downtime (t_{CE})	4452.0
Voted Group Downtime (t_{GE})	n/a
Mean Diagnostic Coverage	0.0

LOOP CRITERIA ACHIEVED	
PFD Total	**1.02E-06**
SIL achieved (Including Fault Tolerance)	**Valid**
Spurious Trip Rate (years)	**5051**

FAULT TOLERANCE CHECK
Conforms to Note 1: YES
Note 1: In order to reduce the fault tolerance by 1, for Final Elements, final elements and non-programmable logic solvers, the following must be satisfied:
1. the hardware is selected on the basis of proven technology (prior use)
2. adjustment, of process related parameters only, allowed to the user.
3. adjustment, of process related parameters, is protected by password or removeable programming link.
4. system function has SIL requirement of <4

P & I Design Ltd — ***Final Element Calculation Sheet 2***

www.pidesign.co.uk — Sheet Title:- Pneumatic Actuator — Version 5.6

Project:	Immingham East	Originator:	PP
Client:	Simon Storage	Checked:	DRR
Client Ref:	No.4 East Tanks	Approved:	DRR
Document:	SI277001.CAL	Issue:	C
SIS Number:		Date:	24/02/2011

Key:: Data Input Cell | Calculation Cell | Results Cell

System Architecture: 1oo1

Data Type: 2 — Failure Rate/hr (λ)

Sub System Item	Actuator
FAILURE DATA	
Failures - Safe, Detected (λSD)	8.00E-08
Failures - Safe, Undetected (λSU)	
Failures - Dangerous, Detected (λDD)	3.31E-07
Failures - Dangerous, Undetected (λDU)	1.54E-07
MTBF all failure modes (hours)	
Safe split fraction (0 to 1.0)	
Diagnostic Coverage	
PFD Value (From Certificate)	

FAILURE CALCULATIONS	
Total Failures (λ)	5.65E-07
Safe Fail Fraction	0.7274
Total Dangerous Failures (λ_D)	4.85E-07
Calculated Diagnostic Coverage	68.25

SUB-SYSTEM DATA	
Mean Time to Repair	72
Proof Test Interval (days)	365
Fraction of detected failures that have common cause (βD)	0.0

CALCULATED DATA	
Total System Dangerous Failure ($\lambda_{D(group)}$)	4.85E-07
Total System Dangerous Detected Failure ($\lambda_{DD(group)}$)	3.31E-07
Total System Dangerous Undetected Failure ($\lambda_{DU(group)}$)	1.54E-07
Fraction of undetected failures that have a common cause (β)	0
Channel Downtime (t_{CE})	1462.8
Voted Group Downtime (t_{GE})	n/a
Mean Diagnostic Coverage	68.2

LOOP CRITERIA ACHIEVED	
PFD Total	**7.09E-04**
SIL achieved (Including Fault Tolerance)	**Valid**
Spurious Trip Rate (years)	**278**

FAULT TOLERANCE CHECK
Conforms to Note 1: YES
Note 1: In order to reduce the fault tolerance by 1, for sensors, final elements and non-programmable logic solvers, the following must be satisfied:
1. the hardware is selected on the basis of proven technology (prior use)
2. adjustment, of process related parameters only, allowed to the user.
3. adjustment, of process related parameters, is protected by password or removeable programming link.
4. system function has SIL requirement of <4

P & I Design Ltd — ***Final Element Calculation Sheet 3***

www.pidesign.co.uk — Sheet Title:- Ball Valve — Version 5.6

Project:	Immingham East	Originator:	PP
Client:	Simon Storage	Checked:	DRR
Client Ref:	No.4 East Tanks	Approved:	DRR
Document:	SI277001.CAL	Issue:	C
SIS Number:		Date:	24/02/2011

Key:: Data Input Cell | Calculation Cell | Results Cell

System Architecture: 1oo1

Data Type: 2 — Failure Rate/hr (λ)

Sub System Item	Ball Valve
FAILURE DATA	
Failures - Safe, Detected (λSD)	1.00E-06
Failures - Safe, Undetected (λSU)	
Failures - Dangerous, Detected (λDD)	2.24E-07
Failures - Dangerous, Undetected (λDU)	2.96E-07
MTBF all failure modes (hours)	
Safe split fraction (0 to 1.0)	
Diagnostic Coverage	
PFD Value (From Certificate)	

FAILURE CALCULATIONS	
Total Failures (λ)	1.52E-06
Safe Fail Fraction	0.81
Total Dangerous Failures (λ_D)	5.20E-07
Calculated Diagnostic Coverage	43.08

SUB-SYSTEM DATA	
Mean Time to Repair	72
Proof Test Interval (days)	365
Fraction of detected failures that have common cause (βD)	10.0

CALCULATED DATA	
Total System Dangerous Failure ($\lambda_{D(group)}$)	5.20E-07
Total System Dangerous Detected Failure ($\lambda_{DD(group)}$)	2.24E-07
Total System Dangerous Undetected Failure ($\lambda_{DU(group)}$)	2.96E-07
Fraction of undetected failures that have a common cause (β)	20
Channel Downtime (t_{CE})	2565.2
Voted Group Downtime (t_{GE})	n/a
Mean Diagnostic Coverage	43.1

LOOP CRITERIA ACHIEVED	
PFD Total	**1.33E-03**
SIL achieved (Including Fault Tolerance)	**Valid**
Spurious Trip Rate (years)	**93**

FAULT TOLERANCE CHECK
Conforms to Note 1: YES
Note 1: In order to reduce the fault tolerance by 1, for sensors, final elements and non-programmable logic solvers, the following must be satisfied:
1. the hardware is selected on the basis of proven technology (prior use)
2. adjustment, of process related parameters only, allowed to the user.
3. adjustment, of process related parameters, is protected by password or removeable programming link.
4. system function has SIL requirement of <4

Appendix 1

Endress & Hauser Safety Manual SD231F/00/en

Limit Level Measuring System
Liquiphant M/S + nivotester FTL 325P

Appendix 2

PILZ PNOZ S2 (16/07/2008)

Internal Safety Integrity Details

Appendix 3

Eugen Seitz

3/2 Way Solenoid Valves CP 0632… oH, CO0632… oHi

TŰV Certificate

From test Report No. V11 2003 S2

Appendix 4

Valve PFD Table

Note 1: MTTR, 8 hours. Proof Test Interval, 1 year
Note 2: Partial Stroke Testing
Note 3: No Partial Stroke Testing
Note 4: MTTR 72 hours. Proof Test Interval, 1 year

Data Supplied

Exida Certificate: Pekos 090168 P0006 C01

Valve Manufacturer	Valve Type	Certification	SFF (Partial Stroke Test)	SFF (No Partial Stroke Test)	Data Type	PFD
Dafram	Trunnion	TUV	91%	65.7%	Full PFD Data	1.12×10^{-4}(notes 1,2) 4.43×10^{-4}(notes 1,3)
Dafram	Floating Ball	TUV	97.7%	91%	Full PFD Data	2.21×10^{-6}(note 1,2) 8.81×10^{-6}(note 1,3)
Pekos	Floating Ball	Pekos	81%	66%	Exida Data	1.33×10^{-3}(note2, 4)
Perar	Trunnion	Perar	?	89%?	Company Data	8.04×10^{-7}(note 1)
Worcester		Worcester	?	90%?	Company Data	1.32×10^{-6}(note 1)
Neway	All	Neway	?	85%	Company Data	4.67×10^{-5}(note 1)

Appendix 5

Actuator PFD Table

Actuator Manufacturer	Certification	SFF (Partial Stroke Test)	SFF (No Partial Stroke Test)	Data Type	PFD
Actreg	Actreg		90%	MTBF	4.58×10^{-5} (note 1)
Emerson (Spring Return)	Exida	94% (73% if no effect failures are not included)	82%	PFD	6.78×10^{-4}(notes 1,2) 2.13×10^{-3}(notes 1,3) 7.09×10^{-4}(notes 2, 4)
Remote Control					
Air Torque	TUV		90%	MTBF	3.75×10^{-5}(note 1)
Paladon	Generic		63%	PFD	8.78×10^{-3}

Note 1: MTTR, 8 hours. Proof Test Interval, 1 year
Note 2: Partial Stroke Testing
Note 3: No Partial Stroke Testing
Note 4: MTTR 72 hours. Proof Test Interval, 1 year

Data Supplied

Exida Certificate: Elomatic P-Series Rack & Pinion Actuator

Report: VAD 03/08-24 R004

P & I Design Ltd

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IMMINGHAM STORAGE Co LTD

IMMINGHAM EAST TERMINAL

No4 SWITCHROOM TANK OVERFILL PROTECTION

SAFETY INSTRUMENT SYSTEM LOGIC PANEL

FACTORY ACCEPTANCE TEST PROCEDURE

Rev	Date	By	Checked	Approved	Description	Client Ref.
A	05.03.14	D.B.Faulkner	DBF	DSR	Original Issue	
						Document No. SI483005_RPT

IF NOT SIGNED THIS DOCUMENT IS UNCONTROLLED

Contents

1.0 INTRODUCTION

This procedure details the requirements for the testing and acceptance of the Immingham Storage Co Ltd, East Terminal, No.4 Switchroom Safety Instrument System logic panel.

This FAT is part of the life cycle approach required for Safety Instrument Systems as required in BS EN 61511-1:2004 Section 13 where the objectives are to ensure the logic solver satisfies the requirements defined in the Safety Requirements Specification and all elements perform correctly. No software is employed in this SIS; hence the tests involve hardware checks only.

Test results including documentation verification are recorded in this report and documentation listed in section 2.0. All results to be initialled and dated. Any failure during the test must be documented and analysed together with details of the appropriate corrective action.

The testing shall be completed in the section and step order laid out in this report.

The logic panel will be 'Cold' tested prior to powered functional testing.
This report will be used to control and record the method statements and functional tests.
Controlled copies of listed documentation will be used to record, by highlighting (yellow), satisfactory terminations and functions. Errors and omissions will be corrected and noted in red. The controlled documentation will constitute a significant proportion of the testing records and provides an audit trail to the 'As Built' issue.

The testing procedure will request confirmation of functions, a change of status not requested will require investigation.

Reference material required –

Quality	**Description**	**Revision**
QIE2006	Quality Instruction QIE2006 Logic Drawings	
Manufacturers Documentation	**Description**	**Revision**
	E&H FTL325P Nivotester Manual	
	PILZ PNOZ s2 Manual	

2.0 DOCUMENTATION VERIFICATION

Purpose of Test			
Verify Correct Documentation used for testing.			
Method of Test			
Confirm documentation and revisions used for testing. Record permit number and type (cold/hot/confined space)			
Permit To Work Number		**Permit To Work Type**	
Safety Instrument System Documentation Manual SI483001_MNL Revision			
Drawing Number	**Title**		**Revision**
SI483005_DWG	SIS Logic Panel External Layout		
SI483006_DWG	SIS Logic Panel Internal Layout		
SI483007_DWG	SIS Logic Drawing 1 , Power Distribution		
SI483008_DWG	SIS Logic Drawing 2 , ESD		
SI483009_DWG	SIS Logic Drawing 3 , Tank 561		
SI483010_DWG	SIS Logic Drawing 4 , Tank 564		
SI483011_DWG	SIS Logic Drawing 5 , Tank 568		
Schedules	**Title**		**Revision**
SI483003_SCH	No.4 East 500 Series Tanks Safety Functions Matrix		
SI483008_SCH	No.5 SIS Logic Panel Label Schedule		
Instrument Specifications	**Title**		**Revision**
SI277001_SPC	Tank Level Switch (Liquiphant)		
Reports	**Title**		**Revision**
SI483002_RPT	500 Series Tank Farm Safety Requirement Specification		
SI483003_RPT	500 Series Tank Farm Management of Functional Safety		
SI483004_RPT	500 Series Safety Instrument System		
Actions/Comments			
		Sign	**Date**
Tested by			

3.0 INSPECTION

3.1 EQUIPMENT CONFORMS TO INSTRUMENT SPECIFICATIONS

Equipment Required	
Hand Tools, yellow highlighter, red pen	
Purpose of Test	
To verify the fitted equipment is as specified. To verify the fitted equipment is set up as specified.	
Method Of Test	**Result/Date**
3.1.1 Controlled copies of listed specifications will be used to record, by highlighting (yellow), correct equipment is installed as per Tag number listed on specification. Errors and omissions will be corrected and noted in red. Record serial numbers of equipment on controlled copy specifications . Switches and dials to be adjusted to correct settings as detailed on drawings, verify set correctly by highlighting (yellow) on controlled copy drawings.	
1. SI277001_SPC - Tank Level Switch (Liquiphant)	
Actions/Comments	

	Sign	**Date**
Tested by		

3.2 LOGIC PANEL CONSTRUCTION INSPECTION

Equipment Required	
Hand Tools, yellow highlighter, red pen.	
Purpose of Test	
To verify the logic panel construction is satisfactory to proceed to powered functional testing**.** The logic panel has been constructed and wired by a competent & reputable panel building company; initial quality checks have been carried out prior to being available for witnessed factory testing.	
Method Of Test	**Result/Date**
3.2.1 Controlled copies of listed logic drawings will be used to record, by highlighting (yellow), satisfactory terminations and functions. Errors and omissions will be corrected and noted in red.	
1. External panel layout and identification conforms to SI483005_DWG and SI483008_SCH.	
2. Internal panel layout and identification conforms to SI483006_DWG.	
3. Panel physical construction and paintwork satisfactory.	
4. Gland plates correctly fitted and satisfactory.	
5. Doors and locks operational.	
6. Equipment mountings secure.	
7. Panel earthing correct.	
8. All equipment voltage rating correct and conforms to specifications.	
Actions/Comments	

	Sign	**Date**
Tested by		

3.3 LOGIC PANEL WIRING INSPECTION

Equipment Required	
Hand Tools, yellow highlighter, red pen.	
Purpose of Test	
To verify the logic panel internal wiring is satisfactory to proceed to powered functional testing. The logic panel has been constructed and wired by a competent & reputable panel building company; initial quality checks have been carried out prior to being available for witnessed factory testing.	
Method Of Test	**Result**
3.3.1 A random sample of the following tests to be carried out. During the procedure of functional testing the controlled copies of listed logic drawings will be used to record, by highlighting (yellow), satisfactory compliance with actions 1 to 6. On completion of all functional testing, all logic drawings should be fully highlighted. Errors and omissions will be corrected and noted in red.	
1. Terminals type and numbering conforms to logic drawings.	
2. Panel wire feruling conforms to logic drawings.	
3. Panel wire gauge and colour conforms to panel specification.	
4. Fuse and MCB ratings conform to logic drawings.	
5. Termination and crimps tight.	
6. Point to point wiring correct to logic drawings.	
Actions/Comments	

	Sign	**Date**
Tested by		

4 FUNCTIONAL TESTING

4.1 PANEL INFRASTRUCTURE

Equipment Required	
Multi-meter, hand tools, yellow highlighter, red pen.	
Purpose of Test	
To verify the functionality of the panel infrastructure.	
Method Of Test	
	Result
1. Initial setup, all MCB's to the off position, all 24Vdc, 0Vdc fuses and links removed. Connect a suitably protected 240Vac supply to the panel isolator incoming terminals.	
2. Select internal isolator to off position, establish ac power to logic panel. Confirm no Vac at MCB's, select internal isolator to on position, confirm and record 240 Vac power on all MCB's.	ISO On ……..Vac ISO Off ……Vac
3. Confirm and record 24Vdc on all TB24V terminals to associated TB0V terminal when MCB 1 on, confirm 0Vdc on all TB24V terminals to associated TB0V terminal when MCB 1 off.	MCB On ……...Vdc MCB Off ……...Vdc
4. Confirm socket energised when MCB 2 on, confirm de-energised when MCB 2 off..	
5. Confirm panel internal light illuminated when MCB 3 on, confirm extinguished when MCB 3 off.	
6. Confirm power on load side of MCB 4 when MCB 4 on, confirm no power on load side when MCB 4 off.	MCB On ……...Vac MCB Off ……...Vac
7. Confirm power on load side of MCB 5 when MCB 5 on, confirm no power on load side when MCB 5 off.	MCB On ……...Vac MCB Off ……...Vac
8. Insert each 24Vdc fuse and 0Vdc link in turn confirming 24Vdc across load side and associated panel equipment powers up where applicable.	
Actions/Comments	

	Sign	**Date**
Tested by		

4.2 LOOP TESTING

4.2.1 MANUAL SHUTDOWN – ESD

Equipment Required	
Multi-meter, hand tools, links, yellow highlighter, red pen.	
Purpose of Test	
To verify the functionality of the ESD logic trip and reset actions. To verify correct lamp status and lamp test action. To verify the functionality of an ESD fuse failure. To verify the functionality of an ESD open circuit failure.	
Method Of Test	
4.2.1.1 Simulate a volt free input to manual shutdowns in the system by applying and removing a link on the associated incoming terminals. Input linked manual shutdown relay energised, input open circuit manual shutdown relay de-energised. Each relay to be tested for energised to de-energised to simulate external ESD pushbutton action. **4.2.1.2** Open circuit manual shutdown incoming and remote reset link on incoming terminals, link ESD input confirming relay does not re-energise until remote reset input is replaced. **4.2.1.3** Remove and replace associated fuse for ESD, confirm ESD relays de-energised whilst removed. **4.2.1.4** Confirm ESD status lamp illuminated whilst relay de-energised, extinguished whilst relay energised. confirm ESD status lamp illuminates whist lamp test pushbutton depressed when relay energised.	Result
1. ISCo Site ESD R124.	
2. ISCo Site ESD R124A.	
Actions/Comments	

Approvals (Note: Signature indicates acceptance of test with actions/comments noted)	**Sign**	**Date**
Tested by		

4.2.2 MANUAL SHUTDOWN - BUND ISOLATION PUSHBUTTONS

Equipment Required	
Multi-meter, hand tools, links, yellow highlighter, red pen.	
Purpose of Test	
To verify the functionality of the bund isolation pushbutton logic. To verify correct BPCS interface status. To verify the functionality of an ESD fuse failure. To verify the functionality of an ESD open circuit failure.	
Method Of Test	
4.2.2.1 Simulate a volt free input to each isolation relay in the system. Incoming terminals linked isolation relay energised, incoming terminals open circuit isolation relay de-energised. Each relay to be tested for energised to de-energised to simulate isolation pushbutton action. **4.2.2.2** Confirm BPCS status on outgoing terminals, outgoing terminals to BPCS closed circuit whilst relay energised, open circuit whilst relay de-energised. **4.2.2.3** Remove and replace associated fuse for each isolation, confirm isolation relay de-energised whilst removed.	Result
1. Tank 561 Isolation R296.	
2. Tank 564 Isolation R376.	
3. Tank 568 Isolation R456.	
Actions/Comments	

	Sign	**Date**
Tested by		

4.2.3 SYSTEM TRIP RESET

Equipment Required	
Multi-meter, hand tools, links, yellow highlighter, red pen.	
Purpose of Test	
To verify the functionality of the system reset logic. To verify the functionality of an fuse failure.	
Method Of Test	
4.2.3.1 Operate local reset pushbutton, confirming system trip reset relays energised whilst reset depressed. Simulate a volt free input to remote reset incoming terminals, incoming terminals linked reset relays energised, incoming terminals open circuit reset relays de-energised. **4.2.3.2** Remove and replace fuse confirm relay de-energised whilst removed and reset pushbutton activated.	Result
1. Reset Relay R84.	
2. Reset Relay R85.	
3. Reset Relay R86.	
Actions/Comments	

Approvals (Note: Signature indicates acceptance of test with actions/comments noted)	**Sign**	**Date**
Tested by		

4.2.4 VALVE FEEDBACK STATUS

Equipment Required	
Multi-meter, hand tools, links, yellow highlighter, red pen.	
Purpose of Test	
To verify the functionality of the limit switch feedback logic. To verify the functionality of the limit switch feedback BPCS interface. To verify correct lamp status and lamp test action. To verify the functionality of a fuse failure. To verify the functionality of open circuit failure.	
Method Of Test	
4.2.4.1 Simulate a volt free input to each limit switch relay in the system. Incoming terminals linked relay energised, incoming terminals open circuit relay de-energised. **4.2.4.2** Confirm BPCS status on outgoing terminals, outgoing terminals to BPCS closed circuit whilst relay energised, open circuit whilst relay de-energised. **4.2.4.3** Remove and replace associated fuse for each limit switch, confirm relay de-energised whilst removed. **4.2.4.4** Confirm limit switch status lamp illuminated whilst relay energised, extinguished whilst relay de-energised. confirm limit switch status lamp illuminates whist lamp test pushbutton depressed when relay de-energised.	Result
1. ZSO56101 Relay R299.	
2. ZSC56101 Relay R304.	
3. ZSO56401 Relay R379.	
4. ZSC56401 Relay R384.	
5. ZSO56801 Relay R459.	
6. ZSC56801 Relay R464.	
Actions/Comments	

	Sign	**Date**
Tested by		

4.2.5 HIGH LEVELS

Equipment Required	
Multi-meter, hand tools, links, yellow highlighter, red pen, SI277001_SPC E&H level switch probe.	
Purpose of Test	
To verify the functionality of each individual high level logic. To verify correct healthy to trip condition of level to open/close circuit self test. To verify correct BPCS interface status. To verify correct Hi Hi Level Annunciator Alarm Status To verify correct lamp status and lamp test action. To verify the functionality of a fuse failure. To verify the functionality of an open circuit failure. To verify the functionality of a short circuit failure.	
Method Of Test	
4.2.5.1 Connect an E&H Liquiphant level probe as Specification SI277001_SPC to incoming terminals. Ensure the probe tip is not covered and the internal switch unit is set to max/>0.7. Immerse and uncover probe tip, confirm relay de-energised whilst immersed. < 2 seconds response time required. **4.2.5.2** Confirm BPCS status on outgoing terminals, closed circuit whilst relay energised, open circuit whilst relay de-energised. **4.2.5.3** Confirm high level alarm status on outgoing annunciator terminals, closed circuit whilst relay energised, open circuit whilst relay de-energised. **4.2.5.4** Confirm high level lamp extinguished whilst relay energised, illuminated whilst relay de-energised, confirm high level lamp illuminates whist lamp test pushbutton depressed and relay energised. **4.2.5.5** Remove and replace associated fuse for each level switch, confirm relay de-energised whilst removed. **4.2.5.6** Open circuit field input to each level switch, confirm relay de-energised whilst open circuit. **4.2.5.7** Short circuit field input to each level switch, confirm relay de-energised whilst short circuit.	Result
1. Tank 561 High Level R283.	
2. Tank 564 High Level R363.	
3. Tank 568 High Level R443.	
Actions/Comments	

	Sign	**Date**
Tested by		

4.2.6 BPCS VALVE COMMANDS

Equipment Required	
Multi-meter, hand tools, links, yellow highlighter, red pen, 24Vdc Supply.	
Purpose of Test	
To verify the functionality of BPCS valve command logic. To verify the functionality of an open circuit failure.	
Method Of Test	
4.2.6.1 Connect a 24Vdc supply to incoming terminals. Confirm BPCS valve command relay energised when 24Vdc supply on and relay de-energised when 24Vdc supply off.	Result
1. Tank 561 XV56101 R306.	
2. Tank 564 XV56401 R386.	
3. Tank 568 XV56801 R466.	
Actions/Comments	

	Sign	**Date**
Tested by		

4.2.7 SAFETY RELAY

Equipment Required	
Multi-meter, hand tools, links, yellow highlighter, red pen, SI277001_SPC E&H level switch probe.	
Purpose of Test	
To verify correct healthy functionality of each individual safety relay. To verify correct healthy to trip condition of each individual safety relay. To verify correct reset actions of each individual safety relay. To verify correct BPCS interface status. To verify correct lamp status and lamp test action. To verify the functionality of a fuse failure.	
Method Of Test	
4.2.7.1 Simulate level switch probe healthy by connecting an E&H Liquiphant level probe as Specification SI277001_SPC to incoming terminals. Ensure the probe tip is not covered and the internal switch unit is set to max/>0.7. **4.2.7.2** Simulate all valve limit switch feedback as valve closed by applying a link to incoming terminals. **4.2.7.3** Momentary depress reset pushbutton, confirm all safety relays energise. **4.2.7.4** Confirm safety relay BPCS status on outgoing terminals, closed circuit whilst safety relay energised, open circuit whilst safety relay de-energised. **4.2.7.5** Confirm safety relay lamp extinguished whilst relay energised, illuminated whilst relay de-energised, confirm safety relay lamp illuminates whist lamp test pushbutton depressed and relay energised. **4.2.7.6** Simulate a high level by immersing probe tip. Confirm safety relay de-energises. **4.2.7.7** Simulate level switch probe healthy by uncovering the probe tip. Confirm safety relay remains de-energised. **4.2.7.8** Simulate associated valve limit switch feedback as valve not closed by removing link applied to incoming terminals. **4.2.7.9** Momentary depress reset pushbutton, confirm safety relays remains de-energised. **4.2.7.10** Simulate associated valve limit switch feedback as valve closed by applying a link to incoming terminals. **4.2.7.11** Momentary depress reset pushbutton, confirm safety relay energised. **4.2.7.12** Remove and replace associated fuse for each safety relay, confirm relay de-energised whilst removed.	Result
1. Tank 561 R250.	
2. Tank 564 R330.	
3. Tank 568 R410.	
Actions/Comments	

	Sign	**Date**
Tested by		

4.2.8 IMPORT VALVES

Equipment Required	
Multi-meter, hand tools, links, yellow highlighter, red pen, SI277001_SPC E&H level switch probe.	
Purpose of Test	
To verify correct healthy functionality of each individual import valve logic. To verify correct healthy to trip condition of each individual import valve logic. To verify the functionality of a fuse failure.	
Method Of Test	
4.2.8.1 Simulate level switch probe healthy by connecting an E&H Liquiphant level probe as Specification SI277001_SPC to incoming terminals. Ensure the probe tip is not covered and the internal switch unit is set to max/>0.7. **4.2.8.2** Simulate all manual shutdown systems healthy by applying a link to incoming terminals. **4.2.8.3** Simulate all valve limit switch feedback as valve closed by applying a link to incoming terminals. **4.2.8.4** Momentary depress reset pushbutton, confirm all safety relays energise. **4.2.8.5** Confirm 24Vdc present at all XSV outgoing terminals. **4.2.8.6** Disconnect BPCS Open Command Wire Link. Confirm associated XSV outgoing terminals de-energised whilst removed and energised when connected. **4.2.8.7** Remove BPCS Open Command Wire Link, apply a 24Vdc supply to incoming BPCS Open commands terminals. Confirm associated XSV outgoing terminals energised whilst BPCS Open Command 24Vdc applied and de-energised when BPCS Open Command 24Vdc removed. **4.2.8.8** Remove BPCS Open Command Wire Link, apply a 24Vdc supply to incoming BPCS Open commands terminals. Confirm associated XSV outgoing terminals energised whilst BPCS Open Command 24Vdc applied and de-energised when BPCS Open Command 24Vdc removed. **4.2.8.9** Trip each interlock as detailed on SI483003_SCH in turn confirming associated XSV outgoing terminals de-energise in trip position and re-energise once healthy and reset. **4.2.8.10** Remove and replace associated fuse for each XSV, confirming associated XSV outgoing terminals de-energise with fuse removed.	Result
1. XSV56101.	
2. XSV56401.	
3. XSV56801.	
Actions/Comments	

	Sign	**Date**
Tested by		

5.0 CHALLENGE TESTING

Equipment Required	
Multi-meter, hand tools, links, yellow highlighter, red pen.	
Purpose of Test	
To verify the actions of operator interactions do not affect the functionality of the system.	
Method Of Test	
5.0.1 Verify rising edge action of safety relay reset logic by depressing reset pushbutton whilst re-establishing level probe connection at incoming terminals with associated valve closed limit on. Confirm safety relay does not energise until reset pushbutton released and repressed. **5.0.2** Verify no impact on functionality by repeating import valve loop test with lamp test pushbutton depressed / linked out. Confirm XSV output actions correct.	Result
1. Tank 561 R250.	
2. Tank 564 R330.	
3. Tank 568 R410.	
4. XSV56101.	
5. XSV56401.	
6. XSV56801.	
Actions/Comments	

	Sign	**Date**
Tested by		

6.0 ADDITIONAL TESTING

Equipment Required	
As required.	
Purpose of Test	
To verify the actions of additional tests requested by client. To verify the actions of additional challenge testing as appropriate.	
Method Of Test	
6.0.1 Detail additional tests carried out.	Result
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
Actions/Comments	

	Sign	**Date**
Tested by		

7.0 HANDOVER AND LIFE CYCLE

Equipment Required	
None specific.	
Purpose of Test	
Return logic panel to working condition as found prior to testing. Update documentation and confirm testing complete to move on to next phase of proof testing.	
Method Of Test	
7.0.1 Remove all test links and test equipment. **7.0.2** Replace all removable links as found. **7.0.3** Replace incoming and outgoing terminals as found. **7.0.4** Replace or secure covers and guards. **7.0.5** Complete handover and deviation list. **7.0.6** Update documentation as required.	Result
1. All test links removed.	
2. All removable links as found.	
3. All incoming and outgoing terminals returned to as found.	
4. All covers and guards replaced or secured inside panel.	
5. Handover and deviation list completed.	
6. Documentation update as required.	
Actions/Comments	

	Sign	**Date**
Tested by		

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IMMINGHAM STORAGE Co LTD

IMMINGHAM EAST TERMINAL

IME-SIS1

SAFETY INSTRUMENT SYSTEM

DOCUMENTATION VERIFICATION PROCEDURE

Rev	Date	By	Checked	Approved	Description	Client Ref.
A	09.04.14	D.B.Faulkner	D.S.Regan	ISCo	Original Issue	
						Document No. **SI483017_RPT**

IF NOT SIGNED THIS DOCUMENT IS UNCONTROLLED

Contents

1 REVISION HISTORY

Rev	Description
A	Original Issue

This document will be revised with any additions to or removals from IME-SIS1 throughout the operational lifecycle of the system.

2 INTRODUCTION

This document provides a procedure for documentation verification to ensure that the Safety Instrument System Life Cycle complies with the requirements of the standard BS EN 61511.

3 SCOPE

Client / Company	-	Immingham Storage Co Ltd
Location / Facility	-	ISCo East Terminal
Plant Unit	-	Tanks 561, 564 & 568
Service	-	No4 East Storage Tank Overfill Protection
SIS Tag No	-	IME-SIS1
SIF's Tag No's	-	TK561-SIF1, TK564-SIF1 & TK568-SIF1
SIL	-	2

Lifecycle Stages

Operation and Maintenance	-	BS EN 61511 Clause 16

Audience

This document has been produced for use by competent persons knowledgeable in testing Safety Instrumented Systems.

Brief System Description

IME-SIS1 under test is to prevent the overfill of storage tanks 561, 564 & 568 when on import duty. The system is classified as SIL2.
Full system description in documentation reference SI277001_RPT – IME-SIS1 Safety Instrument System and Piping & Instrument Diagrams – IME-K-0028 – Tank 561, IME-K-0052 – Tank 564 & IME-K-0050 – Tank 568.

Procedure

This procedure outlines the necessary steps required to verify the correct documentation used for testing and identify modifications to the system since the last testing phase.

Detailed in this report are the methods of test for documentation associated with IME-SIS1. The results of these tests will be recorded in this report, historical data will be recorded and approved as satisfactory in report reference SI483015_RPT - IME-SIS1 Operation, Maintenance and Modification Lifecycle.

All faults should be reported to the system keeper. If further work is required the system keeper will initiate it.

4 DEFINITIONS AND ABBREVIATIONS

The following definitions and abbreviations apply to this document.

BPCS	Basic Process Control System
Logic Solver	Part of the SIS that performs one or more logic functions, e.g. safety relay, trip amplifier
Proof Test	Periodic testing to detect failures in a safety instrumented system
Protection Layer	A mechanism that reduces risk by control, prevention or mitigation
Sensor	Part of the SIS which measures the process condition
SIF	Safety Instrumented Function – A function with a specified safety integrity level which is necessary to achieve functional safety
SIL	Safety integrity level – A numerical number, 1 to 4 stipulating the level of integrity the system shall perform to, 1 being the lowest 4 the highest
SIS	Safety Instrument System – A SIS comprises of sensors, logic solvers and final elements
1ooN	SIS made up of N independent channels, which are so connected, that any single channel is sufficient to perform the correct safety instrumented function
2ooN	SIS made up of N independent channels, which are so connected, that any two of the channels are required to perform the correct safety instrumented function
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
PFD	Probability of Failing on Demand
SCADA	Supervisory Control and Data Acquisition (Visual display screen)
P&ID	Piping & Instrument Diagram
SCH	Schedule
PTW	Permit to Work

5 PREPARATION

Controlled copies of the following documentation will be required :-
SI483015_RPT - IME-SIS1 Operation, Maintenance and Modification Lifecycle
SI483001_REG - IME-SIS1 Report Register
SI483002_REG - IME-SIS1 Instrument Specification Register
SI483003_REG - IME-SIS1 Drawing Register
SI483004_REG - IME-SIS1 Calculation Register

A controlled copy of this procedure will be used to carry out the testing and will form part of the lifecycle testing documentation.
Controlled copies of all documentation required for testing to be attached.

6 DOCUMENTATION VERIFICATION

Purpose of Test
Pre physical on site testing check of documentation to verify correct documentation to be used for testing and identify modifications to the system since last testing phase. *Incorrect or updated documentation may lead to incomplete testing or undesirable effects on other site systems and terminal operation.*
Controlled Copy Documentation Required
SI483015_RPT - IME-SIS1 Operation, Maintenance and Modification Lifecycle SI483001_REG - IME-SIS1 Report Register SI483002_REG - IME-SIS1 Instrument Specification Register SI483003_REG - IME-SIS1 Drawing Register SI483004_REG - IME-SIS1 Calculation Register

Step	**Method of Test**	**Acceptance Criteria**	**Pass (✓) Fail (x) Initial**
6.1	Compare system documentation to registers. Highlight documentation checked on controlled copy of registers. Review changes since last testing phase as documented in SI483015_RPT - IME-SIS1 Operation, Maintenance and Modification Lifecycle.	Documentation available and auditable. Documentation revisions reflect installed system. *Comment any issues in section 6.2 and review / rectify prior to starting site work*	
6.2	Comments/Defects/ Remedial Actions – Report ALL to System Keeper		

Tested by	**Position**	**Qualification**	**Sign**	**Date**

System Keeper Acknowledgement
(Note: Signature confirms System keeper is advised of Comments/Defects/Remedial Actions and will initiate terminal procedures for rectification works and/or isolation of plant as required)

Accepted by	**Position**	**Qualification**	**Sign**	**Date**

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IMMINGHAM STORAGE Co LTD

IMMINGHAM EAST TERMINAL

IME-SIS1

SAFETY INSTRUMENT SYSTEM

SHUTDOWN CONDITIONS PROOF TESTING PROCEDURE

Rev	Date	By	Checked	Approved	Description	Client Ref.
A	09.04.14	D.B.Faulkner	D.S.Regan	ISCo	Original Issue	
						Document No. **SI483018_RPT**

IF NOT SIGNED THIS DOCUMENT IS UNCONTROLLED

Contents

1 REVISION HISTORY

Rev	Description
A	Original Issue

This document will be revised with any additions to or removals from IME-SIS1 throughout the operational lifecycle of the system.

2 INTRODUCTION

This document provides a procedure for shutdown condition functional proof testing to ensure that the Safety Instrument System Life Cycle complies with the requirements of the standard BS EN 61511.

3 SCOPE

Client / Company	-	Immingham Storage Co Ltd
Location / Facility	-	ISCo East Terminal
Plant Unit	-	Tanks 561, 564 & 568
Service	-	No4 East Storage Tank Overfill Protection
SIS Tag No	-	IME-SIS1
SIF's Tag No's	-	TK561-SIF1, TK564-SIF1 & TK568-SIF1
SIL	-	2

Lifecycle Stages

Operation and Maintenance	-	BS EN 61511 Clause 16

Audience

This document has been produced for use by competent persons knowledgeable in testing Safety Instrumented Systems.

Brief System Description

IME-SIS1 under test is to prevent the overfill of storage tanks 561, 564 & 568 when on import duty. The system is classified as SIL2.
Full system description in documentation reference SI277001_RPT – IME-SIS1 Safety Instrument System and Piping & Instrument Diagrams – IME-K-0028 – Tank 561, IME-K-0052 – Tank 564 & IME-K-0050 – Tank 568.

Procedure

This procedure outlines the necessary steps required to verify the correct equipment is installed, the physical condition of the installed equipment and the functional operation performs the SIF's as designed.

Detailed in this report are the methods of test for each SIF.

The results of these tests will be recorded in this report, historical data will be recorded and approved as satisfactory in report reference SI483015_RPT - IME-SIS1 Operation, Maintenance and Modification Lifecycle.

This report details shutdown condition testing whilst no transfer to the tanks is in operation.

All faults should be reported to the system keeper, with minor repairs carried out if practicable. If further maintenance work is required the system keeper will initiate it.

4 DEFINITIONS AND ABBREVIATIONS

The following definitions and abbreviations apply to this document.

BPCS	Basic Process Control System
Logic Solver	Part of the SIS that performs one or more logic functions, e.g. safety relay, trip amplifier
Proof Test	Periodic testing to detect failures in a safety instrumented system
Protection Layer	A mechanism that reduces risk by control, prevention or mitigation
Sensor	Part of the SIS which measures the process condition
SIF	Safety Instrumented Function – A function with a specified safety integrity level which is necessary to achieve functional safety
SIL	Safety integrity level – A numerical number, 1 to 4 stipulating the level of integrity the system shall perform to, 1 being the lowest 4 the highest
SIS	Safety Instrument System – A SIS comprises of sensors, logic solvers and final elements
1ooN	SIS made up of N independent channels, which are so connected, that any single channel is sufficient to perform the correct safety instrumented function
2ooN	SIS made up of N independent channels, which are so connected, that any two of the channels are required to perform the correct safety instrumented function
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
PFD	Probability of Failing on Demand
SCADA	Supervisory Control and Data Acquisition (Visual display screen)
P&ID	Piping & Instrument Diagram
SCH	Schedule
PTW	Permit to Work
RAMS	Risk Assessment and Method Statement

5 PREPARATION

All Health and Safety / Permit To Work systems must be implemented before commencing testing. SI483012_RPT - IME-SIS1 RAMS is to be submitted for approval prior to the site testing.

IME-SIS1 is completely independent of the BPCS, no overrides or special preparations are required to facilitate uncompromised testing.

Controlled copies of the following documentation will be required :-
SI483015_RPT - IME-SIS1 Operation, Maintenance and Modification Lifecycle
SI483018_RPT - IME-SIS1 Shutdown Conditions Proof Testing
SI483010_SCH - IME-SIS1 Instrument Schedule
SI483012_SCH - IME-SIS1 Trip Matrix
SI483001_DWG - Tanks 561, 564 & 568 Cable Overview
IME-K-0028 – Tank 561 P&ID
IME-K-0052 – Tank 564 P&ID
IME-K-0050 – Tank 568 P&ID

SI483017_RPT - IME-SIS1 Documentation Verification to be completed prior to each period of testing to confirm correct revisions of documentation.

A controlled copy of this procedure will be used to carry out the testing and will form part of the lifecycle testing documentation.
Controlled copies of all documentation required for testing to be attached. In addition to procedures documented in this report calibration certificates, engineers reports are to be issued to each item as applicable.

6 HARDWARE VERIFICATION

Purpose of Test
To verify the correct equipment is fitted and no unauthorised modifications have been carried out. To verify equipment physical condition and fitness for purpose. *Equipment may not function correctly if damaged or modified.* *Equipment not identified as SIS may not be reported to the system keeper following works by maintenance / contractors.* *To ensure correct designed/rated equipment is installed.*
Controlled Copy Documentation Required
SI483010_SCH - IME-SIS1 Instrument Schedule SI483012_SCH – IME-SIS1 Trip Matrix SI483001_DWG - Tanks 561, 564 & 568 Cable Overview IME-K-0028 – Tank 561 P&ID IME-K-0052 – Tank 564 P&ID IME-K-0050 – Tank 568 P&ID

Step	**Method of Test**	**Acceptance Criteria**	**Pass (✓) Fail (x) Initial**
6.1	Review procedure with operations and testing personnel.	All personnel familiarised with the scope of works and responsibilities. *Comment any issues in section 6.6 and review / rectify prior to starting testing.*	
6.2	Confirm plant preparations satisfactory. *Record PTW No*……	Conditions satisfied as detailed on PTW and RAMS. *Comment any issues in section 6.6 and review / rectify prior to starting site work*	
6.3	Confirm equipment has not been replaced by comparing against information on SCH. Record method used to identify equipment on controlled copy of SCH Highlight column, e.g. SIS Tag / Serial No etc.	Equipment identified as SCH, Labelling and tagging correct. SIS identification correct. *Comment observations in section 6.6.*	
6.4	Confirm no visible signs of system and equipment modification, relocation, or not fit for purpose by comparing against controlled copy of SCH, P&ID and configuration. Highlight equipment checked on controlled copy of SCH & P&ID.	No visible signs of unauthorised modification or relocation. Equipment is clean and of sound physical condition, mountings, cable entries and process connections are fit for designed purpose with unrestricted access. *Comment observations in section 6.6.*	
6.5	Confirm no visible signs of additional plant or parallel systems which could affect the SIS or invalidate testing.	No new additional plant equipment or BPCS systems. *Comment any issues in section 6.6.and review / rectify prior to starting functional testing.*	

Hardware Verification Continued on page 8

6 Hardware Verification Continued .....

6.6	Comments/Defects/ Remedial Actions – Report ALL to System Keeper

Tested by	Position	Qualification	Sign	Date

System Keeper Acknowledgement
(Note: Signature confirms System keeper is advised of Comments/Defects/Remedial Actions and will initiate terminal procedures for rectification works and/or isolation of plant as required)

Accepted by	Position	Qualification	Sign	Date

7 AS FOUND FUNCTIONAL PROOF TESTING PROCEDURE

7.1 TK561-SIF1 - Tank 561 As Found Functional Testing

Purpose of Test			
To verify the as found operation of LE56101 Tank 561 Independent high high level trip closes XV56101 FINAL ELEMENT valve. To verify the as found Manual Shutdown functions of Tank 561 FINAL ELEMENT XV56101 valve. To verify the correct DIAGNOSTICS information. *If sensing element defective the tank could overfill if a demand is made on the overfill protection system.* *If manual shutdown systems defective the FINAL ELEMENT could fail to close if a demand is made on the terminal shutdown systems.* *If response target time is exceeded the tank could overfill following demand.* *If FINAL ELEMENT travel time is reduced excessive pipeline surge pressure could be generated.* *Diagnostic information not displayed correctly could result in undetected tank overfill, system unavailability or incorrect operational response.*			
Controlled Copy Documentation Required			
SI483012_SCH – IME-SIS1 Trip Matrix			
Step	**Method of Test**	**Acceptance Criteria**	**Pass (✓) Fail (x) Initial**
7.1.1	Review procedure with operations and testing personnel.	All personnel familiarised with the scope of works and responsibilities. *Comment any issues in section 7.1.12 and review / rectify prior to starting testing.*	
7.1.2	Confirm plant preparations satisfactory. *Record PTW No……*	Conditions satisfied as detailed on PTW and RAMS. *Comment any issues in section 7.1.12 and review / rectify prior to starting testing.*	
7.1.3	Confirm system healthy and reset.	System healthy and reset as detailed on SI483013_SCH Sheet 1. *Comment differences from SCH or if found in tripped state in section 7.1.12.*	
7.1.3	XV56101 is normally in the open position, if found closed open via local manual isolation switch. (confirm acceptance criteria @ step 7.1.7 if found open)	Valve action found smooth. *Comment poor action / sticking in section 7.1.12.*	
		Opening time – No specific requirement. *Comment times > 120 seconds in section 7.1.12.*	
		Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 1. *Comment differences from SCH in section 7.1.12.*	

Tank 561 As Found Functional Testing Continued on page 10

7.1 Tank 561 As Found Functional Testing Continued…

Step	Method of Test	Acceptance Criteria	Pass (✓) Fail (x) Initial
7.1.5	Refer to SI483015_RPT Wet test of probe required minimum of every 5 years. 5 yearly wet test due, remove probe from tank and immerse in suitable liquid. 5 yearly wet test not due not use Nivotester test button. *Record method of test* ……	System trips closing and inhibiting from reopening FINAL ELEMENT valve and initiating DIAGNOSTICS as detailed on SI483012_SCH Sheet 2 *Comment differences from SCH in section 7.1.12.*	
		FINAL ELEMENT valve action found smooth. *Comment poor action / sticking in section 7.1.12.*	
		Time from test initiation to trip activation <=2 seconds. *Comment failures in section 7.1.12*	
		FINAL ELEMENT valve traveling time >= 90 Seconds *Comment times < 90 Seconds in section 7.1.12*	
		Time from test initiation to FINAL ELEMENT valve closed <= 180 Seconds *Comment times > 180 Seconds in section 7.1.12*	
7.1.6	Remove probe from liquid/ release Nivotester test button.	System remains tripped inhibiting from reopening FINAL ELEMENT valves. DIAGNOSTICS as detailed on SI483012_SCH sheets 1 & 2 *Comment failure in section 7.1.12*	
7.1.7	Operate Logic Solver Panel SYSTEM RESET pushbutton	System healthy and reset as detailed on SI483012_SCH Sheet 1. FINAL ELEMENT valve automatically reopens. *Comment differences from SCH in section 7.1.12*	
		Valve action found smooth. *Comment poor action / sticking in section 7.1.12.*	
		Opening time – No specific requirement. *Comment times > 120 seconds in section 7.1.12.*	
		Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 1. *Comment differences from SCH in section 7.1.12.*	
7.1.8	Operate HS561 Tank 561 Isolation Pushbutton.	Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 2. *Comment differences from SCH in section 7.1.12.*	
		Time from test initiation to trip activation <=2 seconds. *Comment failures in section 7.1.12*	

Tank 561 As Found Functional Testing Continued on page 11

7.1 Tank 561 As Found Functional Testing Continued…

Step	Method of Test	Acceptance Criteria	Pass (✓) Fail (x) Initial
7.1.9	Release HS561 Tank 561 Isolation Pushbutton.	FINAL ELEMENT valve automatically reopens initiating DIAGNOSTICS as detailed on SI483012_SCH Sheet 1 *Comment differences from SCH in section 7.1.12.*	
7.1.10	Operations to initiate Terminal Shutdown system. *Record method of test* ……	Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 2. *Comment differences from SCH in section 7.1.12.*	
		Time from test initiation to trip activation <=2 seconds. *Comment failures in section 7.1.12*	
7.1.11	Operations to Reset Terminal Shutdown system.	FINAL ELEMENT valve automatically reopens initiating DIAGNOSTICS as detailed on SI483012_SCH Sheet 1 *Comment differences from SCH in section 7.1.12.*	
7.1.12	Comments/Defects/ Remedial Actions – Report ALL to System Keeper		

Tested by	Position	Qualification	Sign	Date

System Keeper Acknowledgement
(Note: Signature confirms System keeper is advised of Comments/Defects/Remedial Actions and will initiate terminal procedures for rectification works and/or isolation of plant as required)

Accepted by	Position	Qualification	Sign	Date

7.2 TK564-SIF1 - Tank 564 As Found Functional Testing

Purpose of Test			
To verify the as found operation of LE56401 Tank 564 Independent high high level trip closes XV56401 FINAL ELEMENT valve. To verify the as found Manual Shutdown functions of Tank 564 FINAL ELEMENT XV56401 valve. To verify the correct DIAGNOSTICS information. *If sensing element defective the tank could overfill if a demand is made on the overfill protection system.* *If manual shutdown systems defective the FINAL ELEMENT could fail to close if a demand is made on the terminal shutdown systems.* *If response target time is exceeded the tank could overfill following demand.* *If FINAL ELEMENT travel time is reduced excessive pipeline surge pressure could be generated.* *Diagnostic information not displayed correctly could result in undetected tank overfill, system unavailability or incorrect operational response.*			
Controlled Copy Documentation Required			
SI483012_SCH – IME-SIS1 Trip Matrix			
Step	**Method of Test**	**Acceptance Criteria**	**Pass (✓) Fail (x) Initial**
7.2.1	Review procedure with operations and testing personnel.	All personnel familiarised with the scope of works and responsibilities. *Comment any issues in section 7.2.12 and review / rectify prior to starting testing.*	
7.2.2	Confirm plant preparations satisfactory. *Record PTW No……*	Conditions satisfied as detailed on PTW and RAMS. *Comment any issues in section 7.2.12 and review / rectify prior to starting testing.*	
7.2.3	Confirm system healthy and reset.	System healthy and reset as detailed on SI483013_SCH Sheet 1. *Comment differences from SCH or if found in tripped state in section 7.2.12.*	
7.2.4	XV56401 is normally in the open position, if found closed open via local manual isolation switch. (confirm acceptance criteria @ step 7.2.7 if found open)	Valve action found smooth. *Comment poor action / sticking in section 7.2.12.*	
		Opening time – No specific requirement. *Comment times > 120 seconds in section 7.2.12.*	
		Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 1. *Comment differences from SCH in section 7.2.12.*	

Tank 564 As Found Functional Testing Continued on page 13

7.2 Tank 564 As Found Functional Testing Continued…

Step	Method of Test	Acceptance Criteria	Pass (✓) Fail (x) Initial
7.2.5	Refer to SI483015_RPT Wet test of probe required minimum of every 5 years. 5 yearly wet test due, remove probe from tank and immerse in suitable liquid. 5 yearly wet test not due not use Nivotester test button. *Record method of test* ……	System trips closing and inhibiting from reopening FINAL ELEMENT valve and initiating DIAGNOSTICS as detailed on SI483012_SCH Sheet 2 *Comment differences from SCH in section 7.2.12.*	
		FINAL ELEMENT valve action found smooth. *Comment poor action / sticking in section 7.2.12.*	
		Time from test initiation to trip activation <=2 seconds. *Comment failures in section 7.2.12*	
		FINAL ELEMENT valve traveling time >= 90 Seconds *Comment times < 90 Seconds in section 7.2.12*	
		Time from test initiation to FINAL ELEMENT valve closed <= 180 Seconds *Comment times > 180 Seconds in section 7.2.12*	
7.2.6	Remove probe from liquid/ release Nivotester test button.	System remains tripped inhibiting from reopening FINAL ELEMENT valves. DIAGNOSTICS as detailed on SI483012_SCH sheets 1 & 2 *Comment failure in section 7.2.12*	
7.2.7	Operate Logic Solver Panel SYSTEM RESET pushbutton	System healthy and reset as detailed on SI483012_SCH Sheet 1. FINAL ELEMENT valve automatically reopens. *Comment differences from SCH in section 7.2.12*	
		Valve action found smooth. *Comment poor action / sticking in section 7.2.12.*	
		Opening time – No specific requirement. *Comment times > 120 seconds in section 7.2.12.*	
		Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 1. *Comment differences from SCH in section 7.2.12.*	
7.2.8	Operate HS564 Tank 564 Isolation Pushbutton.	Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 2. *Comment differences from SCH in section 7.2.12.*	
		Time from test initiation to trip activation <=2 seconds. *Comment failures in section 7.2.12*	

Tank 564 As Found Functional Testing Continued on page 14

7.2 Tank 564 As Found Functional Testing Continued…

Step	Method of Test	Acceptance Criteria	Pass (✓) Fail (x) Initial
7.2.9	Release HS564 Tank 564 Isolation Pushbutton.	FINAL ELEMENT valve automatically reopens initiating DIAGNOSTICS as detailed on SI483012_SCH Sheet 1 *Comment differences from SCH in section 7.2.12.*	
7.2.10	Operations to initiate Terminal Shutdown system. *Record method of test* ……	Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 2. *Comment differences from SCH in section 7.2.12.*	
		Time from test initiation to trip activation <=2 seconds. *Comment failures in section 7.2.12*	
7.2.11	Operations to Reset Terminal Shutdown system.	FINAL ELEMENT valve automatically reopens initiating DIAGNOSTICS as detailed on SI483012_SCH Sheet 1 *Comment differences from SCH in section 7.2.12.*	
7.2.12	Comments/Defects/ Remedial Actions – Report ALL to System Keeper		

Tested by	Position	Qualification	Sign	Date

System Keeper Acknowledgement
(Note: Signature confirms System keeper is advised of Comments/Defects/Remedial Actions and will initiate terminal procedures for rectification works and/or isolation of plant as required)

Accepted by	Position	Qualification	Sign	Date

7.3 TK568-SIF1 - Tank 568 As Found Functional Testing

Purpose of Test
To verify the as found operation of LE56801 Tank 568 Independent high high level trip closes XV56801 FINAL ELEMENT Import / Export valve. To verify the as found Manual Shutdown functions of Tank 568 FINAL ELEMENT XV56801 Import / Export valve. To verify the correct DIAGNOSTICS information. *If sensing element defective the tank could overfill if a demand is made on the overfill protection system.* *If manual shutdown systems defective the FINAL ELEMENT could fail to close if a demand is made on the terminal shutdown systems.* *If response target time is exceeded the tank could overfill following demand.* *If FINAL ELEMENT travel time is reduced excessive pipeline surge pressure could be generated.* *Diagnostic information not displayed correctly could result in undetected tank overfill, system unavailability or incorrect operational response.*
Controlled Copy Documentation Required
SI483012_SCH – IME-SIS1 Trip Matrix

Step	**Method of Test**	**Acceptance Criteria**	**Pass (✓) Fail (x) Initial**
7.3.1	Review procedure with operations and testing personnel.	All personnel familiarised with the scope of works and responsibilities. *Comment any issues in section 7.3.12 and review / rectify prior to starting testing.*	
7.3.2	Confirm plant preparations satisfactory. *Record PTW No……*	Conditions satisfied as detailed on PTW and RAMS. *Comment any issues in section 7.3.12 and review / rectify prior to starting testing.*	
7.3.3	Confirm system healthy and reset.	System healthy and reset as detailed on SI483013_SCH Sheet 1. *Comment differences from SCH or if found in tripped state in section 7.3.12.*	
7.3.4	XV56801 valve is normally in the open position, if found closed open via local manual isolation switch. (confirm acceptance criteria @ step 7.3.7 if found open)	Valve action found smooth. *Comment poor action / sticking in section 7.3.12.*	
		Opening time – No specific requirement. *Comment times > 120 seconds in section 7.3.12.*	
		Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 1. *Comment differences from SCH in section 7.3.12.*	

Tank 568 As Found Functional Testing Continued on page 16

7.3 Tank 568 As Found Functional Testing Continued…

7.3.5	Refer to SI483015_RPT Wet test of probe required minimum of every 5 years. 5 yearly wet test due, remove probe from tank and immerse in suitable liquid. 5 yearly wet test not due not use Nivotester test button. *Record method of test* ……	System trips closing and inhibiting from reopening FINAL ELEMENT valve and initiating DIAGNOSTICS as detailed on SI483012_SCH Sheet 2 *Comment differences from SCH in section 7.3.12.*	
		FINAL ELEMENT valve action found smooth. *Comment poor action / sticking in section 7.3.12.*	
		Time from test initiation to trip activation <=2 seconds. *Comment failures in section 7.3.12*	
		FINAL ELEMENT valve traveling time >= 90 Seconds *Comment times < 90 Seconds in section 7.3.12*	
		Time from test initiation to FINAL ELEMENT valve closed <= 180 Seconds *Comment times > 180 Seconds in section 7.3.12*	
7.3.6	Remove probe from liquid/ release Nivotester test button.	System remains tripped inhibiting from reopening FINAL ELEMENT valves. DIAGNOSTICS as detailed on SI483012_SCH sheets 1 & 2 *Comment failure in section 7.3.12*	
7.3.7	Operate Logic Solver Panel SYSTEM RESET pushbutton	System healthy and reset as detailed on SI483012_SCH Sheet 1. FINAL ELEMENT valve automatically reopens. *Comment differences from SCH in section 7.3.12*	
		Valve action found smooth. *Comment poor action / sticking in section 7.3.12.*	
		Opening time – No specific requirement. *Comment times > 120 seconds in section 7.3.12.*	
		Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 1. *Comment differences from SCH in section 7.3.12.*	
7.3.8	Operate HS568 Tank 568 Isolation Pushbutton.	Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 2. *Comment differences from SCH in section 7.3.12.*	
		Time from test initiation to trip activation <=2 seconds. *Comment failures in section 7.3.12*	

Tank 568 As Found Functional Testing Continued on page 17

7.3 Tank 568 As Found Functional Testing Continued…

Step	Method of Test	Acceptance Criteria	Pass (✓) Fail (x) Initial
7.3.9	Release HS568 Tank 568 Isolation Pushbutton.	FINAL ELEMENT valve automatically reopens initiating DIAGNOSTICS as detailed on SI483012_SCH Sheet 1 *Comment differences from SCH in section 7.3.12.*	
7.3.10	Operations to initiate Terminal Shutdown system. *Record method of test* ……	Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 2. *Comment differences from SCH in section 7.3.12.*	
		Time from test initiation to trip activation <=2 seconds. *Comment failures in section 7.3.12*	
7.3.11	Operations to Reset Terminal Shutdown system.	FINAL ELEMENT valve automatically reopens initiating DIAGNOSTICS as detailed on SI483012_SCH Sheet 1 *Comment differences from SCH in section 7.3.12.*	
7.3.12	Comments/Defects/ Remedial Actions – Report ALL to System Keeper		

Tested by	Position	Qualification	Sign	Date

System Keeper Acknowledgement
(Note: Signature confirms System keeper is advised of Comments/Defects/Remedial Actions and will initiate terminal procedures for rectification works and/or isolation of plant as required)

Accepted by	Position	Qualification	Sign	Date

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Process Instrumentation Consultancy & Design

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Thornaby, TS17 7AF, United Kingdom.
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IMMINGHAM STORAGE Co LTD

IMMINGHAM EAST TERMINAL

IME-SIS1

SAFETY INSTRUMENT SYSTEM

EQUIPMENT FAILURE

PROOF TESTING PROCEDURE

Rev	Date	By	Checked	Approved	Description	Client Ref.
A	09.04.14	D.B.Faulkner	D.S.Regan	ISCo	Original Issue	
						Document No. **SI483019_RPT**

IF NOT SIGNED THIS DOCUMENT IS UNCONTROLLED

Contents

1 REVISION HISTORY

Rev	Description
A	Original Issue

This document will be revised with any additions to or removals from IME-SIS1 throughout the operational lifecycle of the system.

2 INTRODUCTION

This document provides a procedure for equipment failure functional proof testing to ensure that the Safety Instrument System Life Cycle complies with the requirements of the standard BS EN 61511.

3 SCOPE

Client / Company	-	Immingham Storage Co Ltd
Location / Facility	-	ISCo East Terminal
Plant Unit	-	Tanks 561, 564 & 568
Service	-	No4 East Storage Tank Overfill Protection
SIS Tag No	-	IME-SIS1
SIF's Tag No's	-	TK561-SIF1, TK564-SIF1 & TK568-SIF1
SIL	-	2

Lifecycle Stages

Operation and Maintenance	-	BS EN 61511 Clause

Audience

This document has been produced for use by competent persons knowledgeable in testing Safety Instrument Systems.

Brief System Description

IME-SIS1 under test is to prevent the overfill of storage tanks 561, 564 & 568 when on import duty. The system is classified as SIL2.
Full system description in documentation reference SI277001_RPT – IME-SIS1 Safety Instrument System and Piping & Instrument Diagrams – IME-K-0028 – Tank 561, IME-K-0052 – Tank 564 & IME-K-0050 – Tank 568.

Procedure

This procedure outlines the necessary steps required to verify the correct equipment is installed, the physical condition of the installed equipment and the functional operation performs the SIF's as designed.

Detailed in this report are the methods of test for each SIF.

The results of these tests will be recorded in this report, historical data will be recorded and approved as satisfactory in report reference SI483015_RPT - IME-SIS1 Operation, Maintenance and Modification Lifecycle.

This report details equipment failure testing whilst no transfer to the tanks is in operation.

All faults should be reported to the system keeper, with minor repairs carried out if practicable. If further maintenance work is required the system keeper will initiate it.

4 DEFINITIONS AND ABBREVIATIONS

The following definitions and abbreviations apply to this document.

BPCS	Basic Process Control System
Logic Solver	Part of the SIS that performs one or more logic functions, e.g. safety relay, trip amplifier
Proof Test	Periodic testing to detect failures in a safety instrumented system
Protection Layer	A mechanism that reduces risk by control, prevention or mitigation
Sensor	Part of the SIS which measures the process condition
SIF	Safety Instrumented Function – A function with a specified safety integrity level which is necessary to achieve functional safety
SIL	Safety integrity level – A numerical number, 1 to 4 stipulating the level of integrity the system shall perform to, 1 being the lowest 4 the highest
SIS	Safety Instrument System – A SIS comprises of sensors, logic solvers and final elements
1ooN	SIS made up of N independent channels, which are so connected, that any single channel is sufficient to perform the correct safety instrumented function
2ooN	SIS made up of N independent channels, which are so connected, that any two of the channels are required to perform the correct safety instrumented function
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
PFD	Probability of Failing on Demand
SCADA	Supervisory Control and Data Acquisition (Visual display screen)
P&ID	Piping & Instrument Diagram
SCH	Schedule
PTW	Permit to Work
RAMS	Risk Assessment and Method Statement

5 PREPARATION

All Health and Safety / Permit To Work systems must be implemented before commencing testing. SI483012_RPT - IME-SIS1 RAMS is to be submitted for approval prior to the site testing.

IME-SIS1 is completely independent of the BPCS, no overrides or special preparations are required to facilitate uncompromised testing.

Controlled copies of the following documentation will be required :-
SI483015_RPT - IME-SIS1 Operation, Maintenance and Modification Lifecycle
SI483019_RPT - IME-SIS1 Equipment Failure Proof Testing Procedure
SI483010_SCH - IME-SIS1 Instrument Schedule
SI483012_SCH - IME-SIS1 Trip Matrix
SI483001_DWG - Tanks 561, 564 & 568 Cable Overview
SI483020_DWG - LE56101 Tank 561 HiHi Level Switch Loop Sheet
SI483021_DWG - XV56101 Tank 561 Valve Loop Sheet
SI483022_DWG - LE56401 Tank 564 HiHi Level Switch Loop Sheet
SI483023_DWG - XV56401 Tank 564 Valve Loop Sheet
SI483024_DWG - LE564801 Tank 568 HiHi Level Switch Loop Sheet
SI483025_DWG - XV56801 Tank 568 Valve Loop Sheet
SI483026_DWG – No4 East SIS Logic Solver ESD Loop Sheet
IME-K-0028 – Tank 561 P&ID
IME-K-0052 – Tank 564 P&ID
IME-K-0050 – Tank 568 P&ID

SI483017_RPT - IME-SIS1 Documentation Verification to be completed prior to each period of testing to confirm correct revisions of documentation.

SI208018_RPT - IME-SIS1 Shutdown Conditions Proof Testing Procedure to be completed prior to each period of testing to confirm the as found condition.

SECTION 6 – HARDWARE VERIFICATION not required if equipment failure testing is part of a scheduled proof test.
Hardware verification to be completed for the relevant equipment following authorised modifications or like for like equipment replacement following failure

A controlled copy of this procedure will be used to carry out the testing and will form part of the lifecycle testing documentation.
Controlled copies of all documentation required for testing to be attached. In addition to procedures documented in this report calibration certificates, engineers reports are to be issued to each item as applicable.

6 HARDWARE VERIFICATION

Purpose of Test			
To verify the correct equipment is fitted and no unauthorised modifications have been carried out. To verify equipment physical condition and fitness for purpose. *Equipment may not function correctly if damaged or modified.* *Equipment not identified as SIS may not be reported to the system keeper following works by maintenance / contractors.* *To ensure correct designed/rated equipment is installed.*			
Controlled Copy Documentation Required			
SI483010_SCH - IME-SIS1 Instrument Schedule SI483012_SCH – IME-SIS1 Trip Matrix SI483001_DWG - Tanks 561, 564 & 568 Cable Overview IME-K-0028 – Tank 561 P&ID IME-K-0052 – Tank 564 P&ID IME-K-0050 – Tank 568 P&ID			
Step	**Method of Test**	**Acceptance Criteria**	**Pass (✓) Fail (x) Initial**
6.1	Review procedure with operations and testing personnel.	All personnel familiarised with the scope of works and responsibilities. *Comment any issues in section 6.6 and review / rectify prior to starting testing.*	
6.2	Confirm plant preparations satisfactory. *Record PTW No*……	Conditions satisfied as detailed on PTW and RAMS. *Comment any issues in section 6.6 and review / rectify prior to starting site work*	
6.3	Confirm equipment has not been replaced by comparing against information on SCH. Record method used to identify equipment on controlled copy of SCH Highlight column, e.g. SIS Tag / Serial No etc.	Equipment identified as SCH, Labelling and tagging correct. SIS identification correct. *Comment observations in section 6.6.*	
6.4	Confirm no visible signs of system and equipment modification, relocation, or not fit for purpose by comparing against controlled copy of SCH, P&ID and configuration. Highlight equipment checked on controlled copy of SCH & P&ID.	No visible signs of unauthorised modification or relocation. Equipment is clean and of sound physical condition, mountings, cable entries and process connections are fit for designed purpose with unrestricted access. *Comment observations in section 6.6.*	
6.5	Confirm no visible signs of additional plant or parallel systems which could affect the SIS or invalidate testing.	No new additional plant equipment or BPCS systems. *Comment any issues in section 6.6.and review / rectify prior to starting functional testing.*	

Hardware Verification Continued on page 8

6 Hardware Verification Continued .....

6.6	Comments/Defects/ Remedial Actions – Report ALL to System Keeper

Tested by	Position	Qualification	Sign	Date

System Keeper Acknowledgement
(Note: Signature confirms System keeper is advised of Comments/Defects/Remedial Actions and will initiate terminal procedures for rectification works and/or isolation of plant as required)

Accepted by	Position	Qualification	Sign	Date

7 FAILURE MODE TESTING PROCEDURE

7.1 Failure Mode Functional Testing

Purpose of Test			
To verify the correct FAILURE MODES of IME-SIS1. To verify correct failure DIAGNOSTICS information. *Incorrect system / component configuration may not detect fault modes.* *Diagnostic information not displayed correctly could result in undetected tank overfill, system unavailability or incorrect operational response.*			
Controlled Copy Documentation Required			
SI483012_SCH - IME-SIS1 Trip Matrix SI483001_DWG - Tanks 561, 564 & 568 Cable Overview SI483020_DWG - LE56101 Tank 561 HiHi Level Switch Loop Sheet SI483021_DWG - XV56101 Tank 561 Valve Loop Sheet SI483022_DWG - LE56401 Tank 564 HiHi Level Switch Loop Sheet SI483023_DWG - XV56401 Tank 564 Valve Loop Sheet SI483024_DWG - LE564801 Tank 568 HiHi Level Switch Loop Sheet SI483025_DWG - XV56801 Tank 568 Valve Loop Sheet SI483026_DWG - No2 East SIS Logic Solver ESD Loop Sheet			
Step	**Method of Test**	**Acceptance Criteria**	**Pass (✓) Fail (x) Initial**
7.1.1	Review procedure with operations and testing personnel.	All personnel familiarised with the scope of works and responsibilities. *Comment any issues in section 7.1.5 and review / rectify prior to starting testing.*	
7.1.2	Confirm plant preparations satisfactory. *Record PTW No*……	Conditions satisfied as detailed on PTW and RAMS. *Comment any issues in section 7.1.5 and review / rectify prior to starting testing.*	
7.1.3	Confirm system healthy and reset.	System healthy and reset as detailed on SI483012_SCH Sheet 1. *Comment differences from SCH or if found in tripped state in section 7.1.5.*	
7.1.4	Initiate and reset each applicable FAILURE MODE DETECTED as detailed on SI483012_SCH Sheet 2. Highlight tests completed on controlled copy of SCH.	ACTION and DIAGNOSTICS as detailed on SI483012_SCH Sheet 2. System healthy and reset as detailed on SI483012_SCH Sheet 1. *Comment differences from SCH in section 7.1.5*	

Failure Mode Functional Testing Continued on page 10

7.1 Failure Mode Functional Testing Continued…..

7.1.5	Comments/Defects/ Remedial Actions – Report ALL to System Keeper

Tested by	Position	Qualification	Sign	Date

System Keeper Acknowledgement
(Note: Signature confirms System keeper is advised of Comments/Defects/Remedial Actions and will initiate terminal procedures for rectification works and/or isolation of plant as required)

Accepted by	Position	Qualification	Sign	Date

8 AS LEFT FUNCTIONAL PROOF TESTING PROCEDURE

8.1 TK561-SIF1 - Tank 561 As Left Functional Testing

Purpose of Test			
To verify the as left operation of LE56101 Tank 561 Independent high high level trip closes XV56101 FINAL ELEMENT valve following system disturbance. To verify the as left Manual Shutdown functions of Tank 561 FINAL ELEMENT XV56101. To verify the correct DIAGNOSTICS information. *If sensing element defective the tank could overfill if a demand is made on the overfill protection system.* *If manual shutdown systems defective the FINAL ELEMENT could fail to close if a demand is made on the terminal shutdown systems.* *If response target time is exceeded the tank could overfill following demand.* *If FINAL ELEMENT travel time is reduced excessive pipeline surge pressure could be generated.* *Diagnostic information not displayed correctly could result in undetected tank overfill, system unavailability or incorrect operational response.*			
Controlled Copy Documentation Required			
SI483012_SCH – IME-SIS1 Trip Matrix			
Step	**Method of Test**	**Acceptance Criteria**	**Pass (✓) Fail (x) Initial**
8.1.1	Review procedure with operations and testing personnel.	All personnel familiarised with the scope of works and responsibilities. *Comment any issues in section 8.1.12 and review / rectify prior to starting testing.*	
8.1.2	Confirm plant preparations satisfactory. *Record PTW No……*	Conditions satisfied as detailed on PTW and RAMS. *Comment any issues in section 8.1.12 and review / rectify prior to starting testing.*	
8.1.3	Confirm system healthy and reset.	System healthy and reset as detailed on SI483013_SCH Sheet 1. *Comment differences from SCH or if left in tripped state in section 8.1.12.*	
8.1.4	Open XV56101.	Valve action left smooth. *Comment poor action / sticking in section 8.1.12.*	
		Opening time – No specific requirement. *Comment times > 120 seconds in section 8.1.12.*	
		Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 1. *Comment differences from SCH in section 8.1.12.*	

Tank 561 As Left Functional Testing Continued on page 12

8.1 Tank 561 As Left Functional Testing Continued…

Step	Method of Test	Acceptance Criteria	Pass (✓) Fail (x) Initial
8.1.5	Refer to SI483015_RPT Wet test of probe required if probe replaced or disturbed. Wet test required, remove probe from tank and immerse in suitable liquid. Wet test not required use Nivotester test button. *Record method of test* ……	System trips closing and inhibiting from reopening FINAL ELEMENT valve and initiating DIAGNOSTICS as detailed on SI483012_SCH Sheet 2 *Comment differences from SCH in section 8.1.12.*	
		FINAL ELEMENT valve action left smooth. *Comment poor action / sticking in section 8.1.12.*	
		Time from test initiation to trip activation <=2 seconds. *Comment failures in section 8.1.12*	
		FINAL ELEMENT valve traveling time >= 90 Seconds *Comment times < 90 Seconds in section 8.1.12*	
		Time from test initiation to FINAL ELEMENT valve closed <= 180 Seconds *Comment times > 180 Seconds in section 8.1.12*	
8.1.6	Remove probe from liquid / release Nivotester test button.	System remains tripped inhibiting from reopening FINAL ELEMENT valves. DIAGNOSTICS as detailed on SI483012_SCH sheets 1 & 2 *Comment failure in section 8.1.12*	
8.1.7	Operate Logic Solver Panel SYSTEM RESET pushbutton	System healthy and reset as detailed on SI483012_SCH Sheet 1. FINAL ELEMENT valve automatically reopens. *Comment differences from SCH in section 8.1.12*	
		Valve action left smooth. *Comment poor action / sticking in section 8.1.12.*	
		Opening time – No specific requirement. *Comment times > 120 seconds in section 8.1.12.*	
		Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 1. *Comment differences from SCH in section 8.1.12.*	
8.1.8	Operate HS561 Tank 561 Isolation Pushbutton.	Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 2. *Comment differences from SCH in section 8.1.12.*	
		Time from test initiation to trip activation <=2 seconds. *Comment failures in section 8.1.12*	

Tank 561 As Left Functional Testing Continued on page 13

8.1 Tank 561 As Left Functional Testing Continued…

Step	Method of Test	Acceptance Criteria	Pass (✓) Fail (x) Initial
8.1.9	Release HS561 Tank 561 Isolation Pushbutton.	FINAL ELEMENT valve automatically reopens initiating DIAGNOSTICS as detailed on SI483012_SCH Sheet 1 *Comment differences from SCH in section 8.1.12.*	
8.1.10	Operations to initiate Terminal Shutdown system. *Record method of test* ……	Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 2. *Comment differences from SCH in section 8.1.12.*	
		Time from test initiation to trip activation <=2 seconds. *Comment failures in section 8.1.12*	
8.1.11	Operations to Reset Terminal Shutdown system.	FINAL ELEMENT valve automatically reopens initiating DIAGNOSTICS as detailed on SI483012_SCH Sheet 1 *Comment differences from SCH in section 8.1.12.*	
8.1.12	Comments/Defects/ Remedial Actions – Report ALL to System Keeper		

Tested by	Position	Qualification	Sign	Date

System Keeper Acknowledgement
(Note: Signature confirms System keeper is advised of Comments/Defects/Remedial Actions and will initiate terminal procedures for rectification works and/or isolation of plant as required)

Accepted by	Position	Qualification	Sign	Date

8.2 TK564-SIF1 - Tank 564 As Left Functional Testing

Purpose of Test
To verify the as left operation of LE56401 Tank 564 Independent high high level trip closes XV56401 FINAL ELEMENT Import / Export valve following system disturbance. To verify the as left Manual Shutdown functions of Tank 564 FINAL ELEMENT XV56401. To verify the correct DIAGNOSTICS information. *If sensing element defective the tank could overfill if a demand is made on the overfill protection system.* *If manual shutdown systems defective the FINAL ELEMENT could fail to close if a demand is made on the terminal shutdown systems.* *If response target time is exceeded the tank could overfill following demand.* *If FINAL ELEMENT travel time is reduced excessive pipeline surge pressure could be generated.* *Diagnostic information not displayed correctly could result in undetected tank overfill, system unavailability or incorrect operational response.*
Controlled Copy Documentation Required
SI483012_SCH – IME-SIS1 Trip Matrix

Step	**Method of Test**	**Acceptance Criteria**	**Pass (✓) Fail (x) Initial**
8.2.1	Review procedure with operations and testing personnel.	All personnel familiarised with the scope of works and responsibilities. *Comment any issues in section 8.2.12 and review / rectify prior to starting testing.*	
8.2.2	Confirm plant preparations satisfactory. *Record PTW No……*	Conditions satisfied as detailed on PTW and RAMS. *Comment any issues in section 8.2.12 and review / rectify prior to starting testing.*	
8.2.3	Confirm system healthy and reset.	System healthy and reset as detailed on SI483013_SCH Sheet 1. *Comment differences from SCH or if left in tripped state in section 8.2.12.*	
8.2.4	Open XV56401.	Valve action left smooth. *Comment poor action / sticking in section 8.2.12.*	
		Opening time – No specific requirement. *Comment times > 120 seconds in section 8.2.12.*	
		Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 1. *Comment differences from SCH in section 8.2.12.*	

Tank 564 As Left Functional Testing Continued on page 15

8.2 Tank 564 As Left Functional Testing Continued…

Step	Method of Test	Acceptance Criteria	Pass (✓) Fail (x) Initial
8.2.5	Refer to SI483015_RPT Wet test of probe required if probe replaced or disturbed. Wet test required, remove probe from tank and immerse in suitable liquid. Wet test not required use Nivotester test button. *Record method of test* ……	System trips closing and inhibiting from reopening FINAL ELEMENT valve and initiating DIAGNOSTICS as detailed on SI483012_SCH Sheet 2 *Comment differences from SCH in section 8.2.12.*	
		FINAL ELEMENT valve action left smooth. *Comment poor action / sticking in section 8.2.12.*	
		Time from test initiation to trip activation <=2 seconds. *Comment failures in section 8.2.12*	
		FINAL ELEMENT valve traveling time >= 90 Seconds *Comment times < 90 Seconds in section 8.2.12*	
		Time from test initiation to FINAL ELEMENT valve closed <= 180 Seconds *Comment times > 180 Seconds in section 8.2.12*	
8.2.6	Remove probe from liquid / release Nivotester test button.	System remains tripped inhibiting from reopening FINAL ELEMENT valves. DIAGNOSTICS as detailed on SI483012_SCH sheets 1 & 2 *Comment failure in section 8.2.12*	
8.2.7	Operate Logic Solver Panel SYSTEM RESET pushbutton	System healthy and reset as detailed on SI483012_SCH Sheet 1. FINAL ELEMENT valve automatically reopens. *Comment differences from SCH in section 8.2.12*	
		Valve action left smooth. *Comment poor action / sticking in section 8.2.12.*	
		Opening time – No specific requirement. *Comment times > 120 seconds in section 8.2.12.*	
		Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 1. *Comment differences from SCH in section 8.2.12.*	
8.2.8	Operate HS564 Tank 564 Isolation Pushbutton.	Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 2. *Comment differences from SCH in section 8.2.12.*	
		Time from test initiation to trip activation <=2 seconds. *Comment failures in section 8.2.12*	

Tank 564 As Left Functional Testing Continued on page 16

8.2 Tank 564 As Left Functional Testing Continued…

Step	Method of Test	Acceptance Criteria	Pass (✓) Fail (x) Initial
8.2.9	Release HS564 Tank 564 Isolation Pushbutton.	FINAL ELEMENT valve automatically reopens initiating DIAGNOSTICS as detailed on SI483012_SCH Sheet 1 *Comment differences from SCH in section 8.2.12.*	
8.2.10	Operations to initiate Terminal Shutdown system. *Record method of test* ……	Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 1. *Comment differences from SCH in section 8.2.12.*	
		Time from test initiation to trip activation <=2 seconds. *Comment failures in section 8.2.12*	
8.2.11	Operations to Reset Terminal Shutdown system.	FINAL ELEMENT valve automatically reopens initiating DIAGNOSTICS as detailed on SI483012_SCH Sheet 1 *Comment differences from SCH in section 8.2.12.*	
8.2.12	Comments/Defects/ Remedial Actions – Report ALL to System Keeper		

Tested by	Position	Qualification	Sign	Date

System Keeper Acknowledgement
(Note: Signature confirms System keeper is advised of Comments/Defects/Remedial Actions and will initiate terminal procedures for rectification works and/or isolation of plant as required)

Accepted by	Position	Qualification	Sign	Date

8.3 TK568-SIF1 - Tank 568 As Left Functional Testing

Purpose of Test
To verify the as left operation of LE56801 Tank 568 Independent high high level trip closes XV56801 FINAL ELEMENT Import / Export valve following system disturbance. To verify the as left Manual Shutdown functions of Tank 568 FINAL ELEMENT XV56801. To verify the correct DIAGNOSTICS information. *If sensing element defective the tank could overfill if a demand is made on the overfill protection system.* *If manual shutdown systems defective the FINAL ELEMENT could fail to close if a demand is made on the terminal shutdown systems.* *If response target time is exceeded the tank could overfill following demand.* *If FINAL ELEMENT travel time is reduced excessive pipeline surge pressure could be generated.* *Diagnostic information not displayed correctly could result in undetected tank overfill, system unavailability or incorrect operational response.*
Controlled Copy Documentation Required
SI483012_SCH – IME-SIS1 Trip Matrix

Step	Method of Test	Acceptance Criteria	Pass (✓) Fail (x) Initial
8.3.1	Review procedure with operations and testing personnel.	All personnel familiarised with the scope of works and responsibilities. *Comment any issues in section 8.3.12 and review / rectify prior to starting testing.*	
8.3.2	Confirm plant preparations satisfactory. *Record PTW No……*	Conditions satisfied as detailed on PTW and RAMS. *Comment any issues in section 8.3.12 and review / rectify prior to starting testing.*	
8.3.3	Confirm system healthy and reset.	System healthy and reset as detailed on SI483013_SCH Sheet 1. *Comment differences from SCH or if left in tripped state in section 8.3.12.*	
8.3.4	Open XV56801.	Valve action left smooth. *Comment poor action / sticking in section 8.3.12.*	
		Opening time – No specific requirement. *Comment times > 120 seconds in section 8.3.12.*	
		Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 1. *Comment differences from SCH in section 8.3.12.*	

Tank 568 As Left Functional Testing Continued on page 18

8.3 Tank 568 As Left Functional Testing Continued…

Step	Method of Test	Acceptance Criteria	Pass (✓) Fail (x) Initial
8.3.5	Refer to SI483015_RPT Wet test of probe required if probe replaced or disturbed. Wet test required, remove probe from tank and immerse in suitable liquid. Wet test not required use Nivotester test button. *Record method of test* ……	System trips closing and inhibiting from reopening FINAL ELEMENT valve and initiating DIAGNOSTICS as detailed on SI483012_SCH Sheet 2 *Comment differences from SCH in section 8.3.12.*	
		FINAL ELEMENT valve action left smooth. *Comment poor action / sticking in section 8.3.12.*	
		Time from test initiation to trip activation <=2 seconds. *Comment failures in section 8.3.12*	
		FINAL ELEMENT valve traveling time >= 90 Seconds *Comment times < 90 Seconds in section 8.3.12*	
		Time from test initiation to FINAL ELEMENT valve closed <= 180 Seconds *Comment times > 180 Seconds in section 8.3.12*	
8.3.6	Remove probe from liquid / release Nivotester test button.	System remains tripped inhibiting from reopening FINAL ELEMENT valves. DIAGNOSTICS as detailed on SI483012_SCH sheets 1 & 2 *Comment failure in section 8.3.12*	
8.3.7	Operate Logic Solver Panel SYSTEM RESET pushbutton	System healthy and reset as detailed on SI483012_SCH Sheet 1. FINAL ELEMENT valve automatically reopens. *Comment differences from SCH in section 8.3.12*	
		Valve action left smooth. *Comment poor action / sticking in section 8.3.12.*	
		Opening time – No specific requirement. *Comment times > 120 seconds in section 8.3.12.*	
		Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 1. *Comment differences from SCH in section 8.3.12.*	
8.3.8	Operate HS568 Tank 568 Isolation Pushbutton.	Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 2. *Comment differences from SCH in section 8.3.12.*	
		Time from test initiation to trip activation <=2 seconds. *Comment failures in section 8.3.12*	

Tank 568 As Left Functional Testing Continued on page 19

8.3 Tank 568 As Left Functional Testing Continued…

Step	Method of Test	Acceptance Criteria	Pass (✓) Fail (x) Initial
8.3.8	Release HS568 Tank 568 Isolation Pushbutton.	FINAL ELEMENT valve automatically reopens initiating DIAGNOSTICS as detailed on SI483012_SCH Sheet 1 *Comment differences from SCH in section 8.3.12.*	
8.3.9	Operations to initiate Terminal Shutdown system. *Record method of test* ……	Correct FINAL ELEMENT valve position and DIAGNOSTICS as detailed on SI483012_SCH Sheet 2. *Comment differences from SCH in section 8.3.12.*	
		Time from test initiation to trip activation <=2 seconds. *Comment failures in section 8.3.12*	
8.3.10	Operations to Reset Terminal Shutdown system.	FINAL ELEMENT valve automatically reopens initiating DIAGNOSTICS as detailed on SI483012_SCH Sheet 1 *Comment differences from SCH in section 8.3.12.*	
8.3.12	Comments/Defects/ Remedial Actions – Report ALL to System Keeper		

Tested by	Position	Qualification	Sign	Date

System Keeper Acknowledgement
(Note: Signature confirms System keeper is advised of Comments/Defects/Remedial Actions and will initiate terminal procedures for rectification works and/or isolation of plant as required)

Accepted by	Position	Qualification	Sign	Date

CLIENT:	REV	DATE	BY	CHKD	APPD	CLIENT REF.
Simon Storage	A	05/12/13	PP	MM	MM	SIS Restructuring
Immingham East	B	07/02/14	DBF	MM	MM	**P & I REF.** SI277015_SPC
						SHT 1 **OF** 4

ITEM: Electrical Component

GENERAL	B	Tag Number	JB4/199
		Service	Tank Valve Junction Box
		Area Classification	Zone 1 IIB T4
UNIT		Type	Stainless Steel Enclosure (1 bottom gland plate)
		Dimensions	Supplier to Confirm
		Supply	24Vdc
		Case	Stainless Steel
		Connections	See OPTIONS
		Mounting	Surface
		Enclosure Class	IP66
		Electrical Classification	ATEX Ex II 2G Exe II T6
		Certificate Reference	Supplier to Confirm

OPTIONS Enclosure to be fitted with the following:-

1. Terminals
   - 1-off Vertical row of 45-off WDU2.5 EEx'e' terminals. Terminal identification & linking shown on sheet 2.

2. Cable Entries : Enclosure to be drilled for the following entries:-
   - 1 x 32mm
   - 6 x 20mm

   Note : All Holes to be Clearance & Plugged

3. Labels
   - White/Black/White traffolyte label with Tag Number and Service Details – See Sheet 2.
   - ATEX Certification Label.

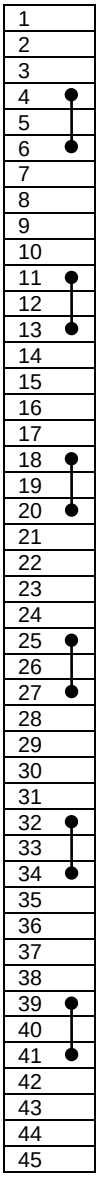
MANUFACTURERS DATA	Supplier	TBC
	Model Number	

DOCUMENTATION See attached Documentation Specification

REVISION HISTORY	
Rev	Description
A	Issued for Tender
B	Issued for Construction – tag number added

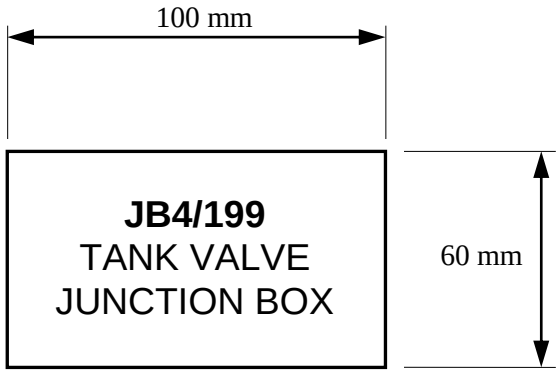
CLIENT:	**REV**	**DATE**	**BY**	**CHKD**	**APPD**	**CLIENT REF.**
Simon Storage	A	05/12/13	PP	MM	MM	SIS Restructuring
Immingham East	B	07/02/14	DBF	MM	MM	**P & I REF.**
						SI277015_SPC
						SHT 2 **OF** 4

TB-1



CLIENT:	REV	DATE	BY	CHKD	APPD	CLIENT REF.
Simon Storage	A	05/12/13	PP	MM	MM	SIS Restructuring
Immingham East	B	07/02/14	DBF	MM	MM	**P & I REF.** SI277015_SPC

1) Label to be manufactured from White/Black/White traffolyte.
2) Engraved text to be best fit.
3) Text to be centered.



CLIENT:	REV	DATE	BY	CHKD	APPD	CLIENT REF.
Simon Storage	A	05/12/13	PP	MM	MM	SIS Restructuring
Immingham East	B	07/02/14	DBF	MM	MM	**P & I REF.**
						SI277015_SPC
						SHT 4 **OF** 4

Documentation Requirement

Item	Quantity	Description
1.		**APPROVAL DOCUMENTATION**
	n/a	To be supplied before manufacture commences
2.		**GENERAL ARRANGEMENT DRAWING**
	n/a	Cross-sectioned to show all details necessary for repair and maintenance purposes.
3.		**MATERIALS TEST CERTIFICATES**
	n/a	a. Mechanical.
	n/a	b. Chemical analysis.
4.		**ITEMISED PARTS LIST**
	n/a	Cross-referenced with G.A. drawing(s) and illustrating manufacturers references for all proprietary items such as bearings, oilseals, mechanical seals, etc.
5.		**RECOMMEND SPARES QUOTATION**
	n/a	a. Two years service.
	n/a	b. Commissioning only.
6.		**INSTALLATION, OPERATING AND MAINTENANCE MANUALS**
		To include calibration instructions where applicable.
	n/a	a. Paper Copy
	n/a	b. Electronic copy (Preferably Adobe Acrobat)
7.		**SOFTWARE**
	n/a	a. Programming manual.
	n/a	b. Operating manual.
8.		**PRESSURE VESSELS**
	n/a	Calculation sheets, spark test certificates (for lined vessels),hydraulic test certificates.
9.		**ELECTRICAL**
	n/a	a. Schematic and circuit diagrams.
	1	b. Certificates of conformity (to include EMC Directive 89/336/EEC).
	1	c. Hazardous area certification.
10.		**INSTRUMENTATION**
	n/a	a. Certificates of conformity (to include EMC Directive 89/336/EEC).
	n/a	b. Calibration certificates.
	n/a	c. Hazardous area certification.
11.	n/a	**SPECIAL REQUIREMENTS**

IMPORTANT NOTICE:

Vendors acceptance of this order is conditional on the provision of the Documentation.
Should the vendor not wish to supply the whole or part of the details herein requested, he shall state in writing any exceptions with the quotation or order acceptance.
P & I Design reserve the right to cancel any order where the documentation does not comply with P & I requirements. No item will be paid in full until documentation specified has been received.

CLIENT:	REV	DATE	BY	CHKD	APPD	CLIENT REF.
Simon Storage	A	05/12/13	PP	MM	MM	SIS Restructuring
Immingham East	B	07/02/14	DBF	MM	MM	**P & I REF.** SI277016_SPC
						SHT 1 **OF** 4

ITEM: Electrical Component

GENERAL	B	Tag Number	JB4/200
		Service	Tank Valve Junction Box
		Area Classification	Zone 1 IIB T4
UNIT		Type	Stainless Steel Enclosure (1 bottom gland plate)
		Dimensions	Supplier to Confirm
		Supply	24Vdc
		Case	Stainless Steel
		Connections	See OPTIONS
		Mounting	Surface
		Enclosure Class	IP66
		Electrical Classification	ATEX Ex II 2G Exe II T6
		Certificate Reference	Supplier to Confirm

OPTIONS Enclosure to be fitted with the following:-

1. Terminals
   - 1-off Vertical row of 60-off WDU2.5 EEx'e' terminals. Terminal identification & linking shown on sheet 2.

2. Cable Entries : Enclosure to be drilled for the following entries:-
   - 1 x 40mm
   - 8 x 20mm

   Note : All Holes to be Clearance & Plugged

3. Labels
   - White/Black/White traffolyte label with Tag Number and Service Details – See Sheet 2.
   - ATEX Certification Label.

MANUFACTURERS DATA Supplier TBC; Model Number

DOCUMENTATION See attached Documentation Specification

REVISION HISTORY	
Rev	Description
A	Issued for Tender
B	Issued For Construction – Tag Number added

ZZ#-ECA1.SPC

CLIENT:	**REV**	**DATE**	**BY**	**CHKD**	**APPD**	**CLIENT REF.**
Simon Storage	A	05/12/13	PP	MM	MM	SIS Restructuring
Immingham East	B	07/02/14	DBF	MM	MM	**P & I REF.**
						SI277016_SPC
						SHT 2 **OF** 4

TB-1

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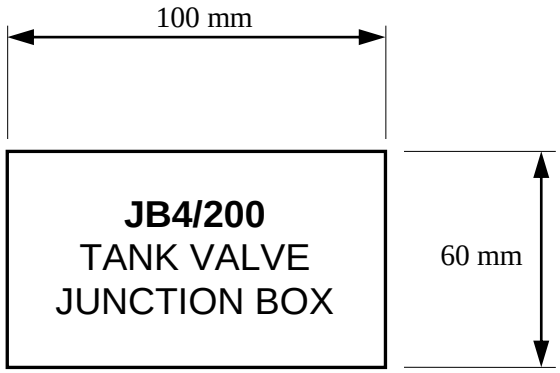
CLIENT:	**REV**	**DATE**	**BY**	**CHKD**	**APPD**	**CLIENT REF.**
Simon Storage	A	05/12/13	PP	MM	MM	SIS Restructuring
Immingham East	B	07/02/14	DBF	MM	MM	**P & I REF.**
						SI277016_SPC
						SHT 3 **OF** 4

1) Label to be manufactured from White/Black/White traffolyte.
2) Engraved text to be best fit.
3) Text to be centered.



CLIENT:	REV	DATE	BY	CHKD	APPD	CLIENT REF.
Simon Storage	A	05/12/13	PP	MM	MM	SIS Restructuring
Immingham East	B	07/02/14	DBF	MM	MM	**P & I REF.**
						SI277016_SPC
						SHT 4 **OF** 4

Documentation Requirement

Item	Quantity	Description
1.		**APPROVAL DOCUMENTATION**
	n/a	To be supplied before manufacture commences
2.		**GENERAL ARRANGEMENT DRAWING**
	n/a	Cross-sectioned to show all details necessary for repair and maintenance purposes.
3.		**MATERIALS TEST CERTIFICATES**
	n/a	a. Mechanical.
	n/a	b. Chemical analysis.
4.		**ITEMISED PARTS LIST**
	n/a	Cross-referenced with G.A. drawing(s) and illustrating manufacturers references for all proprietary items such as bearings, oilseals, mechanical seals, etc.
5.		**RECOMMEND SPARES QUOTATION**
	n/a	a. Two years service.
	n/a	b. Commissioning only.
6.		**INSTALLATION, OPERATING AND MAINTENANCE MANUALS**
		To include calibration instructions where applicable.
	n/a	a. Paper Copy
	n/a	b. Electronic copy (Preferably Adobe Acrobat)
7.		**SOFTWARE**
	n/a	a. Programming manual.
	n/a	b. Operating manual.
8.		**PRESSURE VESSELS**
	n/a	Calculation sheets, spark test certificates (for lined vessels),hydraulic test certificates.
9.		**ELECTRICAL**
	n/a	a. Schematic and circuit diagrams.
	1	b. Certificates of conformity (to include EMC Directive 89/336/EEC).
	1	c. Hazardous area certification.
10.		**INSTRUMENTATION**
	n/a	a. Certificates of conformity (to include EMC Directive 89/336/EEC).
	n/a	b. Calibration certificates.
	n/a	c. Hazardous area certification.
11.	n/a	**SPECIAL REQUIREMENTS**

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CLIENT:	**REV**	**DATE**	**BY**	**CHKD**	**APPD**	**CLIENT REF.**
Simon Storage	A	05/12/13	PP	MM	MM	SIS Restructuring
Immingham East	B	07/02/14	DBF	MM	MM	**P & I REF.**
						SI277017_SPC
						SHT 1 **OF** 4

ITEM: Electrical Component

GENERAL	B	Tag Number	JB4/197
		Service	Tank Level Junction Box
		Area Classification	Zone 1 IIB T4
UNIT		Type	Stainless Steel Enclosure (1 bottom gland plate)
		Dimensions	Supplier to Confirm
		Supply	24Vdc
		Case	Stainless Steel
		Connections	See OPTIONS
		Mounting	Surface
		Enclosure Class	IP66
		Electrical Classification	ATEX Ex II 2G Exe II T6
		Certificate Reference	Supplier to Confirm

OPTIONS Enclosure to be fitted with the following:-

1. Terminals
   - 1-off Vertical row of 30-off WDU2.5 EEx'e' blue terminals. Terminal identification & linking shown on sheet 2.

2. Cable Entries : Enclosure to be drilled for the following entries:-
   - 1 x 32mm
   - 10 x 20mm

   Note : All Holes to be Clearance & Plugged

3. Labels
   - White/Black/White traffolyte label with Tag Number and Service Details – See Sheet 2.
   - ATEX Certification Label.

MANUFACTURERS DATA	Supplier	TBC
	Model Number	

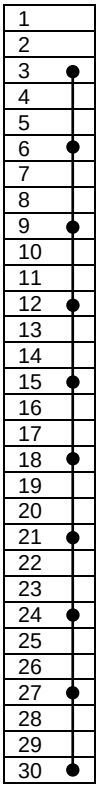
DOCUMENTATION See attached Documentation Specification

REVISION HISTORY	
Rev	Description
A	Issued for Tender
B	Issued For Construction – Tag Number added

Z#-ECA1.SPC

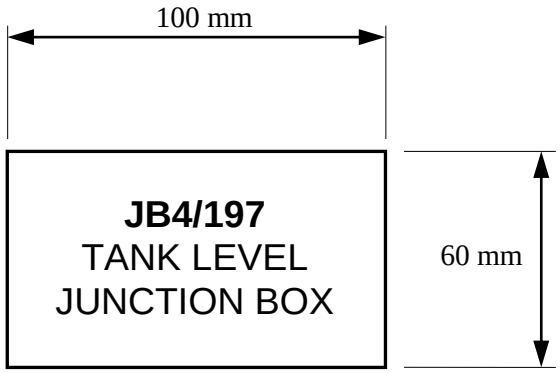
CLIENT:	**REV**	**DATE**	**BY**	**CHKD**	**APPD**	**CLIENT REF.**
Simon Storage	A	05/12/13	PP	MM	MM	SIS Restructuring
Immingham East	B	07/02/14	DBF	MM	MM	**P & I REF.**
						SI277017_SPC
						SHT 2 **OF** 4

TB-1



CLIENT:	**REV**	**DATE**	**BY**	**CHKD**	**APPD**	**CLIENT REF.**
Simon Storage	A	05/12/13	PP	MM	MM	SIS Restructuring
Immingham East	B	07/02/14	DBF	MM	MM	**P & I REF.**
						SI277017_SPC
						SHT 3 **OF** 4

1) Label to be manufactured from White/Black/White traffolyte.
2) Engraved text to be best fit.
3) Text to be centered.



CLIENT:	REV	DATE	BY	CHKD	APPD	CLIENT REF.
Simon Storage	A	05/12/13	PP	MM	MM	SIS Restructuring
Immingham East	B	07/02/14	DBF	MM	MM	**P & I REF.**
						SI277017_SPC
						SHT 4 **OF** 4

Documentation Requirement

Item	Quantity	Description
1.		**APPROVAL DOCUMENTATION**
	n/a	To be supplied before manufacture commences
2.		**GENERAL ARRANGEMENT DRAWING**
	n/a	Cross-sectioned to show all details necessary for repair and maintenance purposes.
3.		**MATERIALS TEST CERTIFICATES**
	n/a	a. Mechanical.
	n/a	b. Chemical analysis.
4.		**ITEMISED PARTS LIST**
	n/a	Cross-referenced with G.A. drawing(s) and illustrating manufacturers references for all proprietary items such as bearings, oilseals, mechanical seals, etc.
5.		**RECOMMEND SPARES QUOTATION**
	n/a	a. Two years service.
	n/a	b. Commissioning only.
6.		**INSTALLATION, OPERATING AND MAINTENANCE MANUALS**
		To include calibration instructions where applicable.
	n/a	a. Paper Copy
	n/a	b. Electronic copy (Preferably Adobe Acrobat)
7.		**SOFTWARE**
	n/a	a. Programming manual.
	n/a	b. Operating manual.
8.		**PRESSURE VESSELS**
	n/a	Calculation sheets, spark test certificates (for lined vessels),hydraulic test certificates.
9.		**ELECTRICAL**
	n/a	a. Schematic and circuit diagrams.
	1	b. Certificates of conformity (to include EMC Directive 89/336/EEC).
	1	c. Hazardous area certification.
10.		**INSTRUMENTATION**
	n/a	a. Certificates of conformity (to include EMC Directive 89/336/EEC).
	n/a	b. Calibration certificates.
	n/a	c. Hazardous area certification.
11.	n/a	**SPECIAL REQUIREMENTS**

IMPORTANT NOTICE:

Vendors acceptance of this order is conditional on the provision of the Documentation.
Should the vendor not wish to supply the whole or part of the details herein requested, he shall state in writing any exceptions with the quotation or order acceptance.
P & I Design reserve the right to cancel any order where the documentation does not comply with P & I requirements. No item will be paid in full until documentation specified has been received.

CLIENT:	REV	DATE	BY	CHKD	APPD	CLIENT REF.
Simon Storage	A	05/12/13	PP	MM	MM	SIS Restructuring
Immingham East	B	07/02/14	DBF	MM	MM	**P & I REF.** SI277018_SPC
						SHT 1 **OF** 4

ITEM: Electrical Component

GENERAL	B	Tag Number	JB4/198
		Service	Tank Level Junction Box
		Area Classification	Zone 1 IIB T4
UNIT		Type	Stainless Steel Enclosure (1 bottom gland plate)
		Dimensions	Supplier to Confirm
		Supply	24Vdc
		Case	Stainless Steel
		Connections	See OPTIONS
		Mounting	Surface
		Enclosure Class	IP66
		Electrical Classification	ATEX Ex II 2G Exe II T6
		Certificate Reference	Supplier to Confirm

OPTIONS Enclosure to be fitted with the following:-

1. Terminals
   - 1-off Vertical row of 30-off WDU2.5 EEx'e' blue terminals. Terminal identification & linking shown on sheet 2.

2. Cable Entries : Enclosure to be drilled for the following entries:-
   - 1 x 32mm
   - 10 x 20mm

   Note : All Holes to be Clearance & Plugged

3. Labels
   - White/Black/White traffolyte label with Tag Number and Service Details – See Sheet 2.
   - ATEX Certification Label.

MANUFACTURERS DATA	Supplier	TBC
	Model Number	

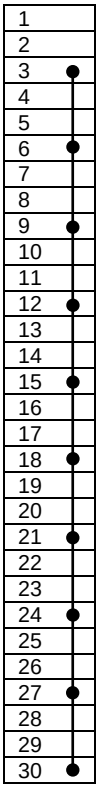
DOCUMENTATION See attached Documentation Specification

REVISION HISTORY	
Rev	Description
A	Issued for Tender
B	Issued for Construction – Tag Number Added

ZZ#-ECA1.SPC

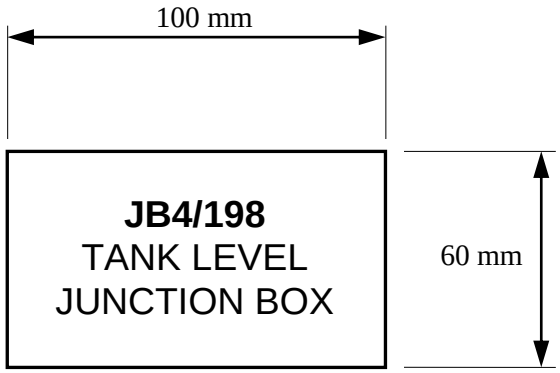
CLIENT:	**REV**	**DATE**	**BY**	**CHKD**	**APPD**	**CLIENT REF.**
Simon Storage	A	05/12/13	PP	MM	MM	SIS Restructuring
Immingham East	B	07/02/14	DBF	MM	MM	**P & I REF.**
						SI277018_SPC
						SHT 2 **OF** 4

TB-1



CLIENT:	REV	DATE	BY	CHKD	APPD	CLIENT REF.
Simon Storage	A	05/12/13	PP	MM	MM	SIS Restructuring
Immingham East	B	07/02/14	DBF	MM	MM	**P & I REF.** SI277018_SPC

1) Label to be manufactured from White/Black/White traffolyte.
2) Engraved text to be best fit.
3) Text to be centered.



CLIENT:	REV	DATE	BY	CHKD	APPD	CLIENT REF.
Simon Storage	A	05/12/13	PP	MM	MM	SIS Restructuring
Immingham East	B	07/02/14	DBF	MM	MM	**P & I REF.**
						SI277018_SPC
						SHT 4 **OF** 4

Documentation Requirement

Item	Quantity	Description
1.		**APPROVAL DOCUMENTATION**
	n/a	To be supplied before manufacture commences
2.		**GENERAL ARRANGEMENT DRAWING**
	n/a	Cross-sectioned to show all details necessary for repair and maintenance purposes.
3.		**MATERIALS TEST CERTIFICATES**
	n/a	a. Mechanical.
	n/a	b. Chemical analysis.
4.		**ITEMISED PARTS LIST**
	n/a	Cross-referenced with G.A. drawing(s) and illustrating manufacturers references for all proprietary items such as bearings, oilseals, mechanical seals, etc.
5.		**RECOMMEND SPARES QUOTATION**
	n/a	a. Two years service.
	n/a	b. Commissioning only.
6.		**INSTALLATION, OPERATING AND MAINTENANCE MANUALS**
		To include calibration instructions where applicable.
	n/a	a. Paper Copy
	n/a	b. Electronic copy (Preferably Adobe Acrobat)
7.		**SOFTWARE**
	n/a	a. Programming manual.
	n/a	b. Operating manual.
8.		**PRESSURE VESSELS**
	n/a	Calculation sheets, spark test certificates (for lined vessels),hydraulic test certificates.
9.		**ELECTRICAL**
	n/a	a. Schematic and circuit diagrams.
	1	b. Certificates of conformity (to include EMC Directive 89/336/EEC).
	1	c. Hazardous area certification.
10.		**INSTRUMENTATION**
	n/a	a. Certificates of conformity (to include EMC Directive 89/336/EEC).
	n/a	b. Calibration certificates.
	n/a	c. Hazardous area certification.
11.	n/a	**SPECIAL REQUIREMENTS**

IMPORTANT NOTICE:

Vendors acceptance of this order is conditional on the provision of the Documentation.
Should the vendor not wish to supply the whole or part of the details herein requested, he shall state in writing any exceptions with the quotation or order acceptance.
P & I Design reserve the right to cancel any order where the documentation does not comply with P & I requirements. No item will be paid in full until documentation specified has been received.

P & I Design Ltd. — *Instrument Specification*

CLIENT:	**REV**	**DATE**	**BY**	**CHKD**	**APPD**	**CLIENT REF.**
Immingham Storage Co Ltd Immingham East Terminal	A	07.02.14	DBF	DSR	DSR	SIS Overfill Protection **P & I REF.** SI483001_SPC **SHT** 1 **OF** 3

ITEM:	Level Switch (Tuning Fork)		
GENERAL	Tag Number		LE56101
	Service		Tank 561 Independent High High Level Probe
	Area Classification		Zone 1 IIB T4
DETECTOR ELEMENT	Type		Vibrating Fork
	Location Classification		Zone 0
	Material:	Wetted Parts	316L Stainless Steel
		Seals	n/a
	Connections:	Size	$1^1/_2$"
		Type	Flanged
		Rating	ASA 150
	Mounting:	Position	Vertical
		Probe Length	1000mm
HOUSING	Material		Polyester
	Enclosure Class		IP66
	Electrical Classification		ATEX II 1/2 G EEx ia IIC T6
	Electrical Connection		M20 x 1.5 Cable Entry
TRANSMISSION	Type		2 Wire
	Supply		via FTL 325P for Overspill Protection to SIL2
	Output		FEL57 Insert, two wire PFM transmission
	Load		20mA
	Action		De-energise on high level & power failure
	Electrical Connection		Screw Terminals
OPTIONS			
PROCESS DATA	Fluid		Gasoline
	Temperature Max./Min.		Ambient
	Temperature Normal.		Ambient
	Pressure Max./Min.		20 mbar
	Pressure Normal.		Atmospheric
	Specific Gravity		0.74
MANUFACTURERS DATA	Supplier		Endress & Hauser
	Model Number		FTL51-G AC2 BB 7 G4 A
DOCUMENTATION	See Attached Documentation Specification		

REVISION HISTORY	
Rev	Description
A	As Built Post SAT – Created from SI277001_SPC

CLIENT:	**REV**	**DATE**	**BY**	**CHKD**	**APPD**	**CLIENT REF.**
Immingham Storage Co Ltd Immingham East Terminal	A	07.02.14	DBF	DSR	DSR	SIS Overfill Protection **P & I REF.** SI483001_SPC **SHT** 2 **OF** 3

ITEM	Isolating Unit (IS)	
GENERAL	Tag Number	LS56101
	Service	Tank 561 Independent High High Level Switch
	Area Classification	Zone 1 IIB T4
UNIT	Type	Nivotester Control Unit
	Supply	20–30Vac / 20–60Vdc
	Number of Channels	3
	Input	Liquiphant FTL51 with electronic insert FEL57
	Output	3 x SPDT + 1 x alarm SPST (2 Safety Outputs)
	Hazardous Area Limits:	
	Voltage Max/Min	To suit FEL 57
	Current Max/Min	To suit FEL 57
HOUSING	Material	Polycarbonate
	Mounting	Top-hat Rail
	Enclosure Class	IP20
	Electrical Classification:	
	Load	n/a
	Unit	ATEX II (1) GD [EExia] IIC
	Electrical Connection	Screw Terminal
OPTIONS	Overspill Protection	SIL 2 (IEC61508)
MANUFACTURERS DATA	Supplier	Endress & Hauser
	Model Number	FTL 325P H3 E3
DOCUMENTATION	See Attached Documentation Specification	

CLIENT:	**REV**	**DATE**	**BY**	**CHKD**	**APPD**	**CLIENT REF.**
Immingham Storage Co Ltd	A	07.02.14	DBF	DSR	DSR	SIS Overfill Protection
Immingham East Terminal						**P & I REF.**
						SI483001_SPC
						SHT 3 **OF** 3

Documentation Requirement

Item	**Quantity**		**Description**
1.			**APPROVAL DOCUMENTATION**
	n/a		To be supplied before manufacture commences
2.			**GENERAL ARRANGEMENT DRAWING**
	n/a		Cross-sectioned to show all details necessary for repair and maintenance purposes.
3.			**MATERIALS TEST CERTIFICATES**
	n/a	a.	Mechanical.
	n/a	b.	Chemical analysis.
4.			**ITEMISED PARTS LIST**
	n/a		Cross-referenced with G.A. drawing(s) and illustrating manufacturers references for all proprietary items such as bearings, oilseals, mechanical seals, etc.
5.			**RECOMMEND SPARES QUOTATION**
	1	a.	Two years service.
	n/a	b.	Commissioning only.
6.			**INSTALLATION, OPERATING AND MAINTENANCE MANUALS**
			To include calibration instructions where applicable.
	1	a.	Paper Copy
	1	b.	Electronic copy (Preferably Adobe Acrobat)
7.			**SOFTWARE**
	n/a	a.	Programming manual.
	n/a	b.	Operating manual.
8.			**PRESSURE VESSELS**
	n/a		Calculation sheets, spark test certificates (for lined vessels),hydraulic test certificates.
9.			**ELECTRICAL**
	n/a	a.	Schematic and circuit diagrams.
	n/a	b.	Certificates of conformity (to include EMC Directive 89/336/EEC).
	n/a	c.	Hazardous area certification.
10.			**INSTRUMENTATION**
	1	a.	Certificates of conformity (to include EMC Directive 89/336/EEC).
	n/a	b.	Calibration certificates.
	1	c.	Hazardous area certification.
11.			**SPECIAL REQUIREMENTS**
	1		IEC 61508 PFD Certified Certificate of Conformity

IMPORTANT NOTICE:

Vendors acceptance of this order is conditional on the provision of the Documentation.
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P & I Design reserve the right to cancel any order where the documentation does not comply with P & I requirements. No item will be paid in full until documentation specified has been received.

P & I Design Ltd. — *Instrument Specification*

CLIENT:	**REV**	**DATE**	**BY**	**CHKD**	**APPD**	**CLIENT REF.**
Immingham Storage Co Ltd Immingham East Terminal	A	07.02.14	DBF	DSR	DSR	SIS Overfill Protection **P & I REF.** SI483002_SPC **SHT** 1 **OF** 3

ITEM:	Level Switch (Tuning Fork)		
GENERAL	Tag Number		LE56401
	Service		Tank 564 Independent High High Level Probe
	Area Classification		Zone 1 IIB T4
DETECTOR ELEMENT	Type		Vibrating Fork
	Location Classification		Zone 0
	Material:	Wetted Parts	316L Stainless Steel
		Seals	n/a
	Connections:	Size	$1^1/_2$"
		Type	Flanged
		Rating	ASA 150
	Mounting:	Position	Vertical
		Probe Length	1000mm
HOUSING	Material		Polyester
	Enclosure Class		IP66
	Electrical Classification		ATEX II 1/2 G EEx ia IIC T6
	Electrical Connection		M20 x 1.5 Cable Entry
TRANSMISSION	Type		2 Wire
	Supply		via FTL 325P for Overspill Protection to SIL2
	Output		FEL57 Insert, two wire PFM transmission
	Load		20mA
	Action		De-energise on high level & power failure
	Electrical Connection		Screw Terminals
OPTIONS			
PROCESS DATA	Fluid		Gasoline
	Temperature Max./Min.		Ambient
	Temperature Normal.		Ambient
	Pressure Max./Min.		20 mbar
	Pressure Normal.		Atmospheric
	Specific Gravity		0.74
MANUFACTURERS DATA	Supplier		Endress & Hauser
	Model Number		FTL51-G AC2 BB 7 G4 A
DOCUMENTATION	See Attached Documentation Specification		

REVISION HISTORY	
Rev	Description
A	As Built Post SAT – Created from SI277001_SPC

CLIENT:	**REV**	**DATE**	**BY**	**CHKD**	**APPD**	**CLIENT REF.**
Immingham Storage Co Ltd Immingham East Terminal	A	07.02.14	DBF	DSR	DSR	SIS Overfill Protection **P & I REF.** SI483002_SPC **SHT** 2 **OF** 3

ITEM	Isolating Unit (IS)	
GENERAL	Tag Number	LS56401
	Service	Tank 564 Independent High High Level Switch
	Area Classification	Zone 1 IIB T4
UNIT	Type	Nivotester Control Unit
	Supply	20–30Vac / 20–60Vdc
	Number of Channels	3
	Input	Liquiphant FTL51 with electronic insert FEL57
	Output	3 x SPDT + 1 x alarm SPST (2 Safety Outputs)
	Hazardous Area Limits:	
	Voltage Max/Min	To suit FEL 57
	Current Max/Min	To suit FEL 57
HOUSING	Material	Polycarbonate
	Mounting	Top-hat Rail
	Enclosure Class	IP20
	Electrical Classification:	
	Load	n/a
	Unit	ATEX II (1) GD [EExia] IIC
	Electrical Connection	Screw Terminal
OPTIONS	Overspill Protection	SIL 2 (IEC61508)
MANUFACTURERS DATA	Supplier	Endress & Hauser
	Model Number	FTL 325P H3 E3
DOCUMENTATION	See Attached Documentation Specification	

CLIENT:	REV	DATE	BY	CHKD	APPD	CLIENT REF.
Immingham Storage Co Ltd	A	07.02.14	DBF	DSR	DSR	SIS Overfill Protection
Immingham East Terminal						**P & I REF.**
						SI483002_SPC
						SHT 3 **OF** 3

Documentation Requirement

Item	Quantity		Description
1.			**APPROVAL DOCUMENTATION**
	n/a		To be supplied before manufacture commences
2.			**GENERAL ARRANGEMENT DRAWING**
	n/a		Cross-sectioned to show all details necessary for repair and maintenance purposes.
3.			**MATERIALS TEST CERTIFICATES**
	n/a	a.	Mechanical.
	n/a	b.	Chemical analysis.
4.			**ITEMISED PARTS LIST**
	n/a		Cross-referenced with G.A. drawing(s) and illustrating manufacturers references for all proprietary items such as bearings, oilseals, mechanical seals, etc.
5.			**RECOMMEND SPARES QUOTATION**
	1	a.	Two years service.
	n/a	b.	Commissioning only.
6.			**INSTALLATION, OPERATING AND MAINTENANCE MANUALS**
			To include calibration instructions where applicable.
	1	a.	Paper Copy
	1	b.	Electronic copy (Preferably Adobe Acrobat)
7.			**SOFTWARE**
	n/a	a.	Programming manual.
	n/a	b.	Operating manual.
8.			**PRESSURE VESSELS**
	n/a		Calculation sheets, spark test certificates (for lined vessels),hydraulic test certificates.
9.			**ELECTRICAL**
	n/a	a.	Schematic and circuit diagrams.
	n/a	b.	Certificates of conformity (to include EMC Directive 89/336/EEC).
	n/a	c.	Hazardous area certification.
10.			**INSTRUMENTATION**
	1	a.	Certificates of conformity (to include EMC Directive 89/336/EEC).
	n/a	b.	Calibration certificates.
	1	c.	Hazardous area certification.
11.			**SPECIAL REQUIREMENTS**
	1		IEC 61508 PFD Certified Certificate of Conformity

IMPORTANT NOTICE:

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Should the vendor not wish to supply the whole or part of the details herein requested, he shall state in writing any exceptions with the quotation or order acceptance.
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P & I Design Ltd. — *Instrument Specification*

CLIENT:	**REV**	**DATE**	**BY**	**CHKD**	**APPD**	**CLIENT REF.**
Immingham Storage Co Ltd Immingham East Terminal	A	07.02.14	DBF	DSR	DSR	SIS Overfill Protection **P & I REF.** SI483003_SPC **SHT** 1 **OF** 3

ITEM:	Level Switch (Tuning Fork)		
GENERAL	Tag Number		LE56801
	Service		Tank 568 Independent High High Level Probe
	Area Classification		Zone 1 IIB T4
DETECTOR ELEMENT	Type		Vibrating Fork
	Location Classification		Zone 0
	Material:	Wetted Parts	316L Stainless Steel
		Seals	n/a
	Connections:	Size	$1^1/_2$"
		Type	Flanged
		Rating	ASA 150
	Mounting:	Position	Vertical
		Probe Length	1000mm
HOUSING	Material		Polyester
	Enclosure Class		IP66
	Electrical Classification		ATEX II 1/2 G EEx ia IIC T6
	Electrical Connection		M20 x 1.5 Cable Entry
TRANSMISSION	Type		2 Wire
	Supply		via FTL 325P for Overspill Protection to SIL2
	Output		FEL57 Insert, two wire PFM transmission
	Load		20mA
	Action		De-energise on high level & power failure
	Electrical Connection		Screw Terminals
OPTIONS			
PROCESS DATA	Fluid		Gasoline
	Temperature Max./Min.		Ambient
	Temperature Normal.		Ambient
	Pressure Max./Min.		20 mbar
	Pressure Normal.		Atmospheric
	Specific Gravity		0.74
MANUFACTURERS DATA	Supplier		Endress & Hauser
	Model Number		FTL51-G AC2 BB 7 G4 A
DOCUMENTATION	See Attached Documentation Specification		

REVISION HISTORY	
Rev	Description
A	As Built Post SAT – Created from SI277001_SPC

CLIENT:	**REV**	**DATE**	**BY**	**CHKD**	**APPD**	**CLIENT REF.**
Immingham Storage Co Ltd Immingham East Terminal	A	07.02.14	DBF	DSR	DSR	SIS Overfill Protection **P & I REF.** SI483003_SPC **SHT** 2 **OF** 3

ITEM	Isolating Unit (IS)	
GENERAL	Tag Number	LS56801
	Service	Tank 568 Independent High High Level Switch
	Area Classification	Zone 1 IIB T4
UNIT	Type	Nivotester Control Unit
	Supply	20–30Vac / 20–60Vdc
	Number of Channels	3
	Input	Liquiphant FTL51 with electronic insert FEL57
	Output	3 x SPDT + 1 x alarm SPST (2 Safety Outputs)
	Hazardous Area Limits:	
	Voltage Max/Min	To suit FEL 57
	Current Max/Min	To suit FEL 57
HOUSING	Material	Polycarbonate
	Mounting	Top-hat Rail
	Enclosure Class	IP20
	Electrical Classification:	
	Load	n/a
	Unit	ATEX II (1) GD [EExia] IIC
	Electrical Connection	Screw Terminal
OPTIONS	Overspill Protection	SIL 2 (IEC61508)
MANUFACTURERS DATA	Supplier	Endress & Hauser
	Model Number	FTL 325P H3 E3
DOCUMENTATION	See Attached Documentation Specification	

CLIENT:	REV	DATE	BY	CHKD	APPD	CLIENT REF.
Immingham Storage Co Ltd	A	07.02.14	DBF	DSR	DSR	SIS Overfill Protection
Immingham East Terminal						**P & I REF.**
						SI483003_SPC
						SHT 3 **OF** 3

Documentation Requirement

Item	Quantity		Description
1.			**APPROVAL DOCUMENTATION**
	n/a		To be supplied before manufacture commences
2.			**GENERAL ARRANGEMENT DRAWING**
	n/a		Cross-sectioned to show all details necessary for repair and maintenance purposes.
3.			**MATERIALS TEST CERTIFICATES**
	n/a	a.	Mechanical.
	n/a	b.	Chemical analysis.
4.			**ITEMISED PARTS LIST**
	n/a		Cross-referenced with G.A. drawing(s) and illustrating manufacturers references for all proprietary items such as bearings, oilseals, mechanical seals, etc.
5.			**RECOMMEND SPARES QUOTATION**
	1	a.	Two years service.
	n/a	b.	Commissioning only.
6.			**INSTALLATION, OPERATING AND MAINTENANCE MANUALS**
			To include calibration instructions where applicable.
	1	a.	Paper Copy
	1	b.	Electronic copy (Preferably Adobe Acrobat)
7.			**SOFTWARE**
	n/a	a.	Programming manual.
	n/a	b.	Operating manual.
8.			**PRESSURE VESSELS**
	n/a		Calculation sheets, spark test certificates (for lined vessels),hydraulic test certificates.
9.			**ELECTRICAL**
	n/a	a.	Schematic and circuit diagrams.
	n/a	b.	Certificates of conformity (to include EMC Directive 89/336/EEC).
	n/a	c.	Hazardous area certification.
10.			**INSTRUMENTATION**
	1	a.	Certificates of conformity (to include EMC Directive 89/336/EEC).
	n/a	b.	Calibration certificates.
	1	c.	Hazardous area certification.
11.			**SPECIAL REQUIREMENTS**
	1		IEC 61508 PFD Certified Certificate of Conformity

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ROSOV PANEL

X40379
12 Core

SIS
TANK OVERFILL
PROTECTION PANEL

P40381
3 Core

SWITCHROOM POWER
DISTRIBUTION BOARD
DB AD/1

X40380
19 Core

SWITCHROOM
ANNUNCIATOR NODE

C40382
7 Core

X40375
10 Pair
Blue Sheath

C40378
37 Core

C40377
48 Core

X40376
10 Pair
Blue Sheath

C40366
7 Core

JB4/208
LOCAL
JUNCTION BOX

No.4 SWITCHROOM

FIELD

JB4/197
TANK LEVEL SWITCH
JUNCTION BOX

JB4/199
TANK VALVE
JUNCTION BOX

JB4/200
TANK VALVE
JUNCTION BOX

JB4/198
TANK LEVEL SWITCH
JUNCTION BOX

C40366
7 Core

X40336
1 Pair

XV56101
LOCAL
J/B

LIQUIPHANT
LE
561
H

C40367
3 Core

C40368
4 Core

TANK 561

ZS
56101

XV56101
IMPORT/EXPORT
VALVE

BUND 'O'

C40283
7 Core

X40341
1 Pair

XV56401
LOCAL
J/B

LIQUIPHANT
LE
564

C40284
3 Core

C40285
4 Core

TANK 564

ZS
56401

XV56401
TANK 8"
IMPORT/EXPORT
VALVE

BUND 'G'

C40295
7 Core

X40345
1 Pair

XV56801
LOCAL
J/B

LIQUIPHANT
LE
568

C40296
3 Core

C40297
4 Core

TANK 568

ZS
56801

XV56801
TANK 8"
IMPORT/EXPORT
VALVE

BUND 'H'

NOTES

1)

IF NOT SIGNED THIS DOCUMENT IS UNCONTROLLED

REV	DATE	BY	DRN	CHK'D		APP'D		DESCRIPTION
A	17/12/13	P.P.	P.P.	D.B.F	D.B.F	M.M.	M.M.	ISSUED FOR TENDER
B	04/02/14	P.P.	P.P.	D.B.F	D.B.F	M.M.	M.M.	ISSUED FOR CONSTRUCTION
C	31/10/14	D.B.F	P.P.	D.B.F		M.M.		AS BUILT

PLANT	IMMINGHAM STORAGE Co. – EAST TERMINAL
TITLE	SIS RESTRUCTURING CABLE OVERVIEW TANKS 561, 564 & 568

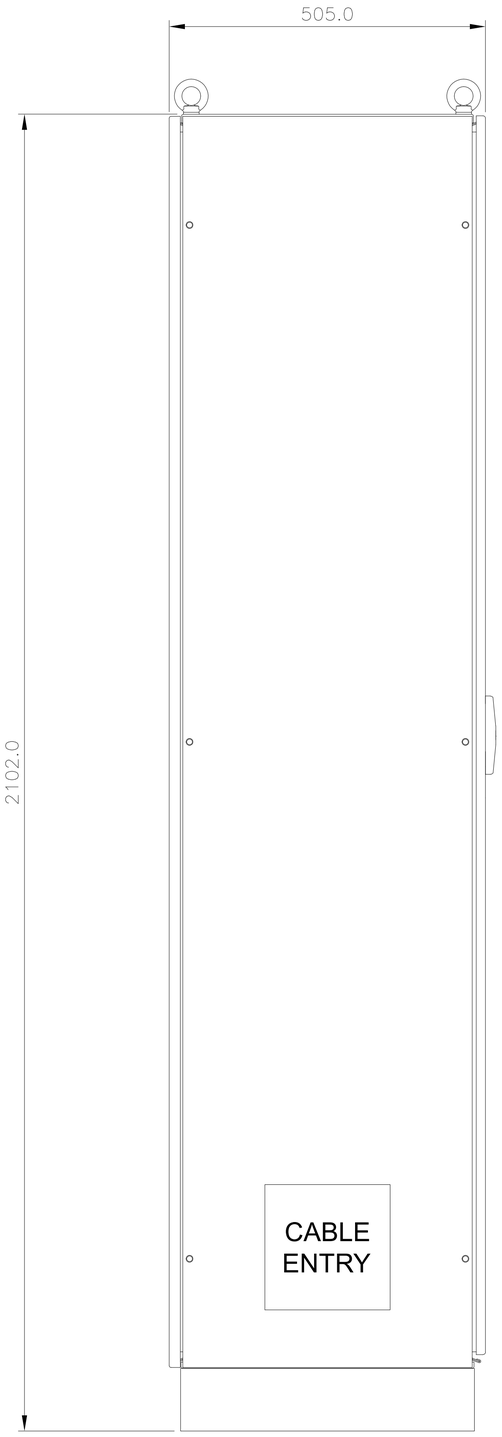
SIMON
IMMINGHAM STORAGE Co Ltd,
IMMINGHAM EAST TERMINAL,
IMMINGHAM DOCK,
IMMINGHAM,
N.E. LINCOLNSHIRE.
DN40 2QW

P & I DESIGN
P & I Design Ltd
Tel. 01642 617444
www.pidesign.co.uk

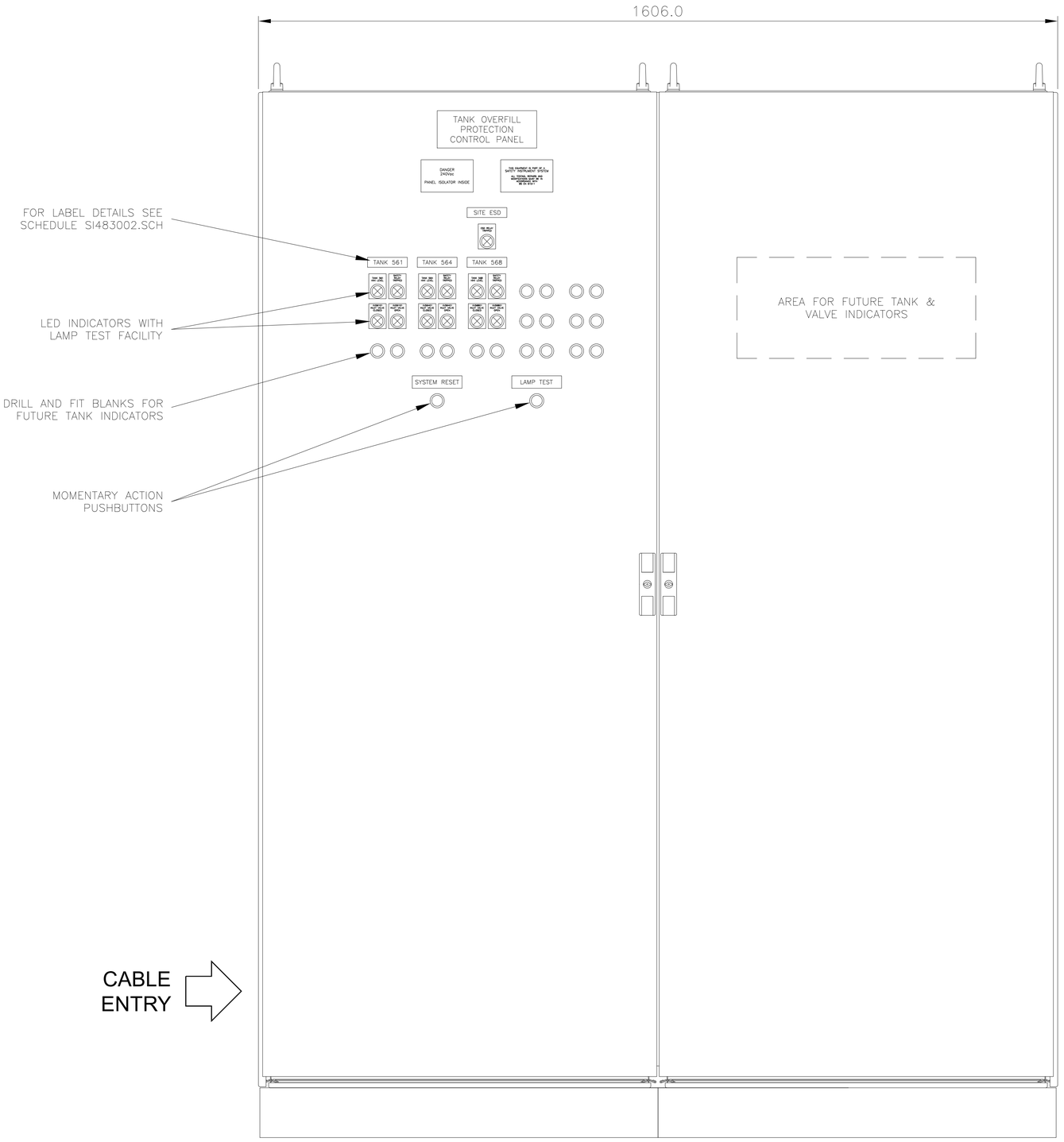
SHEET 1 OF 1

CLIENT DRG. No.

P&I DRG No. SI483001_DWG



SIDE ELEVATION



FRONT ELEVATION

ENCLOSURE	RITTAL TS8
	ENCLOSURE 8805.500
	SIDE PANEL 8105.235
	PLINTH FRONT 8601.800
	PLINTH SIDE 8601.050
PAINT FINISH	RAL 7035
PROTECTION	IP55
LABELS	W/B/W TRAFFOLITE
CABLE INCOMING	SIDE ENTRY
CABLE OUTGOING	SIDE EXIT
SUPPLY	230Vac 50hz

IF NOT SIGNED THIS DOCUMENT IS UNCONTROLLED

REV	DATE	BY	DRN	CHK'D		APP'D		DESCRIPTION
A	17/12/13	P.P.	P.P.	D.B.F	D.B.F	M.M.	M.M.	ISSUED FOR TENDER
B	29/01/14	P.P.	P.P.	D.B.F	D.B.F	M.M.	M.M.	ISSUED FOR CONSTRUCTION
C	25/03/14	D.B.F	P.P.	D.B.F	D.B.F	M.M.	M.M.	POST FAT ISSUE
D	31/10/14	D.B.F	P.P.	D.B.F		M.M.		AS BUILT

PLANT	IMMINGHAM STORAGE Co. – EAST TERMINAL
TITLE	No.4 SWITCHROOM TANK OVERFILL SIS PANEL EXTERNAL LAYOUT

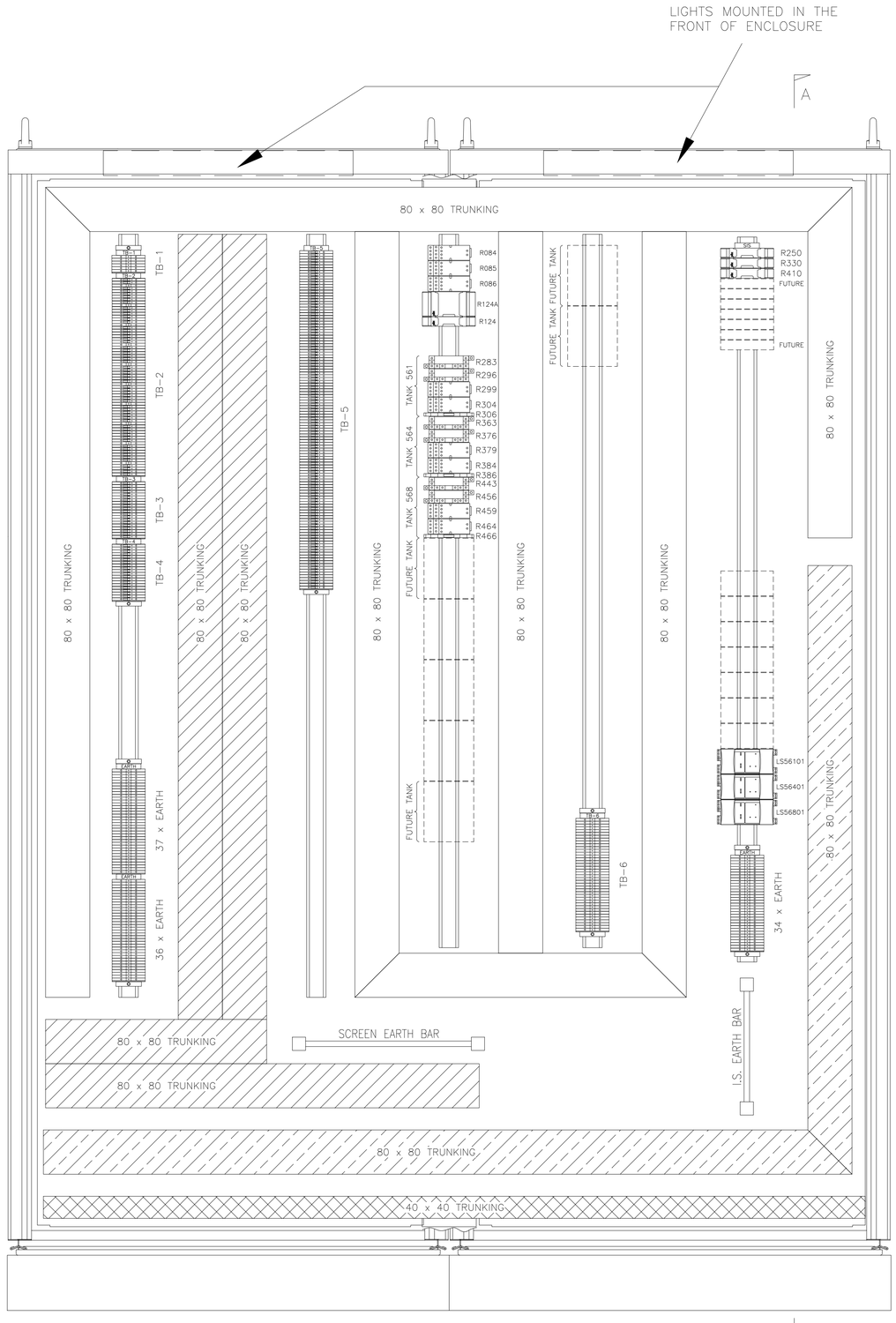
SIMON
IMMINGHAM STORAGE Co Ltd,
IMMINGHAM EAST TERMINAL,
IMMINGHAM DOCK,
IMMINGHAM,
N.E. LINCOLNSHIRE.
DN40 2QW

P & I DESIGN
P & I Design Ltd
Tel. 01642 617444
www.pidesign.co.uk

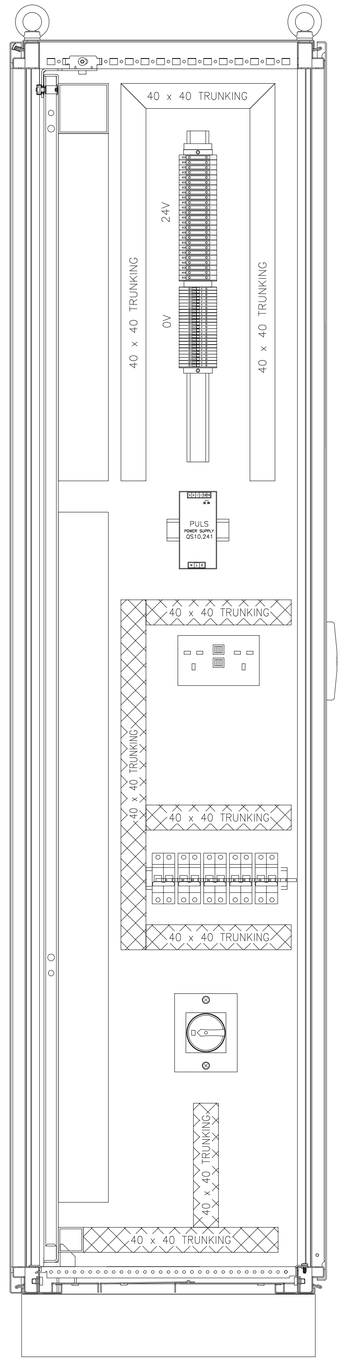
SHEET 1 OF 1

CLIENT DRG. No.

P&I DRG No. SI483005_DWG



VIEW ON BACK PLATE



VIEW ON ARROW A–A

RELAY No.	TYPE
R084	FINDER 4–POLE
R085	FINDER 4–POLE
R086	FINDER 4–POLE
R124	PILZ PNOZs2
R124A	PILZ PNOZs11
R250	PILZ PNOZs2
R330	PILZ PNOZs2
R410	PILZ PNOZs2
R283	OMRON 4–POLE
R296	OMRON 4–POLE
R299	FINDER 4–POLE
R304	FINDER 4–POLE
R306	LUTZ 1–POLE
R363	OMRON 4–POLE
R376	OMRON 4–POLE
R379	FINDER 4–POLE
R384	FINDER 4–POLE
R386	LUTZ 1–POLE
R443	OMRON 4–POLE
R456	OMRON 4–POLE
R459	FINDER 4–POLE
R464	FINDER 4–POLE
R466	LUTZ 1–POLE

NOTES

RELAYS

A) SAFETY RELAYS :–

PILZ TYPE PNOZ s2 (Order No. 750 102)

B) EXPANSION RELAYS :–

PILZ TYPE PNOZ s11 (Order No. 750 111)

C) 4–POLE GUIDED CONTACT RELAYS :–

BASE – OMRON TYPE P7SA–10F–ND

RELAY – OMRON G7SA–3A1B

D) STANDARD 4–POLE RELAYS :–

BASE – FINDER TYPE 94.04.0 (Black)

RELAY – FINDER 55.34.9.024.0094

E) SINGLE POLE RELAYS :–

LUTZ – TYPE RE 7–2312 DC 24V (Order No. 760022)

TERMINAL BLOCKS

BLOCK	QTY	DESCRIPTION
TB–24V	25	WSI 6 (Wiedmuller 1011000000)
TB–0V	25	WTR 2.5 (Wiedmuller 1011000000)
TB–1	6	WDU 2.5 (Wiedmuller 1020000000)
TB–2	60	WTR 2.5 (Wiedmuller 1011000000)
	10	WDU 2.5 (Wiedmuller 1020000000)
TB–3	21	WTR 2.5 (Wiedmuller 1011000000)
TB–4	20	WTR 2.5 (Wiedmuller 1011000000)
TB–5	120	WTR 2.5 (Wiedmuller 1011000000)
TB–6	40	WDU 2.5 (Wiedmuller 1020000000)

WIRING DETAILS

DESCRIPTION

ELECTRICAL 440V / 240V AC:	
SIZE:	n/a
COLOUR:	n/a
INSTRUMENT 230Vac SUPPLIES:	
SIZE:	Suitably Rated with Minimum 0.5mm²
COLOUR:	Live (Brown) / Neutral (Blue) / Earth (Green/Yellow)
INSTRUMENT 110Vdc SUPPLIES:	
SIZE:	n/a
COLOUR:	n/a
24V DC SUPPLIES:	
SIZE:	Suitably Rated with Minimum 0.5mm²
COLOUR:	Positive (Red) / 0V (Black)
DIGITAL SWITCHED AC:	
SIZE:	n/a
COLOUR:	n/a
DIGITAL SWITCHED DC:	
SIZE:	0.5mm²
COLOUR:	White
ANALOGUE:	
SIZE:	0.5mm²
COLOUR:	Grey
CRIMPS:	
TYPE:	Bootlace or Twin Grip Insulated
FERRULES:	
TYPE:	Heat Shrink Thermal Printed Sleeves

GREY TRUNKING – FIELD CABLES (24Vdc)

BLACK TRUNKING – 230Vac

GREY TRUNKING – PANEL WIRING (24Vdc)

BLUE TRUNKING – (I.S.)

a) RELAY & TERMINAL QUANTITY REDUCED AS EXPORT VALVE LOGIC REMOVED.
b) RELAY NUMBERS REVISED TO MATCH SPLIT SIS & BPCS LOGIC ON THE WIRING DRAWINGS.

IF NOT SIGNED THIS DOCUMENT IS UNCONTROLLED

REV	DATE	BY	DRN	CHK'D	APP'D	DESCRIPTION
A	05/12/13	P.P.	P.P.	D.B.F	M.M.	ISSUED FOR TENDER
B	03/02/14	P.P.	P.P.	D.B.F	M.M.	ISSUED FOR CONSTRUCTION
C	25/03/14	D.B.F	P.P.	D.B.F	M.M.	POST FAT ISSUE
D	31/10/14	D.B.F	P.P.	D.B.F	M.M.	AS BUILT

PLANT: IMMINGHAM STORAGE Co. – EAST TERMINAL

TITLE: No.4 SWITCHROOM TANK OVERFILL SIS PANEL INTERNAL LAYOUT (OPTION 1)

simon — IMMINGHAM STORAGE Co Ltd, IMMINGHAM EAST TERMINAL, IMMINGHAM DOCK, IMMINGHAM, N.E. LINCOLNSHIRE. DN40 2QW

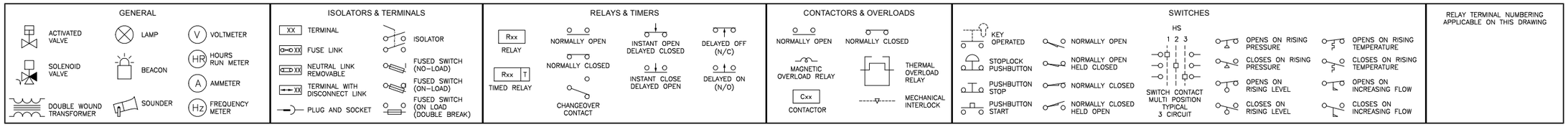
P & I DESIGN — P & I Design Ltd, Tel. 01642 617444, www.pidesign.co.uk

SHEET 1 OF 1

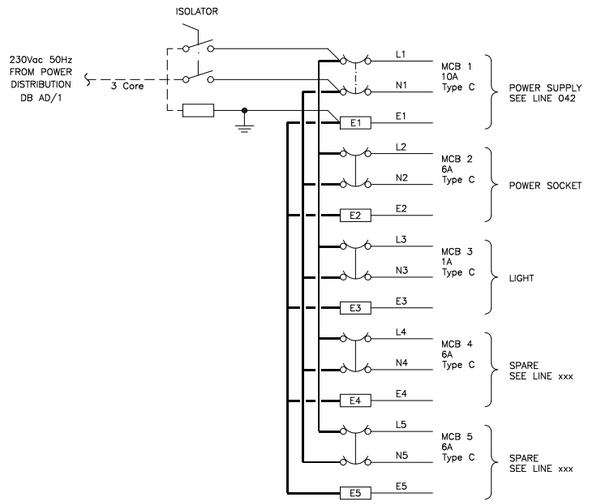
CLIENT DRG. No.

P&I DRG No. SI483006_DWG

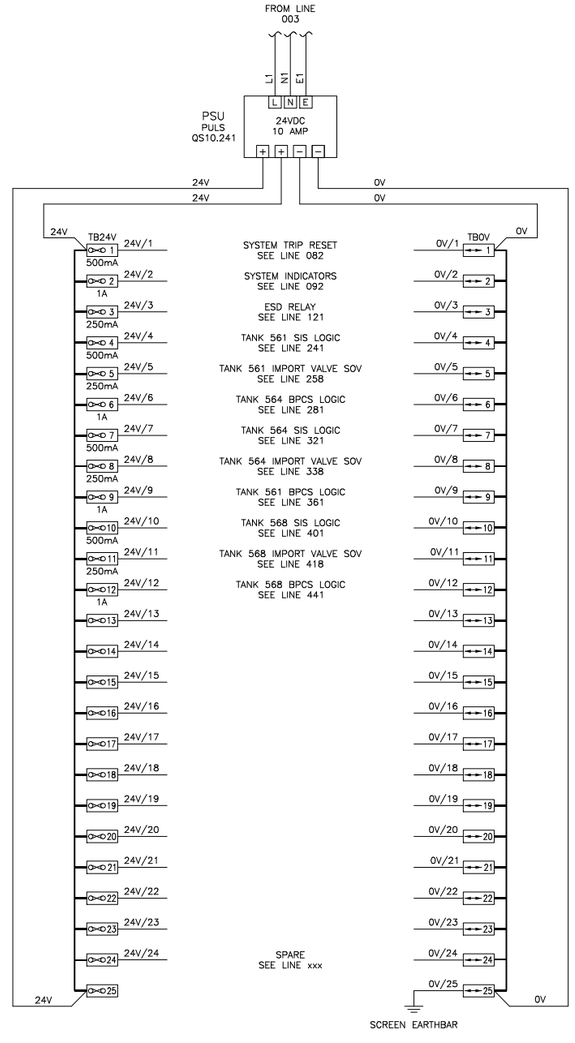
LEGEND OF GRAPHICAL SYMBOLS (ALL CONTACTS SHOWN IN THE DE-ENERGISED STATE)



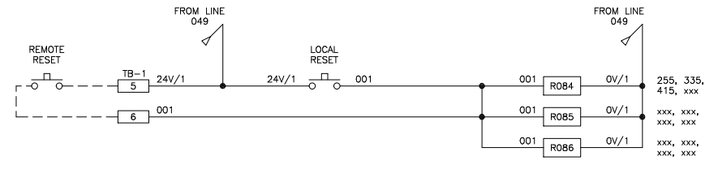
AC POWER DISTRIBUTION



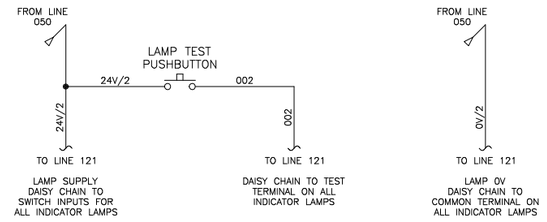
DC POWER DISTRIBUTION



SYSTEM TRIP RESET



LAMP TEST



LAST NUMBER USED : 002
SPARE TO : 020

NOTES
1) LED INDICATORS FITTED WITH INTERNAL DIODES

IF NOT SIGNED THIS DOCUMENT IS UNCONTROLLED

REV	DATE	BY	DRN	CHK'D		APP'D		DESCRIPTION
A	17/12/13	P.P.	P.P.	D.B.F	D.B.F	M.M.	M.M.	ISSUED FOR TENDER
B	29/01/14	P.P.	P.P.	D.B.F	D.B.F	M.M.	M.M.	ISSUED FOR CONSTRUCTION
C	25/03/14	D.B.F	P.P.	D.B.F	D.B.F	M.M.	M.M.	POST FAT ISSUE
D	31/10/14	D.B.F	P.P.	D.B.F		M.M.		AS BUILT

PLANT	IMMINGHAM STORAGE Co. – EAST TERMINAL
TITLE	No.4 SWITCHROOM TANK OVERFILL SIS PANEL LOGIC DRAWING 1 : POWER DISTRIBUTION

SIMON — IMMINGHAM STORAGE Co Ltd, IMMINGHAM EAST TERMINAL, IMMINGHAM DOCK, IMMINGHAM, N.E. LINCOLNSHIRE. DN40 2OW

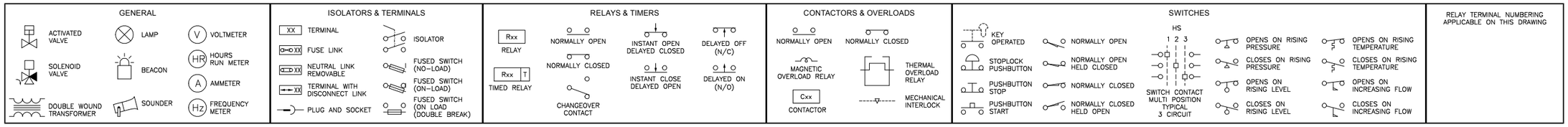
P & I DESIGN — P & I Design Ltd, Tel. 01642 617444, www.pidesign.co.uk

SHEET 1 OF 1

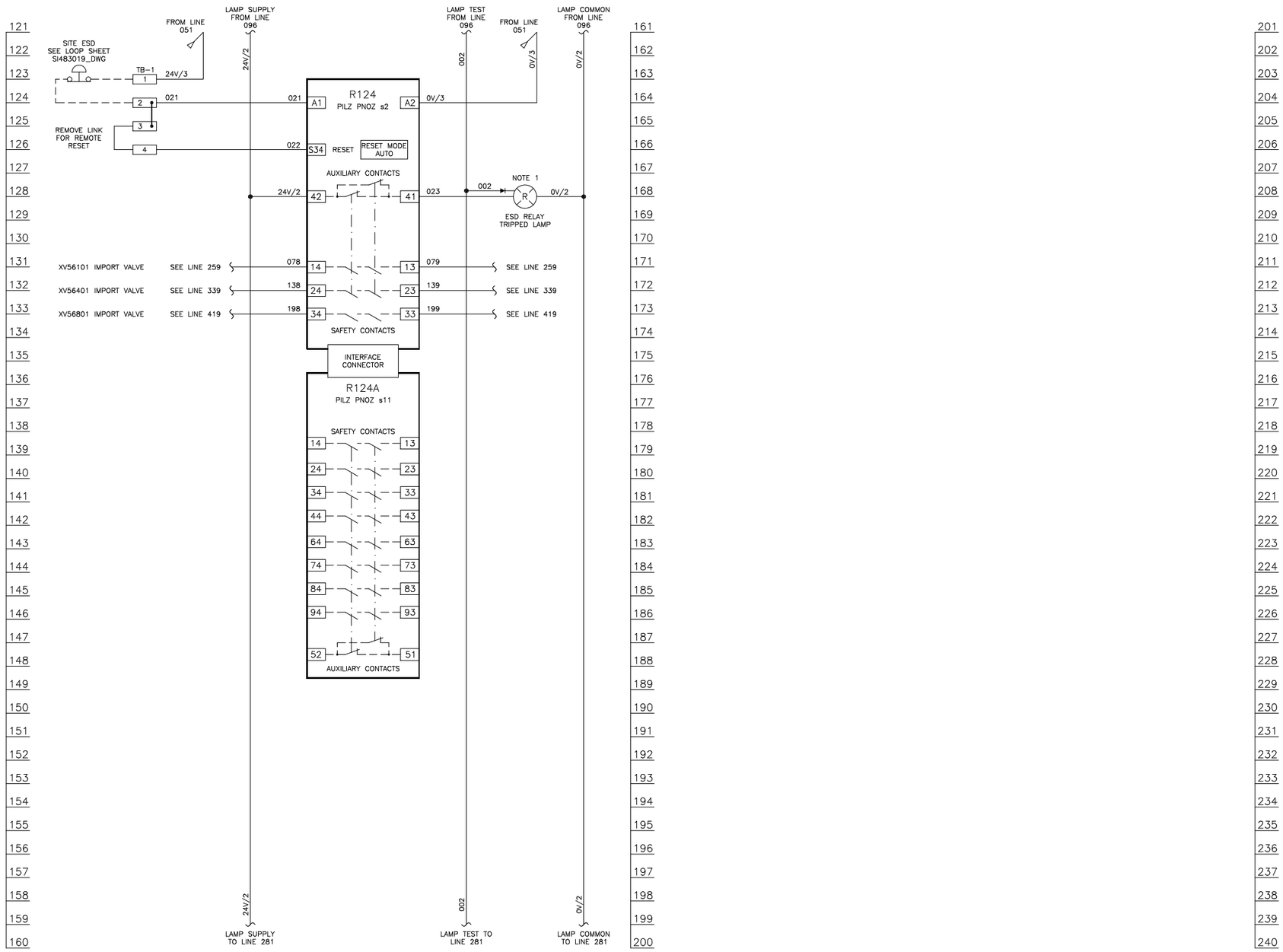
CLIENT DRG. No.

P&I DRG No. SI483007_DWG

LEGEND OF GRAPHICAL SYMBOLS (ALL CONTACTS SHOWN IN THE DE-ENERGISED STATE)



SITE ESD



LAST NUMBER USED : 023
SPARE TO : 030

LAST NUMBER USED : xxx
SPARE TO : 040

LAST NUMBER USED : xxx
SPARE TO : 070

NOTES
1) LED INDICATORS FITTED WITH INTERNAL DIODES

IF NOT SIGNED THIS DOCUMENT IS UNCONTROLLED

REV	DATE	BY	DRN	CHK'D		APP'D		DESCRIPTION
A	17/12/13	P.P.	P.P.	D.B.F	D.B.F	M.M.	M.M.	ISSUED FOR TENDER
B	03/02/14	P.P.	P.P.	D.B.F	D.B.F	M.M.	M.M.	ISSUED FOR CONSTRUCTION
C	25/03/14	D.B.F	P.P.	D.B.F	D.B.F	M.M.	M.M.	POST FAT ISSUE
D	31/10/14	D.B.F	P.P.	D.B.F		M.M.		AS BUILT

PLANT	IMMINGHAM STORAGE Co. – EAST TERMINAL
TITLE	No.4 SWITCHROOM TANK OVERFILL SIS PANEL LOGIC DRAWING 2 : ESD

SIMON — IMMINGHAM STORAGE Co Ltd, IMMINGHAM EAST TERMINAL, IMMINGHAM DOCK, IMMINGHAM, N.E. LINCOLNSHIRE. DN40 2QW

P & I DESIGN — *P & I Design Ltd* Tel. 01642 617444 www.pidesign.co.uk

SHEET 1 OF 1

CLIENT DRG. No.

P&I DRG No. SI483008_DWG

LEGEND OF GRAPHICAL SYMBOLS (ALL CONTACTS SHOWN IN THE DE-ENERGISED STATE)

GENERAL: ACTIVATED VALVE; SOLENOID VALVE; DOUBLE WOUND TRANSFORMER; LAMP; BEACON; SOUNDER; VOLTMETER; HOURS RUN METER; AMMETER; FREQUENCY METER

ISOLATORS & TERMINALS: XX TERMINAL; FUSE LINK; NEUTRAL LINK REMOVABLE; TERMINAL WITH DISCONNECT LINK; PLUG AND SOCKET; ISOLATOR; FUSED SWITCH (NO-LOAD); FUSED SWITCH (ON-LOAD); FUSED SWITCH (ON LOAD (DOUBLE BREAK)

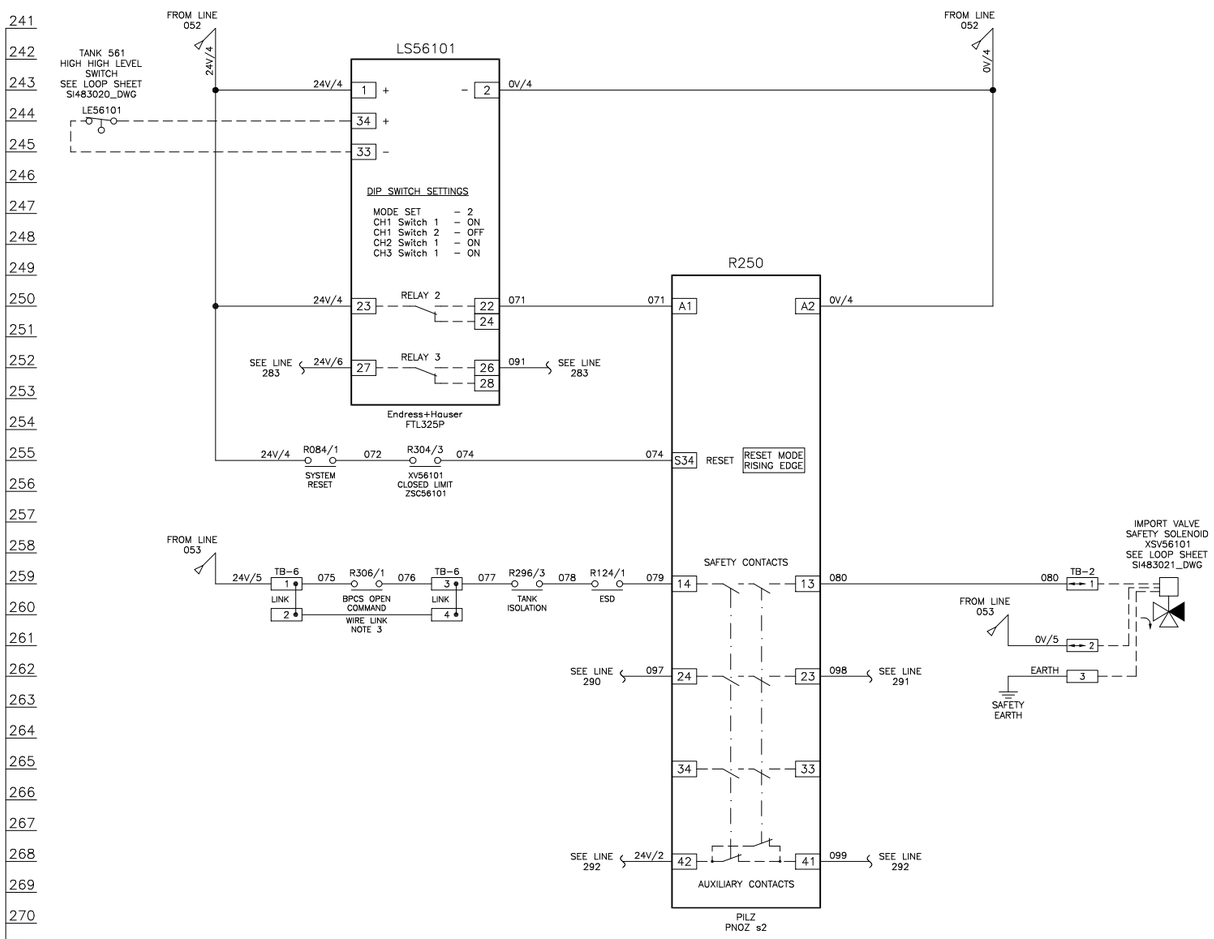
RELAYS & TIMERS: Rxx RELAY; Rxx T TIMED RELAY; NORMALLY OPEN; NORMALLY CLOSED; CHANGEOVER CONTACT; INSTANT OPEN DELAYED CLOSED; INSTANT CLOSE DELAYED OPEN; DELAYED OFF (N/C); DELAYED ON (N/O)

CONTACTORS & OVERLOADS: NORMALLY OPEN; NORMALLY CLOSED; MAGNETIC OVERLOAD RELAY; Cxx CONTACTOR; THERMAL OVERLOAD RELAY; MECHANICAL INTERLOCK

SWITCHES: KEY OPERATED; STOPLOCK PUSHBUTTON; PUSHBUTTON STOP; PUSHBUTTON START; NORMALLY OPEN; NORMALLY OPEN HELD CLOSED; NORMALLY CLOSED; NORMALLY CLOSED HELD OPEN; HS 1 2 3 SWITCH CONTACT MULTI POSITION TYPICAL 3 CIRCUIT; OPENS ON RISING PRESSURE; CLOSES ON RISING PRESSURE; OPENS ON RISING LEVEL; CLOSES ON RISING LEVEL; OPENS ON RISING TEMPERATURE; CLOSES ON RISING TEMPERATURE; OPENS ON INCREASING FLOW; CLOSES ON INCREASING FLOW

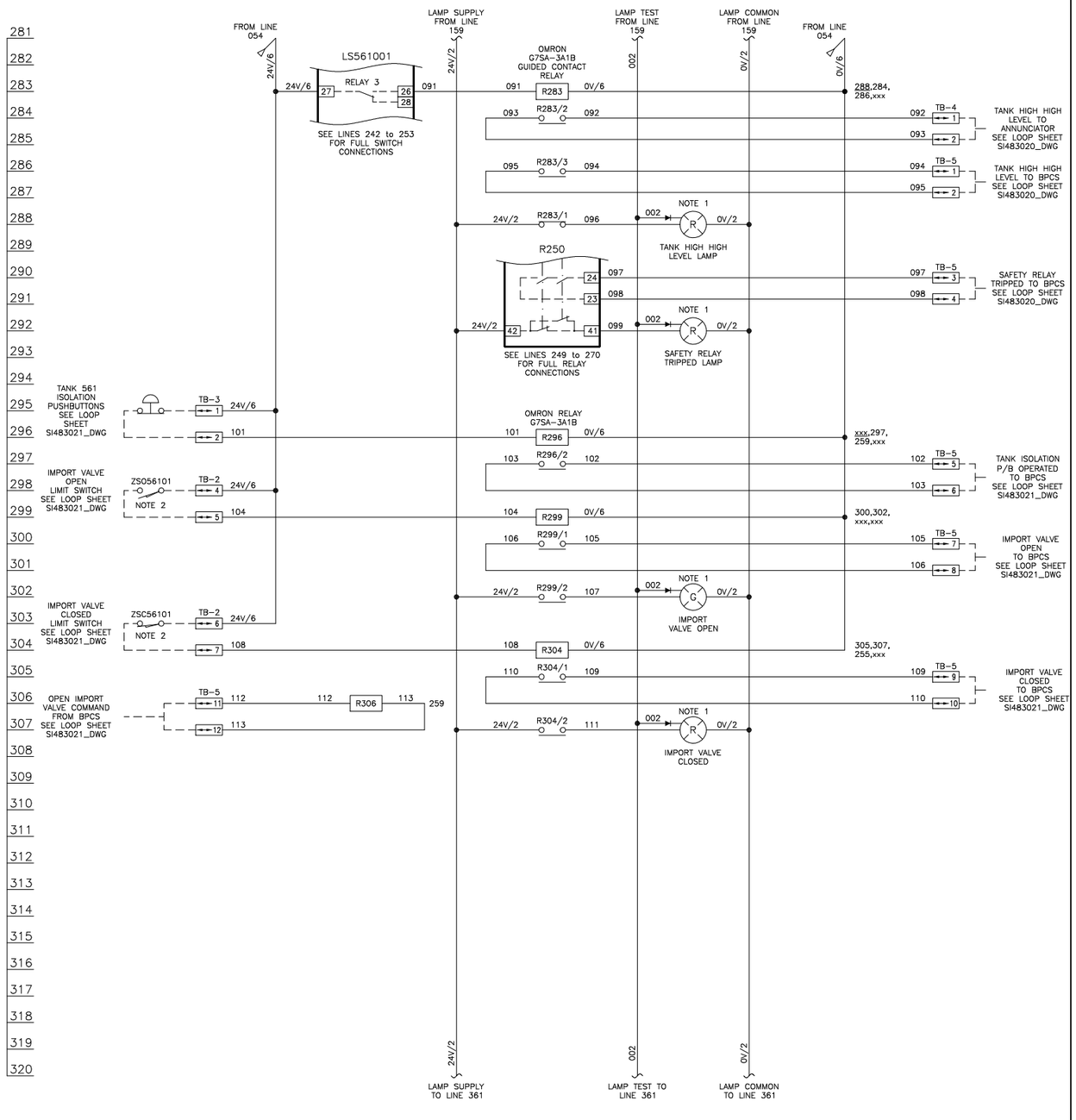
RELAY TERMINAL NUMBERING APPLICABLE ON THIS DRAWING: OMRON G5TA-3A1B RELAY CONNECTION DETAILS; FINDER 4-POLE RELAY CONNECTION DETAILS

TANK 561 - SIS LOGIC



LAST NUMBER USED : 080
SPARE TO : 090

TANK 561 - BPCS LOGIC



LAST NUMBER USED : 113
SPARE TO : 130

NOTES

1) LED INDICATORS FITTED WITH INTERNAL DIODES.

2) VALVE LIMIT SWITCHES SHOWN WITH VALVE IN CLOSED POSITION.

3) REMOVABLE WIRE LINK. LINK REMOVED IF BPCS ACTION REQUIRED. LINK REFITTED FOR SIS TESTING.

IF NOT SIGNED THIS DOCUMENT IS UNCONTROLLED

REV	DATE	BY	DRN	CHK'D		APP'D		DESCRIPTION
A	17/12/13	P.P.	P.P.	D.B.F	D.B.F	M.M.	M.M.	ISSUED FOR TENDER
B	03/02/14	P.P.	P.P.	D.B.F	D.B.F	M.M.	M.M.	ISSUED FOR CONSTRUCTION
C	25/03/14	P.P.	P.P.	D.B.F	D.B.F	M.M.	M.M.	POST FAT ISSUE
D	31/10/14	D.B.F	P.P.	D.B.F		M.M.		AS BUILT

PLANT	IMMINGHAM STORAGE Co. – EAST TERMINAL
TITLE	No.4 SWITCHROOM TANK OVERFILL SIS PANEL LOGIC DRAWING 3 : TANK 561

SIMON — IMMINGHAM STORAGE Co Ltd, IMMINGHAM EAST TERMINAL, IMMINGHAM DOCK, IMMINGHAM, N.E. LINCOLNSHIRE. DN40 2QW

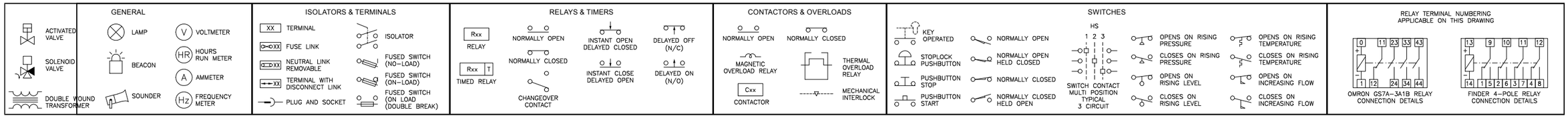
P & I DESIGN — P & I Design Ltd, Tel. 01642 617444, www.pidesign.co.uk

SHEET 1 OF 1

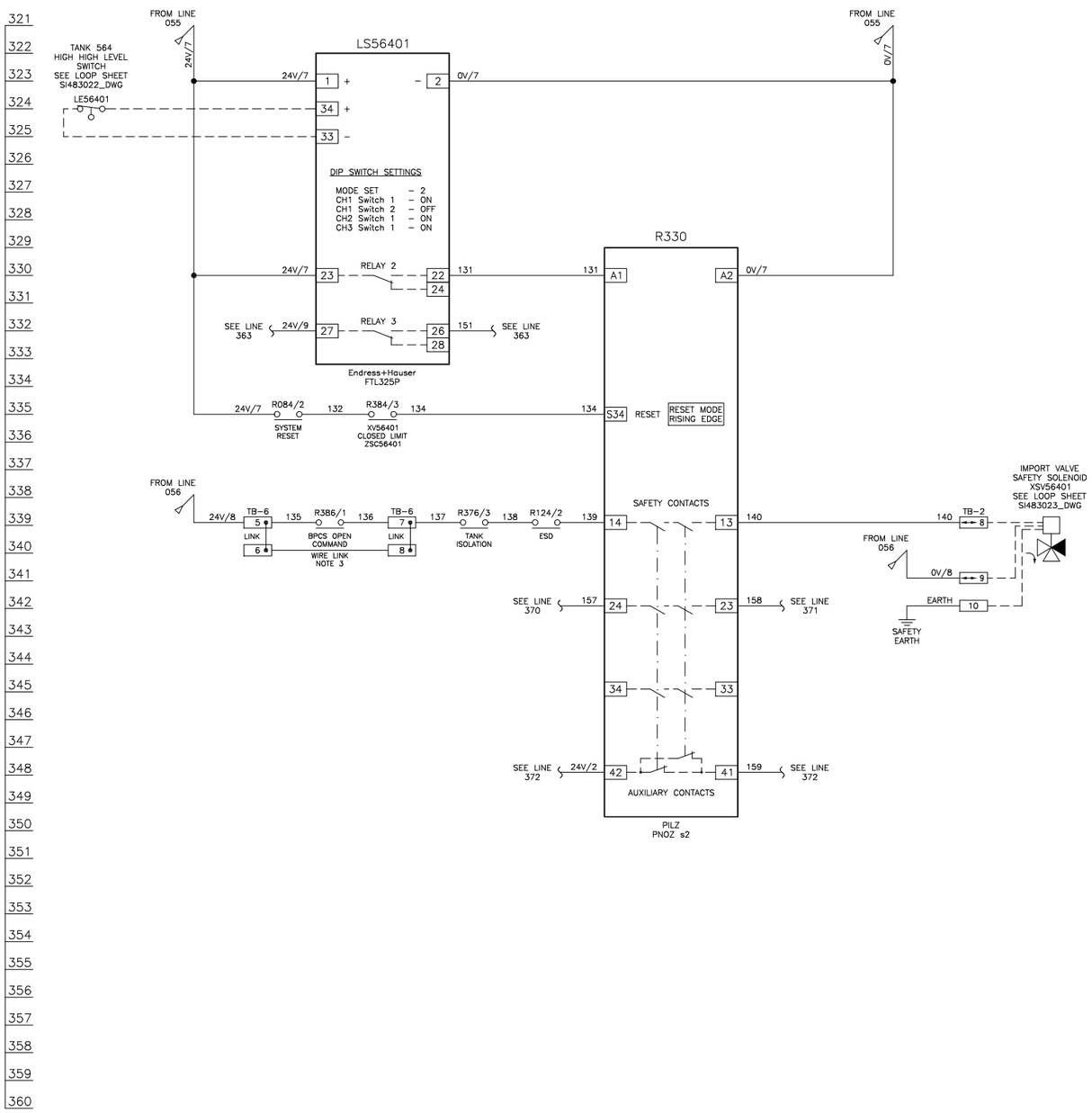
CLIENT DRG. No.

P&I DRG No. SI483009_DWG

LEGEND OF GRAPHICAL SYMBOLS (ALL CONTACTS SHOWN IN THE DE-ENERGISED STATE)

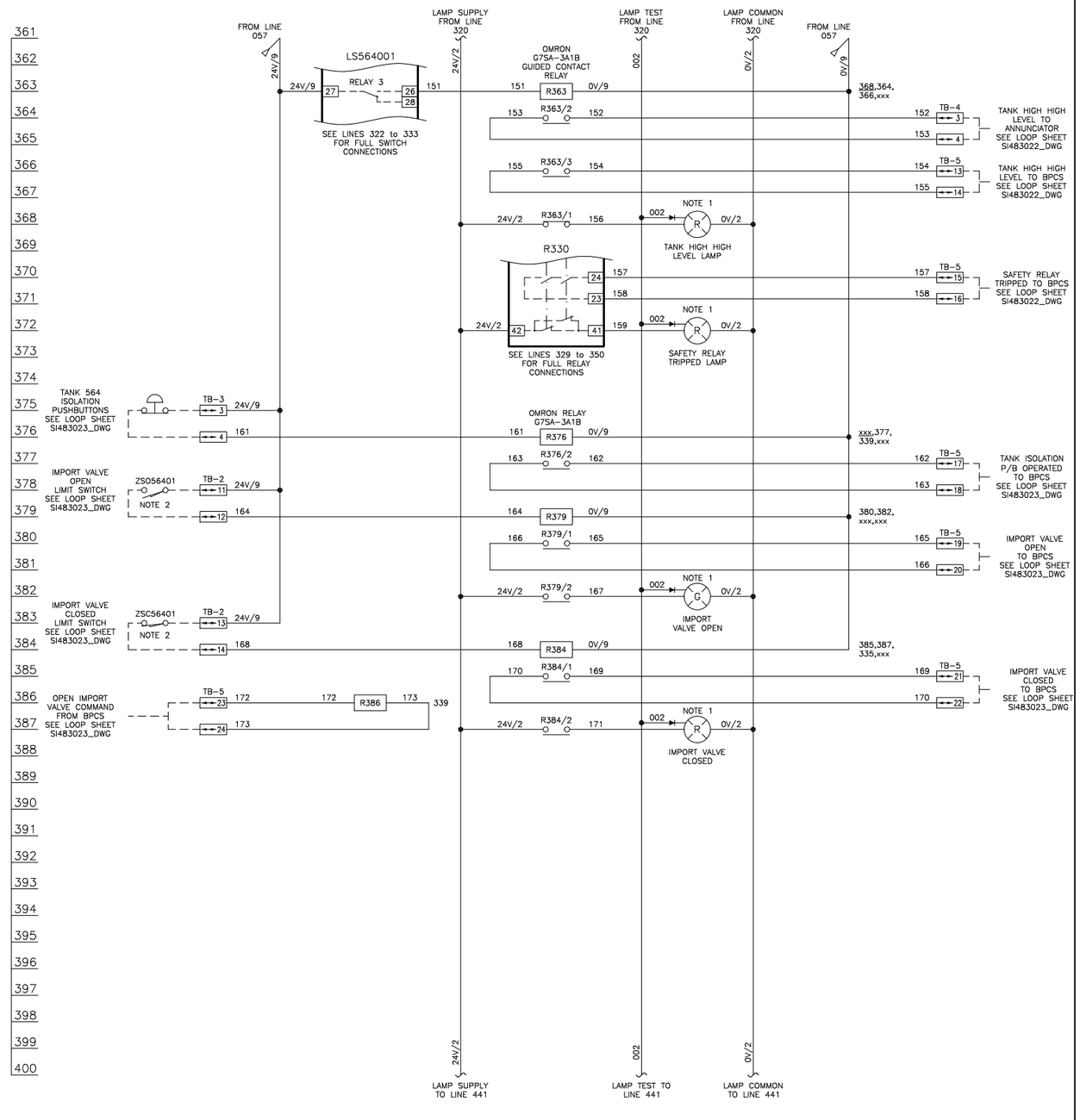


TANK 564 - SIS LOGIC



LAST NUMBER USED : 140
SPARE TO : 150

TANK 564 - BPCS LOGIC



LAST NUMBER USED : 173
SPARE TO : 190

NOTES

1) LED INDICATORS FITTED WITH INTERNAL DIODES.

2) VALVE LIMIT SWITCHES SHOWN WITH VALVE IN CLOSED POSITION.

3) REMOVABLE WIRE LINK. LINK REMOVED IF BPCS ACTION REQUIRED. LINK REFITTED FOR SIS TESTING.

IF NOT SIGNED THIS DOCUMENT IS UNCONTROLLED

REV	DATE	BY	DRN	CHK'D		APP'D		DESCRIPTION
A	17/12/13	P.P.	P.P.	D.B.F	D.B.F	M.M.	M.M.	ISSUED FOR TENDER
B	03/02/14	P.P.	P.P.	D.B.F	D.B.F	M.M.	M.M.	ISSUED FOR CONSTRUCTION
C	25/03/14	P.P.	P.P.	D.B.F	D.B.F	M.M.	M.M.	POST FAT ISSUE
D	31/10/14	D.B.F	P.P.	D.B.F		M.M.		AS BUILT

PLANT	IMMINGHAM STORAGE Co. – EAST TERMINAL
TITLE	No.4 SWITCHROOM TANK OVERFILL SIS PANEL LOGIC DRAWING 4 : TANK 564

SIMON — IMMINGHAM STORAGE Co Ltd., IMMINGHAM EAST TERMINAL, IMMINGHAM DOCK, IMMINGHAM, N.E. LINCOLNSHIRE. DN40 2QW

P & I Design Ltd
Tel. 01642 617444
www.pidesign.co.uk

SHEET 1 OF 1

CLIENT DRG. No.

P&I DRG No. SI483010_DWG

LEGEND OF GRAPHICAL SYMBOLS (ALL CONTACTS SHOWN IN THE DE-ENERGISED STATE)

GENERAL: ACTIVATED VALVE; SOLENOID VALVE; DOUBLE WOUND TRANSFORMER; LAMP; BEACON; SOUNDER; VOLTMETER; HOURS RUN METER; AMMETER; FREQUENCY METER

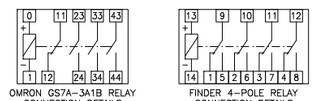
ISOLATORS & TERMINALS: XX TERMINAL; FUSE LINK; NEUTRAL LINK REMOVABLE; TERMINAL WITH DISCONNECT LINK; PLUG AND SOCKET; ISOLATOR; FUSED SWITCH (NO-LOAD); FUSED SWITCH (ON-LOAD); FUSED SWITCH (ON LOAD (DOUBLE BREAK)

RELAYS & TIMERS: Rxx RELAY; Rxx T TIMED RELAY; NORMALLY OPEN; NORMALLY CLOSED; CHANGEOVER CONTACT; INSTANT OPEN DELAYED CLOSED; INSTANT CLOSE DELAYED OPEN; DELAYED OFF (N/C); DELAYED ON (N/O)

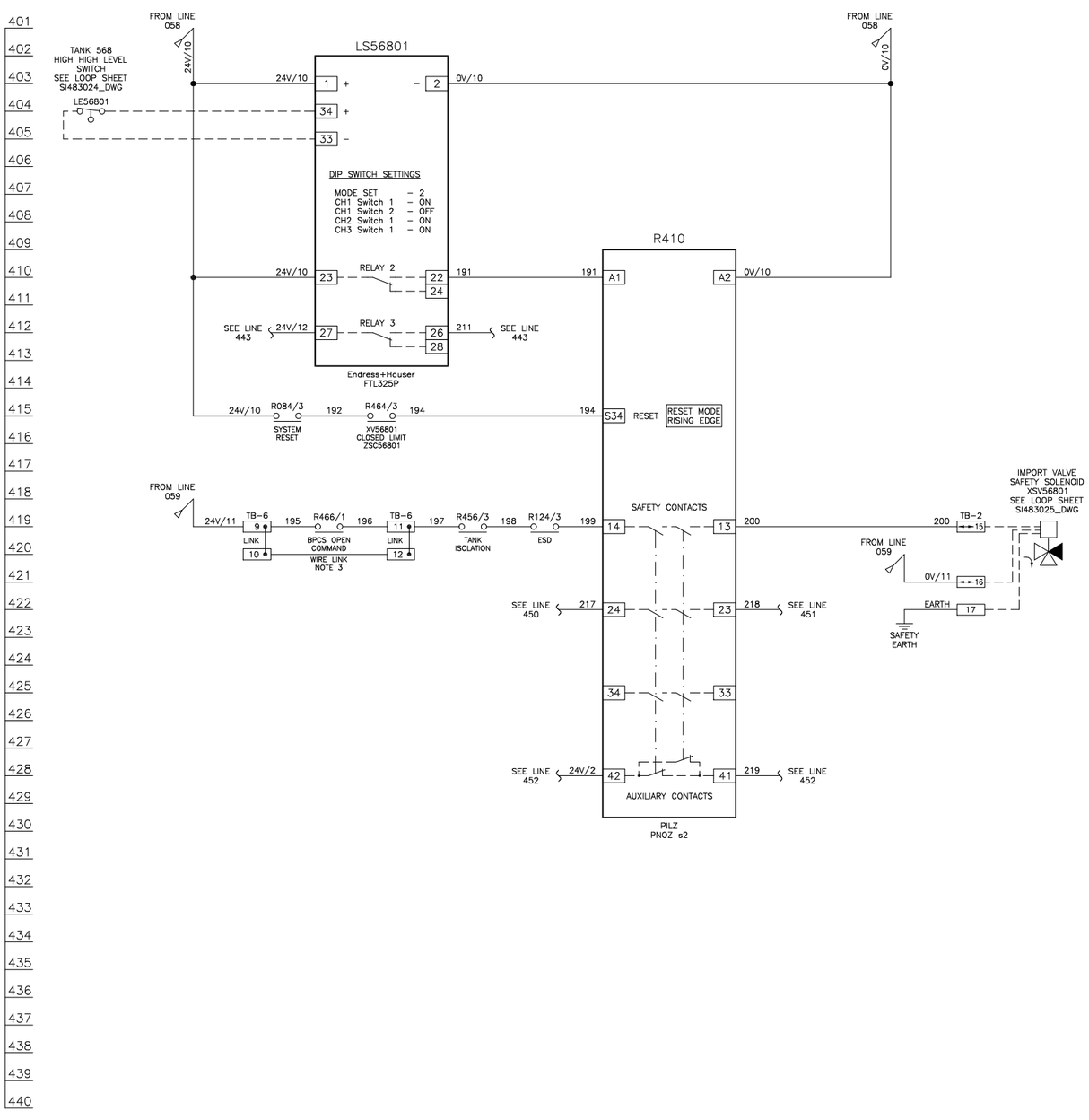
CONTACTORS & OVERLOADS: NORMALLY OPEN; NORMALLY CLOSED; MAGNETIC OVERLOAD RELAY; Cxx CONTACTOR; THERMAL OVERLOAD RELAY; MECHANICAL INTERLOCK

SWITCHES: KEY OPERATED; STOPLOCK PUSHBUTTON; PUSHBUTTON STOP; PUSHBUTTON START; NORMALLY OPEN; NORMALLY OPEN HELD CLOSED; NORMALLY CLOSED; NORMALLY CLOSED HELD OPEN; HS 1 2 3 SWITCH CONTACT MULTI POSITION TYPICAL 3 CIRCUIT; OPENS ON RISING PRESSURE; CLOSES ON RISING PRESSURE; OPENS ON RISING LEVEL; CLOSES ON RISING LEVEL; OPENS ON RISING TEMPERATURE; CLOSES ON RISING TEMPERATURE; OPENS ON INCREASING FLOW; CLOSES ON INCREASING FLOW

RELAY TERMINAL NUMBERING APPLICABLE ON THIS DRAWING

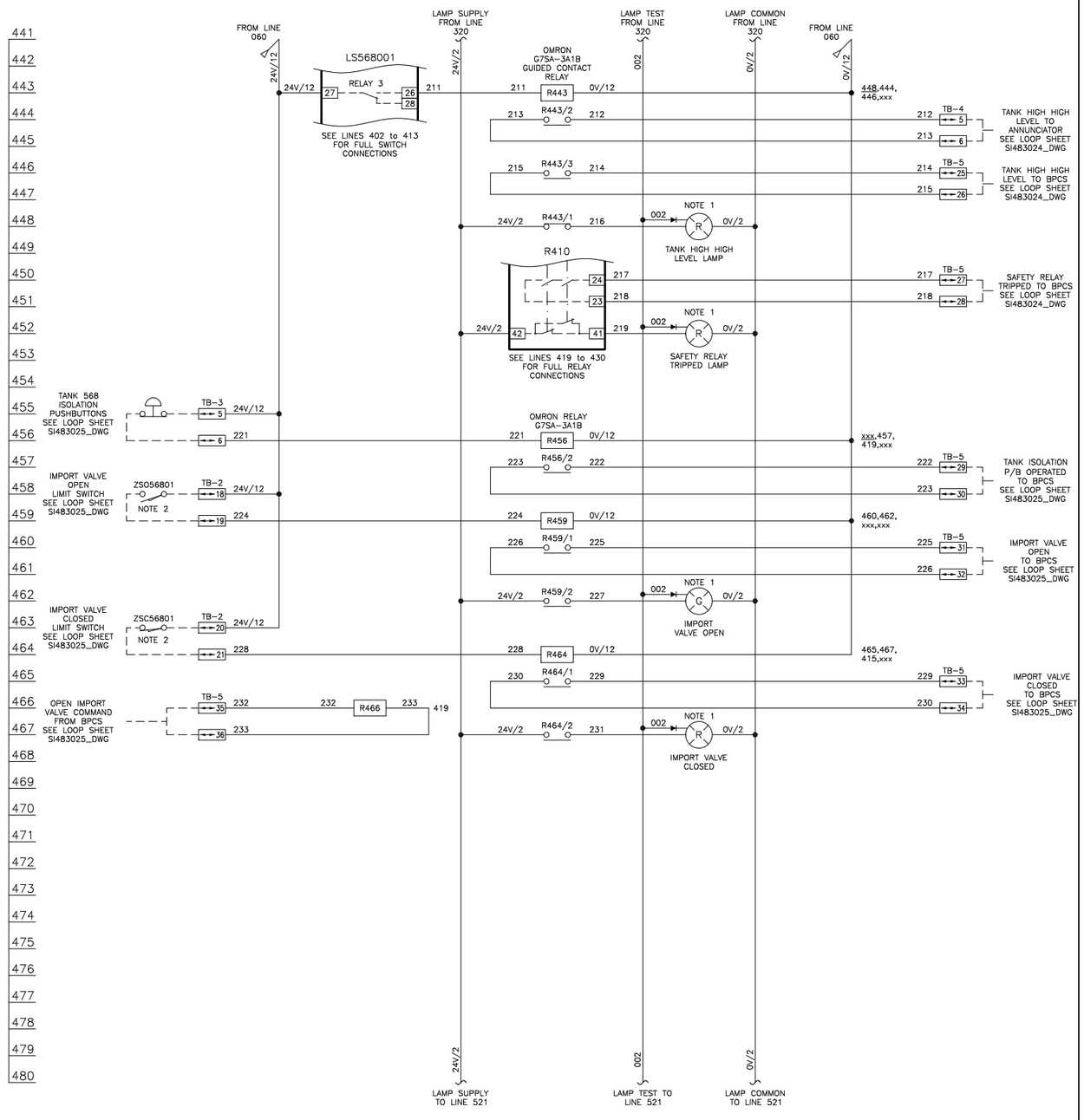


TANK 568 - SIS LOGIC



LAST NUMBER USED : 200
SPARE TO : 210

TANK 568 - BPCS LOGIC



LAST NUMBER USED : 233
SPARE TO : 250

NOTES

1) LED INDICATORS FITTED WITH INTERNAL DIODES.

2) VALVE LIMIT SWITCHES SHOWN WITH VALVE IN CLOSED POSITION.

3) REMOVABLE WIRE LINK. LINK REMOVED IF BPCS ACTION REQUIRED. LINK REFITTED FOR SIS TESTING.

IF NOT SIGNED THIS DOCUMENT IS UNCONTROLLED

REV	DATE	BY	DRN	CHK'D		APP'D		DESCRIPTION
A	16/12/13	P.P.	P.P.	D.B.F	D.B.F	M.M.	M.M.	ISSUED FOR TENDER
B	03/02/14	P.P.	P.P.	D.B.F	D.B.F	M.M.	M.M.	ISSUED FOR CONSTRUCTION
C	25/03/14	P.P.	P.P.	D.B.F	D.B.F	M.M.	M.M.	POST FAT ISSUE
D	31/10/14	D.B.F	P.P.	D.B.F		M.M.		AS BUILT

PLANT	IMMINGHAM STORAGE Co. – EAST TERMINAL
TITLE	No.4 SWITCHROOM TANK OVERFILL SIS PANEL LOGIC DRAWING 5 : TANK 568

SIMON — IMMINGHAM STORAGE Co Ltd, IMMINGHAM EAST TERMINAL, IMMINGHAM DOCK, IMMINGHAM, N.E. LINCOLNSHIRE. DN40 2QW

P & I DESIGN — P & I Design Ltd, Tel. 01642 617444, www.pidesign.co.uk

SHEET 1 OF 1

CLIENT DRG. No.

P&I DRG No. SI483011_DWG

SAFE AREA

No.4 SWITCHROOM ANNEX

CRASH/JETTY STOP PANEL	ROSOV PANEL	TANK OVERFILL SIS PROTECTION PANEL

CRASH STOP RELAY FEED via MARSHALLING CABINET FROM A4/10

CRASH STOP RELAY

12 Relay N

CRASH STOP/4

SIS24V/3 TB-4 79 40379/11

SIS/021 80 40379/12

X40379 Part of 12 Core

40379/11 TB-1 1 24V/3

40379/12 2 021

3

4 022

REMOVE LINK FOR REMOTE RESET

24V/3 TB-24V 3 250mA

LAMP FEED 24V/2

24V/2

R124 PILZ PNOZ s2

A1 A2 0V/3

S34 RESET RESET MODE AUTO

AUXILIARY CONTACTS

24V/2 42 41 023

14 13

24 23

34 33

SAFETY CONTACTS

INTERFACE CONNECTOR

LAMP TEST FEED 002

002

0V/3 TB-0V 3

LAMP COMMON 0V/2

0V/2

002 NOTE 1 R 0V/2

ESD RELAY TRIPPED LAMP

REFER TO ROSOV PANEL ESD LOOP SHEET SI277135_DWG

R124A PILZ PNOZ s11

SAFETY CONTACTS

14 13

24 23

34 33

44 43

64 63

74 73

84 83

94 93

52 51

AUXILIARY CONTACTS

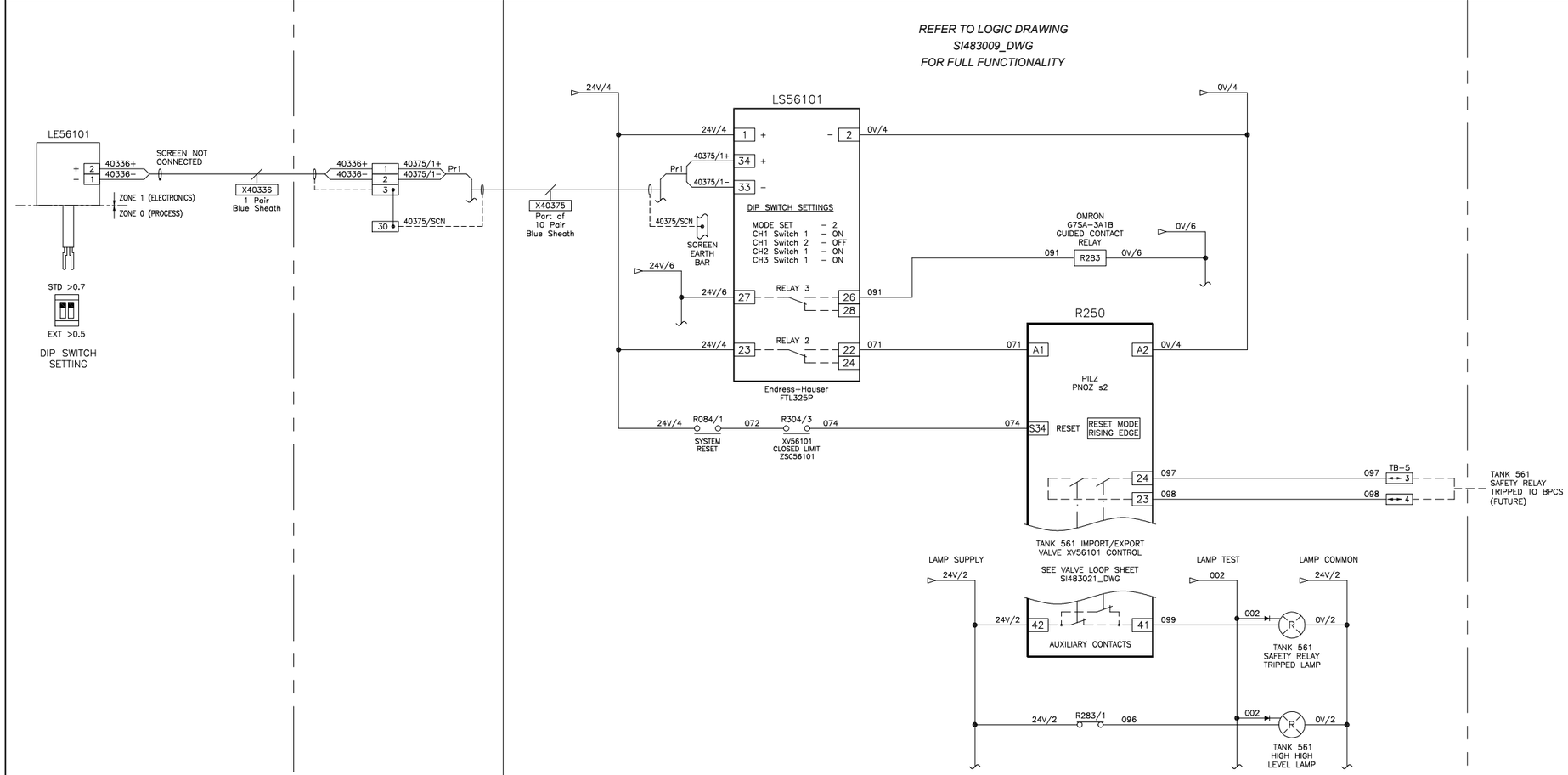
FOR FULL FUNCTIONALITY REFER TO LOGIC DRAWING SI483008_DWG

IF NOT SIGNED THIS DOCUMENT IS UNCONTROLLED

REV	DATE	BY	DRN	CHK'D		APP'D		DESCRIPTION
A	31/10/14	D.B.F	P.P.	D.B.F		M.M.		AS BUILT

PLANT	IMMINGHAM STORAGE Co. – EAST TERMINAL
TITLE	TANK OVERFILL PROTECTION SAFETY INSTRUMENT SYSTEM No.4 EAST SIS ESD LOOP SHEET
SIMON	IMMINGHAM STORAGE Co Ltd, IMMINGHAM EAST TERMINAL, IMMINGHAM DOCK, IMMINGHAM, N.E. LINCOLNSHIRE. DN40 2QW
P & I DESIGN	P & I Design Ltd Tel. 01642 617444 www.pidesign.co.uk
INSTRUMENT LOOP SHEET FOR USE IN HAZARDOUS AREA	SHEET 1 OF 1
CLIENT DRG. No.	P&I DRG No. SI483019_DWG

ZONE 1 II B T4 (UNLESS SPECIFIED OTHERWISE)		SAFE AREA	
FIELD - BUND 'O'	FIELD - TOP TANK 563	No.4 SWITCHROOM	
TANK 561	JB4/197 TANK LEVEL SIS JUNCTION BOX	TANK OVERFILL SIS MONITORING PANEL	BPCS (FUTURE)



IF NOT SIGNED THIS DOCUMENT IS UNCONTROLLED

CERTIFIED EQUIPMENT

TAG No.	CERTIFICATE No.	ATEX CERTIFICATION	I.S. CALCULATION
LE56101	KEMA 99 ATEX 0523	Ex II 1/2 G EEx ia IIC T6	SI483001_CAL
LS56101	DMT 01 ATEX E 052	Ex II (1) GD [EEx ia] IIC	
JB4/197	KEMA 10 ATEX 0050	Ex II 2 G EEx ia IIC T6	

simon
bulk liquid & gas network

REV	DATE	BY	DRN	CHK'D		APP'D		DESCRIPTION
A	13/02/14	P.P.	P.P.	D.B.F	D.B.F	M.M.	M.M.	ISSUED FOR CONSTRUCTION
B	31/10/14	D.B.F	P.P.	D.B.F		M.M.		AS BUILT

PLANT	IMMINGHAM STORAGE Co. − EAST TERMINAL
TITLE	TANK OVERFILL PROTECTION SAFETY INSTRUMENT SYSTEM LE56101 − TANK 561 HIGH HIGH LEVEL LOOP SHEET
	IMMINGHAM STORAGE Co Ltd, IMMINGHAM EAST TERMINAL, IMMINGHAM DOCK, IMMINGHAM, N.E. LINCOLNSHIRE. DN40 2QW
	P & I Design Ltd Tel. 01642 617444 www.pidesign.co.uk
INSTRUMENT LOOP SHEET FOR USE IN HAZARDOUS AREA	SHEET 1 OF 1
CLIENT DRG. No.	P&I DRG No. SI483020_DWG

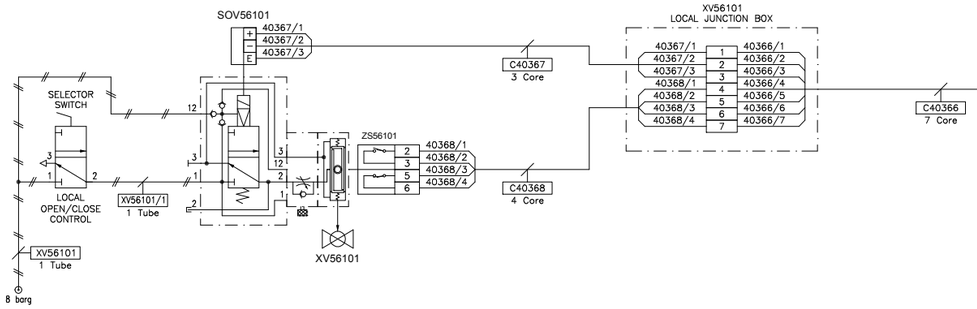
ZONE 1 II B T4 (UNLESS SPECIFIED OTHERWISE)

FIELD - BUND 'O'

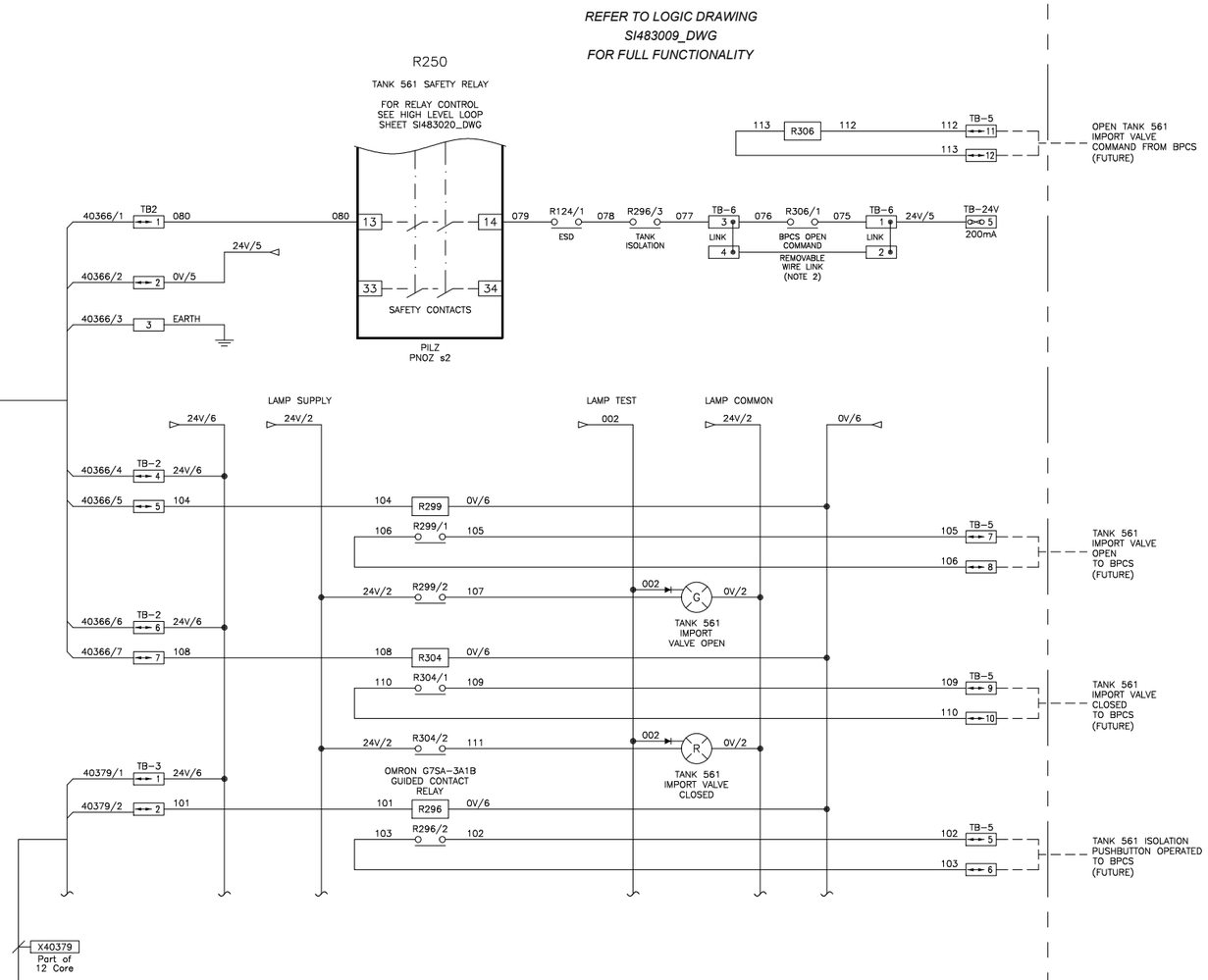
SAFE AREA

No.4 SWITCHROOM : TANK OVERFILL SIS PANEL

BPCS (FUTURE)

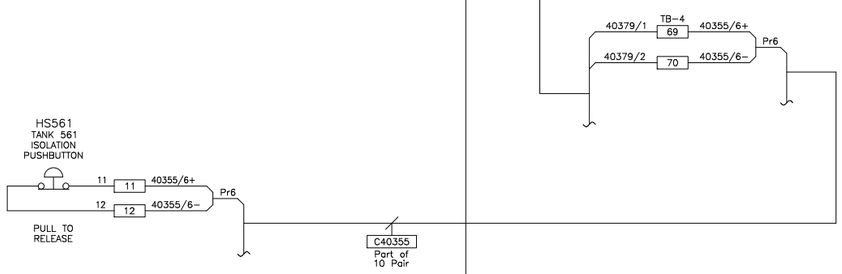


REFER TO LOGIC DRAWING SI483009_DWG FOR FULL FUNCTIONALITY



JB4/87 : TANK ISOLATION JUNCTION BOX - BUND 'O'

No.4 SWITCHROOM : ROSOV PANEL



CERTIFIED EQUIPMENT			
TAG No.	CERTIFICATE No.	ATEX CERTIFICATION	I.S. CALCULATION
SOV56101	PTB 02 ATEX 2125X	Ex II 2 G EEx em II T6	N/A
ZS56101	EPSILON 08 ATEX 2370X	Ex II 2 G EEx d IIB+H_2 T6	N/A
JB4/87	PTB 02 ATEX 1014	Ex II 2 GD EEx e ia II T6	N/A
LOCAL J/B	SIRA 06 ATEX 3185	Ex II 2 GD EEx e II T6	N/A

NOTES

1) LED INDICATORS FITTED WITH INTERNAL DIODES.

2) REMOVABLE WIRE LINK. LINK REMOVED IF BPCS ACTION REQUIRED. LINK REFITTED FOR SIS TESTING.

IF NOT SIGNED THIS DOCUMENT IS UNCONTROLLED

REV	DATE	BY	DRN	CHK'D		APP'D		DESCRIPTION
A	13/02/14	P.P.	P.P.	D.B.F	D.B.F	M.M.	M.M.	ISSUED FOR CONSTRUCTION
B	31/10/14	D.B.F	P.P.	D.B.F		M.M.		AS BUILT

PLANT	IMMINGHAM STORAGE Co. – EAST TERMINAL
TITLE	TANK OVERFILL PROTECTION SAFETY INSTRUMENT SYSTEM XV56101 – TANK 561 IMPORT/EXPORT VALVE LOOP SHEET
	SIMON — IMMINGHAM STORAGE Co Ltd, IMMINGHAM EAST TERMINAL, IMMINGHAM DOCK, IMMINGHAM, N.E. LINCOLNSHIRE. DN40 2QW
	P & I Design Ltd, Tel. 01642 617444, www.pidesign.co.uk
INSTRUMENT LOOP SHEET FOR USE IN HAZARDOUS AREA	SHEET 1 OF 1
CLIENT DRG. No.	P&I DRG No. SI483021_DWG

ZONE 1 II B T4 (UNLESS SPECIFIED OTHERWISE)		SAFE AREA	
FIELD - BUND 'G'	FIELD - BUND 'J'	No.4 SWITCHROOM	
TANK 564	JB4/198 TANK LEVEL SIS JUNCTION BOX	TANK OVERFILL SIS MONITORING PANEL	BPCS (FUTURE)

REFER TO LOGIC DRAWING SI483010_DWG FOR FULL FUNCTIONALITY

LE56401
SCREEN NOT CONNECTED
40341+
40341−
ZONE 1 (ELECTRONICS)
ZONE 0 (PROCESS)
X40341
1 Pair Blue Sheath
STD >0.7
EXT >0.5
DIP SWITCH SETTING

40341+ / 40341− / 40341 → 40376/1+ / 40376/1− / 40376/SCN, Pr1

X40376
Part of 10 Pair Blue Sheath

LS56401
24V/7
0V/7
40376/1+
40376/1−
Pr1
40376/SCN
SCREEN EARTH BAR
DIP SWITCH SETTINGS
MODE SET – 2
CH1 Switch 1 – ON
CH1 Switch 2 – OFF
CH2 Switch 1 – ON
CH3 Switch 1 – ON
RELAY 3
RELAY 2
24V/9
0V/9
Endress+Hauser FTL325P

OMRON G7SA-3A1B GUIDED CONTACT RELAY
R363
151

R330
PILZ PNOZ s2
A1
A2
S34 RESET
RESET MODE RISING EDGE
TANK 564 IMPORT/EXPORT VALVE XV56401 CONTROL

R084/2 SYSTEM RESET
132
R384/3 XV56401 CLOSED LIMIT ZSC56401
134

24
23
157
158
TB-5
15
16
TANK 564 SAFETY RELAY TRIPPED TO BPCS (FUTURE)

LAMP SUPPLY
24V/2
SEE VALVE LOOP SHEET SI483023_DWG
42
41
AUXILIARY CONTACTS
159
LAMP TEST
002
LAMP COMMON
TANK 564 SAFETY RELAY TRIPPED LAMP

R363/1
156
TANK 564 HIGH HIGH LEVEL LAMP

R363/3
155
154
TB-5
13
14
TANK 564 HIGH HIGH LEVEL TO BPCS (FUTURE)

R283/2
153
152
TB-4
3
4
40380/3
40380/4
X40380
Part of 19 Core

ANNUNCIATOR SYSTEM PANEL	OPS OFFICE

TB1
CF3
24Vdc
0V
CLK3
SLOT 1
COM 2
INPUT 10
1/10
ANNUNCIATOR WINDOW
ROW 10 – COLUMN 2
LAHH56401
TANK 564
HIGH HIGH LEVEL

REFER TO ANNUNCIATOR & RADIO MESSAGING SYSTEM MANUAL FOR FULL DETAILS – SI468001_MNL

IF NOT SIGNED THIS DOCUMENT IS UNCONTROLLED

CERTIFIED EQUIPMENT

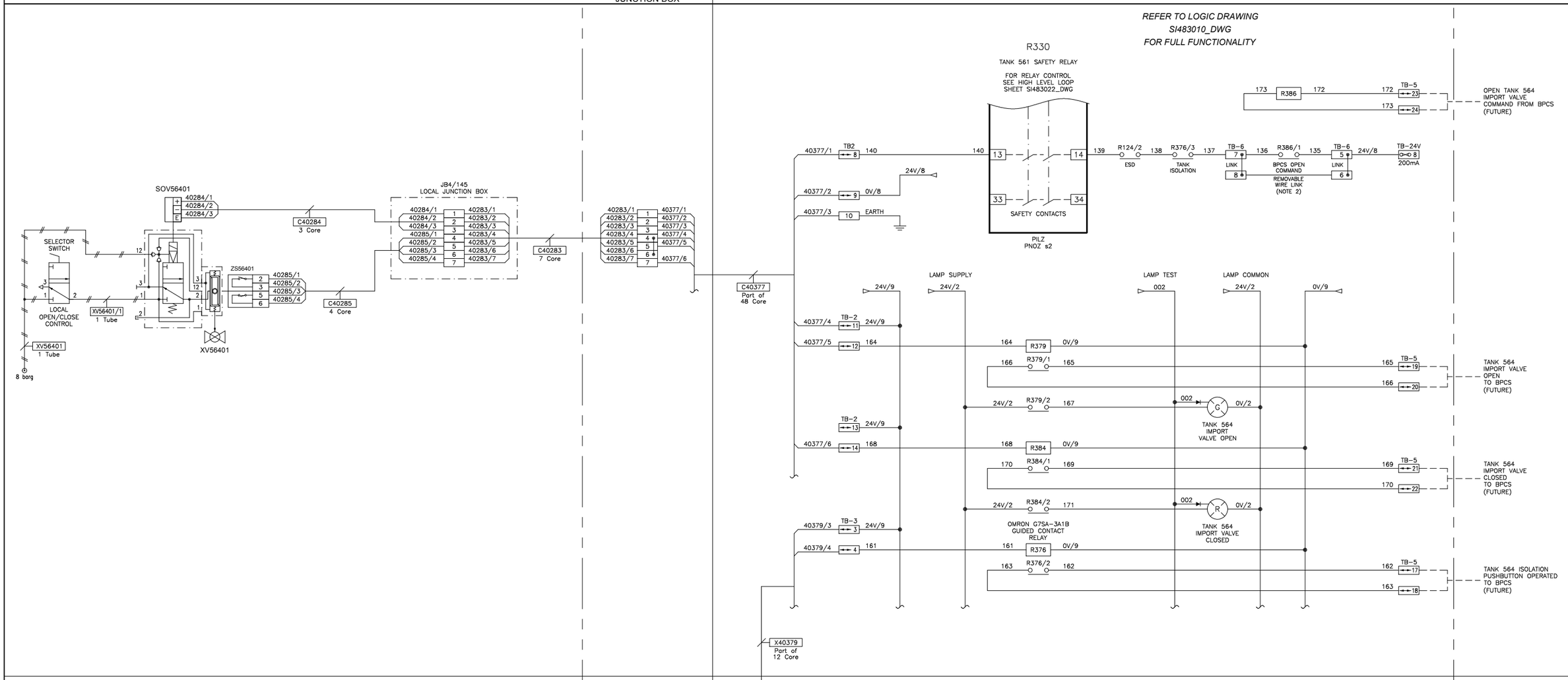
TAG No.	CERTIFICATE No.	ATEX CERTIFICATION	I.S. CALCULATION
LE56401	KEMA 99 ATEX 0523	Ex II 1/2 G EEx ia IIC T6	SI483002_CAL
LS56401	DMT 01 ATEX E 052	Ex II (1) GD [EEx ia] IIC	
JB4/198	KEMA 10 ATEX 0050	Ex II 2 G EEx ia IIC T6	

SIMON bulk liquid & gas network

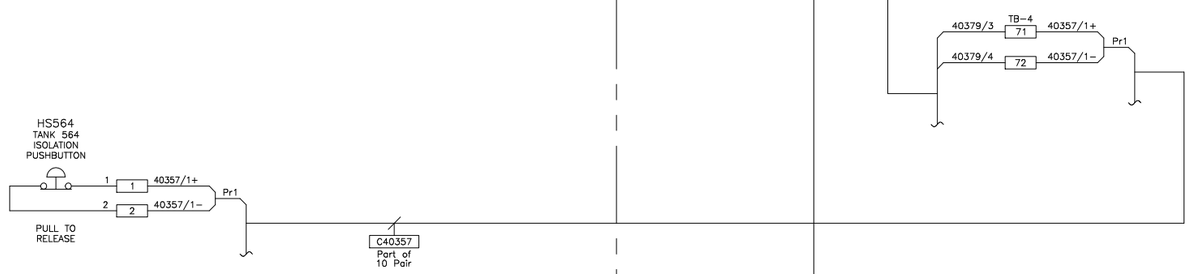
REV	DATE	BY	DRN	CHK'D		APP'D		DESCRIPTION
A	13/02/14	P.P.	P.P.	D.B.F	D.B.F	M.M.	M.M.	ISSUED FOR CONSTRUCTION
B	31/10/14	D.B.F	P.P.	D.B.F		M.M.		AS BUILT

PLANT	IMMINGHAM STORAGE Co. – EAST TERMINAL
TITLE	TANK OVERFILL PROTECTION SAFETY INSTRUMENT SYSTEM LE56401 – TANK 564 HIGH HIGH LEVEL LOOP SHEET
SIMON	IMMINGHAM STORAGE Co Ltd, IMMINGHAM EAST TERMINAL, IMMINGHAM DOCK, IMMINGHAM, N.E. LINCOLNSHIRE. DN40 2QW
P & I DESIGN	*P & I Design Ltd* Tel. 01642 617444 www.pidesign.co.uk
INSTRUMENT LOOP SHEET FOR USE IN HAZARDOUS AREA	SHEET 1 OF 1
CLIENT DRG. No.	P&I DRG No. SI483022_DWG

ZONE 1 II B T4 (UNLESS SPECIFIED OTHERWISE)		SAFE AREA	
FIELD - BUND 'G'	FIELD - BUND 'J'	No.4 SWITCHROOM : TANK OVERFILL SIS PANEL	BPCS (FUTURE)
TANK 564	JB4/200 TANK VALVE JUNCTION BOX		



JB4/88 : TANK ISOLATION JUNCTION BOX - BUND 'I'	No.4 SWITCHROOM : ROSOV PANEL



CERTIFIED EQUIPMENT			
TAG No.	CERTIFICATE No.	ATEX CERTIFICATION	I.S. CALCULATION
SOV56401	PTB 02 ATEX 2125X	Ex II 2 G EEx em II T6	N/A
ZS56401	EPSILON 08 ATEX 2370X	Ex II 2 G EEx d IIB+H_2 T6	N/A
JB4/88	PTB 02 ATEX 1014	Ex II 2 GD EEx e ia II T6	N/A
JB4/145	SIRA 06 ATEX 3185	Ex II 2 GD EEx e II T6	N/A
JB4/200	KEMA 10 ATEX 0050	Ex II 2 G EEx ia IIC T6	

NOTES

1) LED INDICATORS FITTED WITH INTERNAL DIODES.

2) REMOVABLE WIRE LINK. LINK REMOVED IF BPCS ACTION REQUIRED. LINK REFITTED FOR SIS TESTING.

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REV	DATE	BY	DRN	CHK'D		APP'D		DESCRIPTION
A	13/02/14	P.P.	P.P.	D.B.F	D.B.F	M.M.	M.M.	ISSUED FOR CONSTRUCTION
B	31/10/14	D.B.F	P.P.	D.B.F		M.M.		AS BUILT

PLANT	IMMINGHAM STORAGE Co. – EAST TERMINAL
TITLE	TANK OVERFILL PROTECTION SAFETY INSTRUMENT SYSTEM XV56401 – TANK 564 IMPORT/EXPORT VALVE LOOP SHEET
SIMON	IMMINGHAM STORAGE Co Ltd, IMMINGHAM EAST TERMINAL, IMMINGHAM DOCK, IMMINGHAM, N.E. LINCOLNSHIRE. DN40 2QW
P & I DESIGN	P & I Design Ltd Tel. 01642 617444 www.pidesign.co.uk
INSTRUMENT LOOP SHEET FOR USE IN HAZARDOUS AREA	SHEET 1 OF 1
CLIENT DRG. No.	P&I DRG No. SI483023_DWG

ZONE 1 II B T4 (UNLESS SPECIFIED OTHERWISE)		SAFE AREA	
FIELD - BUND 'H'	FIELD - BUND 'I'	No.4 SWITCHROOM	
TANK 568	JB4/198 TANK LEVEL SIS JUNCTION BOX	TANK OVERFILL SIS MONITORING PANEL	BPCS (FUTURE)

REFER TO LOGIC DRAWING SI483011_DWG FOR FULL FUNCTIONALITY

LE56801
ZONE 1 (ELECTRONICS)
ZONE 0 (PROCESS)
STD >0.7
EXT >0.5
DIP SWITCH SETTING
40345+
40345−
SCREEN NOT CONNECTED
X40345
1 Pair Blue Sheath
40376/SCN
40376/2+
40376/2−
Pr2
X40376
Part of 10 Pair Blue Sheath
SCREEN EARTH BAR
LS56801
DIP SWITCH SETTINGS
MODE SET – 2
CH1 Switch 1 – ON
CH1 Switch 2 – OFF
CH2 Switch 1 – ON
CH3 Switch 1 – ON
Endress+Hauser FTL325P
24V/10
0V/10
24V/12
0V/12
RELAY 3
RELAY 2
OMRON G7SA-3A1B GUIDED CONTACT RELAY
R443
R410
PILZ PNOZ s2
RESET
RESET MODE RISING EDGE
R084/2
SYSTEM RESET
R384/3
XV56801 CLOSED LIMIT ZSC56801
TANK 568 IMPORT/EXPORT VALVE XV56801 CONTROL
TB-5
TANK 568 SAFETY RELAY TRIPPED TO BPCS (FUTURE)
LAMP SUPPLY
LAMP TEST
LAMP COMMON
SEE VALVE LOOP SHEET SI483025_DWG
AUXILIARY CONTACTS
TANK 568 SAFETY RELAY TRIPPED LAMP
R443/1
TANK 568 HIGH HIGH LEVEL LAMP
R443/3
TANK 568 HIGH HIGH LEVEL TO BPCS (FUTURE)
R443/2
TB-4
40380/5
40380/6
X40380
Part of 19 Core

ANNUNCIATOR SYSTEM PANEL	OPS OFFICE

TB1
CF3
24Vdc
0V
CLK3
SLOT 1
COM 2
INPUT 14
1/14
ANNUNCIATOR WINDOW
ROW 10 – COLUMN 6
LAHH56801
TANK 568
HIGH HIGH LEVEL

REFER TO ANNUNCIATOR & RADIO MESSAGING SYSTEM MANUAL FOR FULL DETAILS – SI468001_MNL

IF NOT SIGNED THIS DOCUMENT IS UNCONTROLLED

CERTIFIED EQUIPMENT

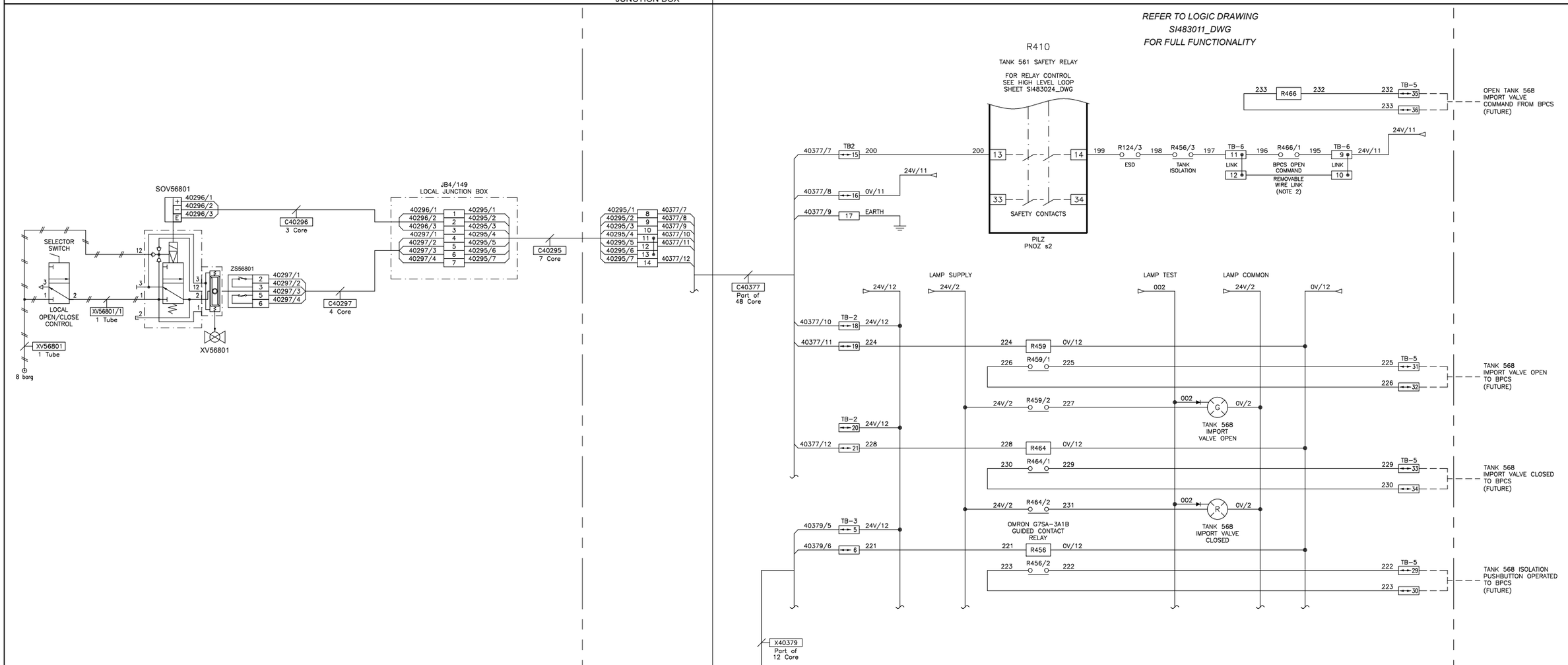
TAG No.	CERTIFICATE No.	ATEX CERTIFICATION	I.S. CALCULATION
LE56801	KEMA 99 ATEX 0523	Ex II 1/2 G EEx ia IIC T6	SI483003_CAL
LS56801	DMT 01 ATEX E 052	Ex II (1) GD [EEx ia] IIC	
JB4/198	KEMA 10 ATEX 0050	Ex II 2 G EEx ia IIC T6	

bulk liquid & gas network

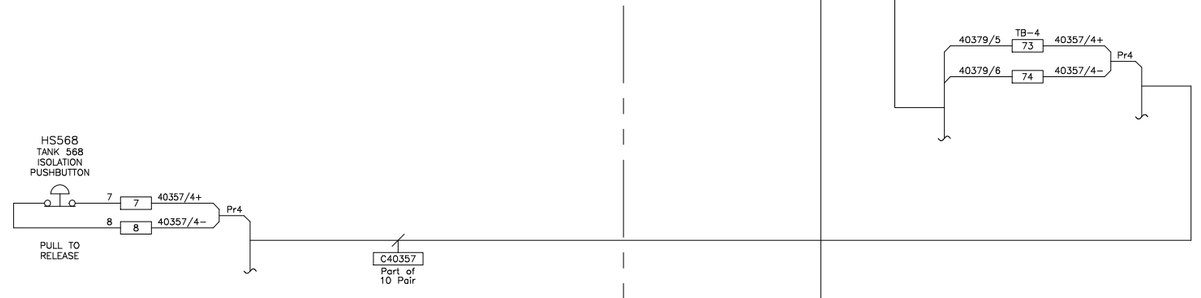
REV	DATE	BY	DRN	CHK'D		APP'D		DESCRIPTION
A	13/02/14	P.P.	P.P.	D.B.F	D.B.F	M.M.	M.M.	ISSUED FOR CONSTRUCTION
B	31/10/14	D.B.F	P.P.	D.B.F		M.M.		AS BUILT

PLANT	IMMINGHAM STORAGE Co. – EAST TERMINAL
TITLE	TANK OVERFILL PROTECTION SAFETY INSTRUMENT SYSTEM LE56801 – TANK 568 HIGH HIGH LEVEL LOOP SHEET
	IMMINGHAM STORAGE Co Ltd, IMMINGHAM EAST TERMINAL, IMMINGHAM DOCK, IMMINGHAM, N.E. LINCOLNSHIRE. DN40 2QW
	P & I Design Ltd Tel. 01642 617444 www.pidesign.co.uk
INSTRUMENT LOOP SHEET FOR USE IN HAZARDOUS AREA	SHEET 1 OF 1
CLIENT DRG. No.	P&I DRG No. SI483024_DWG

ZONE 1 II B T4 (UNLESS SPECIFIED OTHERWISE)		SAFE AREA	
FIELD - BUND 'H'	FIELD - BUND 'J'	No.4 SWITCHROOM : TANK OVERFILL SIS PANEL	BPCS (FUTURE)
TANK 568	JB4/200 TANK VALVE JUNCTION BOX		



JB4/88 : TANK ISOLATION JUNCTION BOX - BUND 'I'	No.4 SWITCHROOM : ROSOV PANEL



CERTIFIED EQUIPMENT

TAG No.	CERTIFICATE No.	ATEX CERTIFICATION	I.S. CALCULATION
SOV56801	PTB 02 ATEX 2125X	Ex II 2 G EEx em II T6	N/A
ZS56801	EPSILON 08 ATEX 2370X	Ex II 2 G EEx d IIB+H_2 T6	N/A
JB4/88	PTB 02 ATEX 1014	Ex II 2 GD EEx e ia II T6	N/A
JB4/149	SIRA 06 ATEX 3185	Ex II 2 GD EEx e II T6	N/A
JB4/200	KEMA 10 ATEX 0050	Ex II 2 G EEx ia IIC T6	

NOTES

1) LED INDICATORS FITTED WITH INTERNAL DIODES.

2) REMOVABLE WIRE LINK. LINK REMOVED IF BPCS ACTION REQUIRED. LINK REFITTED FOR SIS TESTING.

IF NOT SIGNED THIS DOCUMENT IS UNCONTROLLED

REV	DATE	BY	DRN	CHK'D		APP'D		DESCRIPTION
A	13/02/14	P.P.	P.P.	D.B.F	D.B.F	M.M.	M.M.	ISSUED FOR CONSTRUCTION
B	31/10/14	D.B.F	P.P.	D.B.F		M.M.		AS BUILT

PLANT	IMMINGHAM STORAGE Co. – EAST TERMINAL
TITLE	TANK OVERFILL PROTECTION SAFETY INSTRUMENT SYSTEM XV56801 – TANK 568 IMPORT/EXPORT VALVE LOOP SHEET
	SIMON — IMMINGHAM STORAGE Co Ltd, IMMINGHAM EAST TERMINAL, IMMINGHAM DOCK, IMMINGHAM, N.E. LINCOLNSHIRE. DN40 2QW
	P & I Design Ltd, Tel. 01642 617444, www.pidesign.co.uk
INSTRUMENT LOOP SHEET FOR USE IN HAZARDOUS AREA	SHEET 1 OF 1
CLIENT DRG. No.	P&I DRG No. SI483025_DWG

GENERAL REQUIREMENTS

1. De-energise to trip
2. Trip to Safe State on loss of electric or pneumatic power supply.

HEALTHY STATE	TAG	TYPE	TERMINALS	TYPE	SET	ORIGIN
MANUAL SHUTDOWN						
ISCO Site ESD Healthy / Reset	R124	H	TB1/1 - TB1/2	VFC	Closed	RA
No4 East Area ESD Healthy / Reset	R124	H	TB1/1 - TB1/2	VFC	Closed	RA
Tank 561 Manual Isolation Button Healthy	HS561	H	TB3/1 - TB3/2	VFC	Closed	RA
Tank 564 Manual Isolation Button Healthy	HS564	H	TB3/3 - TB3/4	VFC	Closed	RA
Tank 568 Manual Isolation Button Healthy	HS568	H	TB3/5 - TB3/6	VFC	Closed	RA
STORAGE TANK OVERFILL PROTECTION						
Tank 561 IHLA Healthy / SIS Not Reset	LE56101	H	LS56101/34 - /33	Nivo	<97%	RA
Tank 561 IHLA Healthy / SIS Reset	LE56101	H	LS56101/34 - /33	Nivo	<97%	RA
Tank 564 IHLA Healthy / SIS Not Reset	LE56401	H	LS56401/34 - /33	Nivo	<97%	RA
Tank 564 IHLA Healthy / SIS Reset	LE56401	H	LS56401/34 - /33	Nivo	<97%	RA
Tank 568 IHLA Healthy / SIS Not Reset	LE56801	H	IS56801/34 - /33	Nivo	<97%	RA
Tank 568 IHLA Healthy / SIS Reset	LE56801	H	IS56801/34 - /33	Nivo	<97%	RA
FINAL ELEMENT FEEDBACK						
XV56101 Valve Position (detected by limit switch)	ZSO56101	H	TB2/4 - TB2/5	VFC	Closed	
XV56101 Valve Position (detected by limit switch)	ZSC56101	H	TB2/6 - TB2/7	VFC	Closed	
XV56401 Valve Position (detected by limit switch)	ZSO56401	H	TB2/11 - TB2/12	VFC	Closed	
XV56401 Valve Position (detected by limit switch)	ZSC56401	H	TB2/13 - TB2/14	VFC	Closed	
XV56801 Valve Position (detected by limit switch)	ZSO56801	H	TB2/18 - TB2/19	VFC	Closed	
XV56801 Valve Position (detected by limit switch)	ZSC56801	H	TB2/20 - TB2/21	VFC	Closed	
REMOTE RESET						
Remote Reset		H	TB1/5 - TB1/6	VFC	Closed	
LAMP TEST						
Lamp Test Pushbutton		H	Front of Panel	PB	IIN	

PERFORMANCE	FINAL ELEMENT	SAFE STATE
	XV56101 - Tank 561 Import / Export Valve	Operable
	XV56401 - Tank 564 Import / Export Valve	Operable
	XV56801 - Tank 568 Import / Export Valve	Operable
PERFORMANCE	**SAFETY CRITICAL LOGIC SOLVER RELAYS**	**STATE**
	R124, R124A ESD Relay	**Energised**
	R250 Tank 561 Safety Relay	Energised
	R330 Tank 564 Safety Relay	Energised
	R410 Tank 568 Safety Relay	Energised
	BPCS LOGIC SOLVER RELAYS	**STATE**
	R084, R085, R086 Reset	Energise
	R306 XV56101 BPCS Request	Energise
	R386 XV56401 BPCS Request	Energise
	R466 XV56801 BPCS Request	Energise
LAMPS	**OPEATOR INTERFACE LOGIC SOLVER**	**STATE**
	ESD Relay Tripped	Illuminated
	Tank 561 High High Level	Illuminated
	Tank 561 Safety Relay Tripped	Illuminated
	XV56101 Open	Illuminated
	XV56101 Closed	Illuminated
	Tank 564 High High Level	Illuminated
	Tank 564 Safety Relay Tripped	Illuminated
	XV56401 Open	Illuminated
	XV56401 Closed	Illuminated
	Tank 568 High High Level	Illuminated
	Tank 568 Safety Relay Tripped	Illuminated
	XV56801 Open	Illuminated
	XV56801 Closed	Illuminated
TERMINALS	**OPERATOR INTERFACE BPCS**	**VFC**
TB5/1 - TB5/2	Tank 561 High High Level	Closed
TB5/3 - TB5/4	Tank 561 Safety Relay Tripped	Closed
TB5/7 - TB5/8	XV56101 Open	Closed
TB5/9 - TB5/10	XV56101 Closed	Closed
TB5/5 - TB5/6	Tank 561 Isolation Button Activated	Closed
TB5/13 - TB5/14	Tank 564 High High Level	Closed
TB5/15 - TB5/16	Tank 564 Safety Relay Tripped	Closed
TB5/19 - TB5/20	XV56401 Open	Closed
TB5/21 - TB5/22	XV56401 Closed	Closed
TB5/17 - TB5/18	Tank 564 Isolation Button Activated	Closed
TB5/25 - TB5/26	Tank 568 High High Level	Closed
TB5/27 - TB5/28	Tank 568 Safety Relay Tripped	Closed
TB5/31 - TB5/32	XV56801 Open	Closed
TB5/33 - TB5/34	XV56801 Closed	Closed
TB5/29 - TB5/30	Tank 568 Isolation Button Activated	Closed
TERMINALS	**OPERATOR INTERFACE ANNUNCIATOR**	**VFC**
TB4/1 - TB4/2	Tank 561 High High Level	Closed
TB4/3 - TB4/4	Tank 564 High High Level	Closed
TB4/5 - TB4/6	Tank 568 High High Level	Closed

See Page 2
See Page 2
See Page 2

DEFINITIONS AND ABBREVIATIONS

1. RA - Risk Assessment
2. H = Hardwired
3. SAFE STATE = Physical action necessary to achieve a state of the process when safety is achieved
4. IHLA - Independent High Level
5. VFC - Volt Free Contact

REFERENCE DOCUMENTS

REV	DATE	BY	DRN	CHK'D		APPD		DESCRIPTION
A	03.02.14	DBF	DBF	DBF		DSR		Original Issue for Review

PLANT : Immingham Storage Co Ltd - East Terminal
TITLE : No4E 500 Series Tanks - Safety Functions Matrix

simon bulk liquid & gas network

P & I DESIGN

CLIENT DRG
REF N0. SI483003 SCH
QSF112
DATE 20.09.00

GENERAL REQUIREMENTS

1. De-energise to trip
2. Trip to Safe State on loss of electric or pneumatic power supply.

						FINAL ELEMENT	XV56101 - Tank 561 Import / Export Valve	XV56401 - Tank 564 Import / Export Valve	XV56801 - Tank 568 Import / Export Valve	SAFETY CRITICAL LOGIC SOLVER RELAYS	R124, R124A ESD Relay	R250 Tank 561 Safety Relay	R330 Tank 564 Safety Relay	R410 Tank 568 Safety Relay	BPCS LOGIC SOLVER RELAYS	R084, R085, R086 Reset	R306 XV56101 BPCS Request	R386 XV56401 BPCS Request	R466 XV56801 BPCS Request	OPERATOR INTERFACE LOGIC SOLVER	ESD Relay Tripped	Tank 561 High High Level	Tank 561 Safety Relay Tripped	XV56101 Open	XV56101 Closed	Tank 564 High High Level	Tank 564 Safety Relay Tripped	XV56401 Open	XV56401 Closed	Tank 568 High High Level	Tank 568 Safety Relay Tripped	XV56801 Open	XV56801 Closed	OPERATOR INTERFACE BPCS	Tank 561 High High Level	Tank 561 Safety Relay Tripped	XV56101 Open	XV56101 Closed	Tank 561 Isolation Button Activated	Tank 564 High High Level	Tank 564 Safety Relay Tripped	XV56401 Open	XV56401 Closed	Tank 564 Isolation Button Activated	Tank 568 High High Level	Tank 568 Safety Relay Tripped	XV56801 Open	XV56801 Closed	Tank 568 Isolation Button Activated	OPERATOR INTERFACE ANNUNCIATOR	Tank 561 High High Level	Tank 564 High High Level	Tank 568 High High Level	
						SAFE STATE	Close / Inhibited	Close / Inhibited	Close / Inhibited	STATE	De-energise	De-energise	De-energise	De-energise	STATE	Energise	Energise	Energise	Energise	STATE	Illuminated	Illuminated	Illuminated	Illuminated	Illuminated	Illuminated	Illuminated	Illuminated	Illuminated	Illuminated	Illuminated	Illuminated	Illuminated	VFC	Open	Open	Closed	Closed	Open	Open	Open	Closed	Closed	Open	Open	Open	Closed	Closed	Open	VFC	Open	Open	Open	
						PERFORMANCE	Travel>60s Total<180s	Travel>60s Total<180s	Travel>60s Total<180s	PERFORMANCE		< 2 Seconds	< 2 Seconds	> 2 Seconds						LAMPS														TERMINALS	TB5/1 - TB5/2	TB5/3 - TB5/4	TB5/7 - TB5/8	TB5/9 - TB5/10	TB5/5 - TB5/6	TB5/13 - TB5/14	TB5/15 - TB5/16	TB5/19 - TB5/20	TB5/21 - TB5/22	TB5/17 - TB5/18	TB5/25 - TB5/26	TB5/27 - TB5/28	TB5/31 - TB5/32	TB5/33 - TB5/34	TB5/29 - TB5/30	TERMINALS	TB4/1 - TB4/2	TB4/3 - TB4/4	TB4/5 - TB4/6	
SAFETY FUNCTION	TAG	TYPE	TERMINALS	TYPE	SET	ORIGIN																																																	
MANUAL SHUTDOWN																																																						
ISCO Site ESD Activated	R124/R124A	H	TB1/1 - TB1/2	VFC	Open	RA	H	H	H												H																																	
No4 East Area ESD Activated	R124/R124A	H	TB1/1 - TB1/2	VFC	Open	RA	H	H	H												H																																	
Tank 561 Manual Isolation Button Activated	HS561	H	TB3/1 - TB3/2	VFC	Open	RA	H																																H														
Tank 564 Manual Isolation Button Activated	HS564	H	TB3/3 - TB3/4	VFC	Open	RA		H																																				H									
Tank 568 Manual Isolation Button Activated	HS568	H	TB3/5 - TB3/6	VFC	Open	RA			H																																								H					
STORAGE TANK OVERFILL PROTECTION																																																					
Tank 561 IHLA Immersed	LE56101	H	LS56101/34 - /33	Nivo	>97%	RA	H					H1										H	H												H	H																H			1 Reset Required
Tank 564 IHLA Immersed	LE56401	H	LS56401/34 - /33	Nivo	>97%	RA		H					H1													H	H													H	H											H		1 Reset Required
Tank 568 IHLA Immersed	LE56801	H	LS56801/34 - /33	Nivo	>97%	RA			H					H1																H	H														H	H							H	1 Reset Required
FINAL ELEMENT FEEDBACK																																																					
XV56101 Valve Position (detected by limit switch)	ZSO56101	H	TB2/4 - TB2/5	VFC	Closed																			H													H																	
XV56101 Valve Position (detected by limit switch)	ZSC56101	H	TB2/6 - TB2/7	VFC	Closed																				H													H																
XV56401 Valve Position (detected by limit switch)	ZSO56401	H	TB2/11 - TB2/12	VFC	Closed																							H													H												
XV56401 Valve Position (detected by limit switch)	ZSC56401	H	TB2/13 - TB2/14	VFC	Closed																								H													H											
XV56801 Valve Position (detected by limit switch)	ZSO56801	H	TB2/18 - TB2/19	VFC	Closed																											H														H							
XV56801 Valve Position (detected by limit switch)	ZSC56801	H	TB2/20 - TB2/21	VFC	Closed																												H														H						
RESET LOGIC SEQUENCE TANK561																																																					
1. Manual Shutdowns Inactive / Healthy							H					H										H	H		H													H													H			
2. BPCS XV56101 Request On / Linked	R306	H	TB5/11 - TB5/12	24Vdc	ON		H					H					H					H	H		H													H													H			
3.Tank 561 IHLA Healthy, XV56101 Closed		H			<97%	RA	H					H											H		H													H																
4.Reset Pushbutton Operated		H			IN											H								H													H																	
RESET LOGIC SEQUENCE TANK564																																																					
1. Manual Shutdowns Inactive / Healthy		H						H					H													H	H		H															H								H		
2. BPCS XV56401 Request On	R386	H	TB5/23 - TB5/24	24Vdc	ON			H					H					H								H	H		H															H								H		
3.Tank 564 IHLA Healthy, XV56401 Closed		H			<97%	RA		H					H														H		H															H										
4.Reset Pushbutton Operated		H			IN											H												H															H											
RESET LOGIC SEQUENCE TANK568																																																					
1. Manual Shutdowns Inactive / Healthy		H							H					H																H	H		H															H					H	
2. BPCS XV56801 Request On	R466	H	TB5/35 - TB5/36	24Vdc	ON				H					H					H											H	H		H															H					H	
3.Tank 568 IHLA Healthy, XV56801 Closed		H			<97%	RA			H					H																	H		H															H						
4.Reset Pushbutton Operated		H			IN											H																H														H							
REMOTE RESET																																																						
Remote Reset		H	TB1/5 - TB1/6	VFC	Closed											H																																						
LAMP TEST																																																						
Lamp Test Pushbutton		H	Front of Panel	PB	IIN																																																		

DEFINITIONS AND ABBREVIATIONS	REFERENCE DOCUMENTS	REV	DATE	BY	DRN	CHK'D	APPD	DESCRIPTION
1. RA - Risk Assessment		A	03.02.14	DBF	DBF	DBF	DSR	Original Issue for Review
2. H = Hardwired								
3. SAFE STATE = Physical action necessary to achieve a state of the process when safety is achieved								
4. IHLA - Independent High Level								
5. VFC - Volt Free Contact								

PLANT : Immingham Storage Co Ltd - East Terminal

TITLE : No4E 500 Series Tanks - Safety Functions Matrix

simon bulk liquid & gas network

P & I DESIGN

SHEET 2 OF 2

CLIENT DRG

REF N0. SI483003_SCH

QSF112

DATE 20.09.00

INSTRUMENT SCHEDULE

Instrument Tag. No.	Service	Instrument Spec. _SPC	Manufacturer	Model Number	Serial Number	Atex Certification	Atex Certificate No	Site Specific SIS Tag (ATEX Tag)	P & I Drawing Client (REV)	Loop Drawing _DWG	I/O Requirement No4 East SIS Overfill Protection Logic Solver						Notes D = Digital, A = Analogue, I = In, O = Out S = Software, H = Hardwired,
											DI	DO	AI	AO	Address	Comms	
TANK 561	**Gasoline Storage Tank**								**SI483001_DWG (1)**								**(1) Tanks 561, 564 & 568 Cable Overview**
Sensing Element	**Independent High High Level Probe**																
LE56101	Liquiphant Probe	SI483001	Endress & Hauser	FTL51-GAC2BB7G4A	A40BDA01027	Ex II 1/2 G Ex ia IIC T 80 C	KEMA99ATEX0523	E1765 (E10001)	IME-K-0028	SI483020	1						
LS56101	Nivotester	SI483001	Endress & Hauser	FTL 325P H3 E3	A4029A01093	Ex II(1)GD [EEx ia] IIC	DMT01ATEXE052	N/A	IME-K-0028	SI483020		2					
R250	Safety Relay		PILZ	PNOZ s2	750102 138641	N/A	N/A	N/A	IME-K-0028	SI483020		1					
Final Element	**Pipeline Import / Export Block Valve**																
XV56101	Valve Body		Dafram	150 TM9N DN250	197181	N/A	N/A	E10098	IME-K-0028	SI483021							
XV56101	Valve Actuator		Actreg	ACT400R	P-03-4000-10256	N/A	N/A	E10093	IME-K-0028	SI483021							
ZS56101	Limit Switch Box		Westlock	2245	N/A	Ex d IIB+H2 T5	EPSILON08ATEX2370X	E10094 (E0519)	IME-K-0028	SI483021	2	2					
SOV56101	Solenoid Body		Seitz	CP 0632 CPU oH		N/A	N/A	E10095	IME-K-0028	SI483021							
SOV56101	Solenoid Coil		Seitz	121.104.024C (Art.No)	110625 (F.no)	Ex II 2 G Ex emb II T6	PTB02ATEX2125X	E10096 (E0518)	IME-K-0028	SI483021	1	1					
JB XV5601	Local Junction Box		Feel	Range 9000	01152-10	Ex II 2 GD EExe II T6	SIRA06ATEX3185	E10097 (E0517)	IME-K-0028	SI483021							
Manual Shutdown	**Bund Isolation**																
HS561	Bund Isolation Station		Copper Crouse Hinds	GHG4181101 R0003	N/A	EExde IIC Ex II 2G	PTB97ATEX1081U	N/A		SI483021	1	1					Located in JB4/87
Local	Local Selector Switch		N/A	N/A	N/A	N/A	N/A	N/A		SI483021							
TANK 564	**Gasoline Storage Tank**								**SI483001_DWG (1)**								**(1) Tanks 561, 564 & 568 Cable Overview**
Sensing Element	**Independent High High Level Probe**																
LE56401	Liquiphant Probe	SI483002	Endress & Hauser	FTL51-GAC2BB7G4A	A40BD901027	Ex II 1/2 G Ex ia IIC T 80 C	KEMA99ATEX0523	E1771 (E10016)	IME-K-0052	SI483022	1						
LS56401	Nivotester	SI483002	Endress & Hauser	FTL 325P H3 E3	A4029801093	Ex II(1)GD [EEx ia] IIC	DMT01ATEXE052	N/A	IME-K-0052	SI483022		2					
R330	Safety Relay		PILZ	PNOZ s2	750102 139139	N/A	N/A	N/A	IME-K-0052	SI483022		1					
Final Element	**Pipeline Import / Export Block Valve**																
XV56401	Valve Body		Dafram	150 TM9XN DN200	LF2 204248	N/A	N/A	E10099	IME-K-0052	SI483023							
XV56401	Valve Actuator		Actreg	ACT2500R	N/A	N/A	N/A	E10033	IME-K-0052	SI483023							
ZS56401	Limit Switch Box		Westlock	2245	N/A	Ex d IIB+H2 T5	EPSILON08ATEX2370X	E10034 (E0516)	IME-K-0052	SI483023	2	2					
SOV56401	Solenoid Body		Seitz	CP 0632 CPU oH	1108 (F.No)	N/A	N/A	E10035	IME-K-0052	SI483023							
SOV56401	Solenoid Coil		Seitz	121.104.024C (Art.No)	110624 (F.No)	Ex II 2 G Ex emb II T6	PTB02ATEX2125X	E10036 (E0515)	IME-K-0052	SI483023	1	1					
JB4/145	Local Junction Box		Feel	Range 9000	08/11510	Ex II 2 GD EExe II T6	SIRA02ATEX3111	E10037 (E1841)	IME-K-0052	SI483023							
Manual Shutdown	**Bund Isolation**																
HS564	Bund Isolation Station		Copper Crouse Hinds	GHG4181101 R0003	N/A	EExde IIC Ex II 2G	PTB97ATEX1081U	N/A		SI483023	1	1					Located in JB4/88
Local	Local Selector Switch		N/A	N/A	N/A	N/A	N/A	N/A		SI483023							
TANK 568	**Gasoline Storage Tank**								**SI483001_DWG (1)**								**(1) Tanks 561, 564 & 568 Cable Overview**
Sensing Element	**Independent High High Level Probe**																
LE56801	Liquiphant Probe	SI483003	Endress & Hauser	FTL51-GAC2BB7G4A	A40BDF01027	Ex II 1/2 G Ex ia IIC T 80 C	KEMA99ATEX0523	E1772 (E10010)	IME-K-0050	SI483024	1						
LS56801	Nivotester	SI483003	Endress & Hauser	FTL 325P H3 E3	A4029501093	Ex II(1)GD [EEx ia] IIC	DMT01ATEXE052	N/A	IME-K-0050	SI483024		2					
R410	Safety Relay		PILZ	PNOZ s2	750102 138629	N/A	N/A	N/A	IME-K-0050	SI483024		1					
Final Element	**Pipeline Import / Export Block Valve**																
XV56801	Valve Body		Dafram	150 TB9 XM DN200	LF2 204248	N/A	N/A	E10106	IME-K-0050	SI483025							
XV56801	Valve Actuator		Actreg	ACT2500R	N/A	N/A	N/A	E10038	IME-K-0050	SI483025							
ZS56801	Limit Switch Box		Westlock	2245	N/A	Ex d IIB+H2 T5	EPSILON08ATEX2370X	E10039 (E3240)	IME-K-0050	SI483025	2	2					
SOV56801	Solenoid Body		Seitz	CP 0632 CPU oH	1109 (F.No)	N/A	N/A	E10042	IME-K-0050	SI483025							
SOV56801	Solenoid Coil		Seitz	121.104.024C (Art.No)	110727 (F.No)	Ex II 2 G Ex emb II T6	PTB02ATEX2125X	E10043 (E3250)	IME-K-0050	SI483025	1	1					
JB4/149	Local Junction Box		Feel	Range 9000	08/11521	Ex II 2 GD EExe II T6	SIRA02ATEX3111	E10044 (E1838)	IME-K-0050	SI483025							
Manual Shutdown	**Bund Isolation**																
HS568	Bund Isolation Station		Copper Crouse Hinds	GHG4181101 R0003	N/A	EExde IIC Ex II 2G	PTB97ATEX1081U	N/A		SI483025	1	1					Located in JB4/88
Local	Local Selector Switch		N/A	N/A	N/A	N/A	N/A	N/A		SI483025							
ESD	**Terminal Shutdown**								**SI483001_DWG (1)**								**(1) Tanks 561, 564 & 568 Cable Overview**
ESD	**Emergency Shutdown**																
R124	Safety Relay		PILZ	PNOZ s2	750102 138683	N/A	N/A	N/A		SI483026	1						
R124A	Safety Relay		PILZ	PNOZ s11	750111 126494	N/A	N/A	N/A		SI483026							
Infrastructure	**500 Series Field Equipment**																
JB4/87	Bund Isolation Panel		Copper Crouse Hinds	XLH	SJ 3338-08	Ex II 2 G Exde IIC T6	PTB02ATEX1014	E10041 (E1792)									
JB4/88	Bund Isolation Panel		Copper Crouse Hinds	EX-CELL	SJ 3339-08	Ex II 2 G Exde IIC T6	PTB02ATEX1014	E10040 (E3042)									
JB4/197	SIS Independent High High Level JB		Weidmuller	TB MH 262620S4E3	XA GBB001746	Ex II 2 G Exia IIC T6	KEMA10ATEX0050	(E3542)									
JB4/198	SIS Independent High High Level JB		Weidmuller	TB MH 262620S4E3	XA GBB001747	Ex II 2 G Exia IIC T6	KEMA10ATEX0050	(E3545)									
JB4/199	SIS Valves JB		Weidmuller	TB MH 303015S4E3	XA GBB009221	Ex II 2 G Exia IIC T6	KEMA10ATEX0050	(E3543)									
JB4/200	SIS Valves JB		Weidmuller	TB MH 453815S4E1	XA GBB009222	Ex II 2 G Exia IIC T6	KEMA10ATEX0050	(E3544)									
Spares																	
TOTALS											16	21					

NOTES	REVISION	DATE	BY	CHECKED		APPROVED		DESCRIPTION
	A	04.02.14	DBF	MM	MM	MM	MM	Original Issue for Review
	B	31.10.14	DBF	DSR		DSR		As Built Post SAT

PLANT	ISCo East Terminal
TITLE	IME-SIS1 Instrument Schedule
P & I DESIGN	SIMON bulk liquid & gas network
SHEET 1 OF 1	REF N0. SI483010_SCH

HEALTHY STATE

DESCRIPTION	TAG	ACTION	NOTES
SIS AUTOMATIC SHUTDOWN	**IME-SIS1**		
Tank 561 Independent High Level	LE56101	Probe	* Reset if Enabled & Pushbutton Activated
Tank 564 Independent High Level	LE56401	Probe	* Reset if Enabled & Pushbutton Activated
Tank 568 Independent High Level	LE56801	Probe	* Reset if Enabled & Pushbutton Activated
ROSOV MANUAL SHUTDOWN			
Terminal Shutdown		N/A	
Tank 561 Bund Isolation	HS561	Button	
Tank 564 Bund Isolation	HS564	Button	
Tank 568 Bund Isolation	HS568	Button	
BPCS CONTROL			
Local Pneumatic Control Station	XV56101	Switch	
Local Pneumatic Control Station	XV56401	Switch	
Local Pneumatic Control Station	XV56801	Switch	
DIAGNOSTICS			
Tank 561 Import Valve Closed	ZSC56101	Limits	
Tank 561 Import Valve Open	ZSO56101	Limits	
Tank 564 Import Valve Closed	ZSC56401	Limits	
Tank 564 Import Valve Open	ZSO56401	Limits	
Tank 568 Import Valve Closed	ZSC56801	Limits	
Tank 568 Import Valve Open	ZSO56801	Limits	
SIS Logc Solver Lamp Test		Button	

DESCRIPTION	TAG	TYPE	CALIBRATION	UNITS	SET	ORIGIN
SIS AUTOMATIC SHUTDOWN	**IME-SIS1**		**SIL 2**			
Tank 561 Independent High Level	LE56101	Probe	1000 (3)	mm	<97%	SRS
Tank 564 Independent High Level	LE56401	Probe	1000 (3)	mm	<97%	SRS
Tank 568 Independent High Level	LE56801	Probe	1000 (3)	mm	<97%	SRS
ROSOV MANUAL SHUTDOWN						
Terminal Shutdown			N/A		HEALTHY	SRS
Tank 561 Bund Isolation	HS561	Button	N/A		HEALTHY	SRS
Tank 564 Bund Isolation	HS564	Button	N/A		HEALTHY	SRS
Tank 568 Bund Isolation	HS568	Button	N/A		HEALTHY	SRS
BPCS CONTROL						
Local Pneumatic Control Station	XV56101	Switch	"OPEN" or "CLOSE"	N/A	OPEN	SRS
Local Pneumatic Control Station	XV56401	Switch	"OPEN" or "CLOSE"	N/A	OPEN	SRS
Local Pneumatic Control Station	XV56801	Switch	"OPEN" or "CLOSE"	N/A	OPEN	SRS
DIAGNOSTICS						
Tank 561 Import Valve Closed	ZSC56101	Limits	N/A	N/A	Closed	SRS
Tank 561 Import Valve Open	ZSO56101	Limits	N/A	N/A	Open	SRS
Tank 564 Import Valve Closed	ZSC56401	Limits	N/A	N/A	Closed	SRS
Tank 564 Import Valve Open	ZSO56401	Limits	N/A	N/A	Open	SRS
Tank 568 Import Valve Closed	ZSC56801	Limits	N/A	N/A	Closed	SRS
Tank 568 Import Valve Open	ZSO56801	Limits	N/A	N/A	Open	SRS
SIS Logc Solver Lamp Test		Button	N/A	N/A	Test	SRS

ABBREVIATIONS
SIS - Safety Instrument System
IHL Independent High Level
BPCS - Basic Process
Control System
ESD - Emergency Shutdown
LB - Line Break / SC - Short Circuit
H - Hardwired / S - Software

NOTES
(1) ESD trips other terminal systems - see xxxxx
(2) Self test, 2 pulse trip and fault condition.
(3) Switch length
(4) Full Annunciator functionality in SI468001_MNL

REFERENCE DOCUMENTS	
SRS	SI277010_RPT
Overfill Protection Trip Matrix	SI003100_SCH

REV	DATE	BY	DRN	CHK'D		APPD		DESCRIPTION
A	03/02/14	DBF	DBF	MM		MM		Original Issue for Review

PLANT Immingham Storage Co Ltd - East Terminal

TITLE IME-SIS1 Tip Matrix

P & I DESIGN

simon bulk liquid & gas network

SHEET 1 OF 2

CLIENT DRG

REF N0. SI483012_SCH

SAFETY FUNCTION

DESCRIPTION	TAG	ACTION	NOTES
FINAL ELEMENTS			
Valves			
Tank 561 Import / Export Valve	XV56101	Close / Inhibit	
Tank 564 Import / Export Valve	XV56401	Close / Inhibit	
Tank 568 Import / Export Valve	XV56801	Close / Inhibit	
DIAGNOSTICS			
No4 East Switchroom SIS Logic Solver			
ESD Relay Tripped		Lamp	
Tank 561 High High Level	LSHH56101	Lamp	
Tank 561 Safety Relay Tripped		Lamp	
Tank 561 Import / Export Valve Closed	XV56101	Lamp	
Tank 561 Import / Export Valve Open	XV56101	Lamp	
Tank 564 High High Level	LSHH56401	Lamp	
Tank 564 Safety Relay Tripped		Lamp	
Tank 564 Import / Export Valve Closed	XV56401	Lamp	
Tank 564 Import / Export Valve Open	XV56401	Lamp	
Tank 568 High High Level	LSHH56801	Lamp	
Tank 568 Safety Relay Tripped		Lamp	
Tank 568 Import / Export Valve Closed	XV56801	Lamp	
Tank 568 Import / Export Valve Open	XV56801	Lamp	
No3 East Control Room Annunciator (4)			
Site ESD (Window 3/3)		Activated	
Tank 561 High High Level (Window 7/9)	LSHH56101	Activated	
Tank 564 High High Level (Window 10/2)	LSHH56401	Actvated	
Tank 568 High High Level (Window 10/6)	LSHH56801	Actvated	
SI468007_SCH - Radio Message Schedule		Activated	

DESCRIPTION	TAG	TYPE	CALIBRATION	UNITS	SET	ORIGIN	Tank 561 Import / Export Valve	Tank 564 Import / Export Valve	Tank 568 Import / Export Valve	ESD Relay Tripped	Tank 561 High High Level	Tank 561 Safety Relay Tripped	Tank 561 Import / Export Valve Closed	Tank 561 Import / Export Valve Open	Tank 564 High High Level	Tank 564 Safety Relay Tripped	Tank 564 Import / Export Valve Closed	Tank 564 Import / Export Valve Open	Tank 568 High High Level	Tank 568 Safety Relay Tripped	Tank 568 Import / Export Valve Closed	Tank 568 Import / Export Valve Open	Site ESD (Window 3/3)	Tank 561 High High Level (Window 7/9)	Tank 564 High High Level (Window 10/2)	Tank 568 High High Level (Window 10/6)	SI468007_SCH - Radio Message Schedule	NOTES
SIS AUTOMATIC SHUTDOWN	**IME-SIS1**		**SIL2**			**LOPA**																						
Tank 561 Independent High Level	LE56101	Probe	1000 (3)	mm	>97%	SRS	H				Red	Red	Red											H			S	Safety Relay Reset Required - See Sht 1
Tank 564 Independent High Level	LE56401	Probe	1000 (3)	mm	>97%	SRS		H							Red	Red	Red								H		S	Safety Relay Reset Required - See Sht 1
Tank 568 Independent High Level	LE56801	Probe	1000 (3)	mm	>97%	SRS			H										Red	Red	Red					H	S	Safety Relay Reset Required - See Sht 1
ROSOV MANUAL SHUTDOWN																												
Site ESD	N/A	N/A	N/A	N/A	Tripped	SRS	H(1)	H(1)	H(1)	Red			Red				Red				Red		H				S	
Tank 561 Bund Isolation	HS561	Button	N/A	N/A	Activated	SRS	H						Red															
Tank 564 Bund Isolation	HS564	Button	N/A	N/A	Activated	SRS		H									Red											
Tank 568 Bund Isolation	HS568	Button	N/A	N/A	Activated	SRS			H												Red							
TEST FUNCTIONS																												
Tank 561 Test Button (2)	LS56101	Switch	N/A	N/A	Test	SRS	H				Red	Red	Red											H			S	Safety Relay Reset Required - See Sht 1
Tank 564 Test Button (2)	LS56401	Switch	N/A	N/A	Test	SRS		H							Red	Red	Red								H		S	Safety Relay Reset Required - See Sht 1
Tank 568 Test Button (2)	LS56801	Switch	N/A	N/A	Test	SRS			H										Red	Red	Red					H	S	Safety Relay Reset Required - See Sht 1
FAILURE MODES DETECTED																												
ESD Logic 24V/3 Failure	ESD	Fuse	N/A	N/A	Fail	SRS	H(1)	H(1)	H(1)	Red			Red				Red				Red		H				S	
Tank 561 IHL Short Circuit	LE56101	SC	N/A	N/A	SC	SRS	H				Red	Red	Red											H			S	Safety Relay Reset Required - See Sht 1
Tank 561 IHL Open Circuit	LE56101	LB	N/A	N/A	LB	SRS	H				Red	Red	Red											H			S	Safety Relay Reset Required - See Sht 1
Tank 561 SIS Logic 24V/4 Failure	LS56401	Fuse	N/A	N/A	Fail	SRS	H				Red	Red	Red											H			S	Safety Relay Reset Required - See Sht 1
Tank 561 Valve 24V/5 Failure	XV56101	Fuse	N/A	N/A	Fail	SRS	H						Red															
Tank 561 BPCS Logic 24V/6 Failure		Fuse	N/A	N/A	Fail	SRS	H				Red													H			S	
Tank 561 Valve Air Failure	XV56101	N/A	N/A	N/A	Iso & Vent	SRS	H						Red															
Tank 564 IHL Short Circuit	LE56401	SC	N/A	N/A	SC	SRS		H							Red	Red	Red								H		S	Safety Relay Reset Required - See Sht 1
Tank 564 IHL Open Circuit	LE56401	LB	N/A	N/A	LB	SRS		H							Red	Red	Red								H		S	Safety Relay Reset Required - See Sht 1
Tank 564 SIS Logic 24V/7 Failure	LS56401	Fuse	N/A	N/A	Fail	SRS		H							Red	Red	Red								H		S	Safety Relay Reset Required - See Sht 1
Tank 564 Valve 24V/8 Failure	XV56101	Fuse	N/A	N/A	Fail	SRS		H									Red											
Tank 564 BPCS Logic 24V/9 Failure		Fuse	N/A	N/A	Fail	SRS		H							Red										H		S	
Tank 564 Valve Air Failure	XV56401	N/A	N/A	N/A	Iso & Vent	SRS		H									Red											
Tank 568 IHL Short Circuit	LE56801	SC	N/A	N/A	SC	SRS			H										Red	Red	Red					H	S	Safety Relay Reset Required - See Sht 1
Tank 568 IHL Open Circuit	LE56801	LB	N/A	N/A	LB	SRS			H										Red	Red	Red					H	S	Safety Relay Reset Required - See Sht 1
Tank 568 SIS Logic 24V/10 Failure	LS56801	Fuse	N/A	N/A	Fail	SRS			H										Red	Red	Red					H	S	Safety Relay Reset Required - See Sht 1
Tank 568 Valve 24V/11 Failure	XV56801	Fuse	N/A	N/A	Fail	SRS			H												Red							
Tank 568 BPCS Logic 24V/12 Failure		Fuse	N/A	N/A	Fail	SRS			H										Red							H	S	
Tank 568 Valve Air Failure	XV56801	N/A	N/A	N/A	Iso & Vent	SRS			H												Red							
BPCS CONTROL																												
Local Pneumatic Control Station	XV56101	Switch	"OPEN" or "CLOSE"	N/A	CLOSE	SRS	H																					
Local Pneumatic Control Station	XV56401	Switch	"OPEN" or "CLOSE"	N/A	CLOSE	SRS		H																				
Local Pneumatic Control Station	XV56801	Switch	"OPEN" or "CLOSE"	N/A	CLOSE	SRS			H																			

ABBREVIATIONS
SIS - Safety Instrument System
IHL Independent High Level
BPCS - Basic Process
Control System
ESD - Emergency Shutdown
LB - Line Break / SC - Short Circuit
H - Hardwired / S - Software

NOTES
(1) ESD trips other terminal systems - see xxxxx
(2) Self test, 2 pulse trip and fault condition.
(3) Switch lengh
(4) Full Annunciator functionality in SI468001_MNL

REFERENCE DOCUMENTS	
SRS	SI277010_RPT
Overfill Protection Trip Matrix	SI003100_SCH

REV	DATE	BY	DRN	CHK'D	APPD	DESCRIPTION
A	03/02/14	DBF	DBF	MM	MM	Original Issue for Review

PLANT Immingham Storage Co Ltd - East Terminal

TITLE IME-SIS1 Tip Matrix

P & I DESIGN

simon bulk liquid & gas network

SHEET 2 OF 2

CLIENT DRG

REF N0. SI483012_SCH

INTRINSICALLY SAFE CIRCUIT CALCULATION

E & H LIQUIPHANT FTL 51 WITH FEL 57 INSERT AND FTL 325P NIVOTESTER

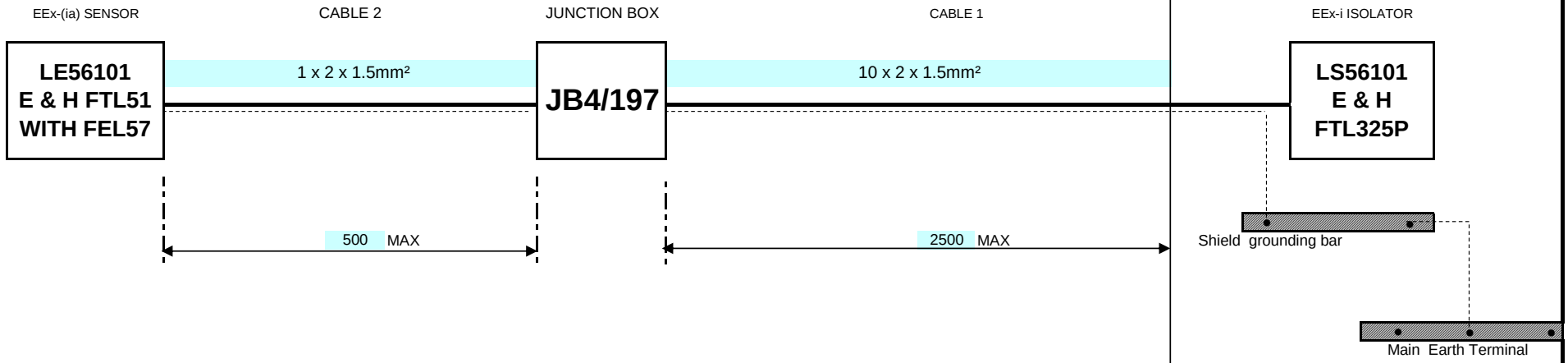
Customer:	Simon Storage						
Plant:	Immingham East	A	DBF	MM	MM	09.04.14	
Project :	SI483	Rev	BY	Check	App	Date	
Calculation N° :	SI483001_CAL		Sheet :	1	of	1	

Loop Sheet No.

SI483020_DWG

HAZARDOUS AREA | **SAFE AREA**

Zone		Gas Group	Temperature Class
0	1	IIB	T4
Process	Electronics		



	Cable 2	Cable 1	Cable 1 + Cable 2	
Supply by	P&I Design			P&I Design
Specification	SI483001_SPC	BS5308 Part 1 Type 2	BS5308 Part 1 Type 2	SI483001_SPC
Manufacturer	Endress+Hauser			Endress+Hauser
Model	FTL51 with FEL57 Insert			FTL 325P
Description	Vibronics Level Sensor	Single twisted pair - SWA armoured	Multiple twisted pairs - SWA armoured	3 ch Nivotester
Certification	Ex II 1 2 G EEx ia IIC T6			Ex II (1) G D [EEx ia] IIC T6
Certificate No.	KEMA 99 ATEX 0523			DMT 01 ATEX E 052
Voltage	Ui: 16.7 V			Uo: 14.6 V
I current	Ii: 150 mA			Io: 97 mA
Power	Pi: 1.00 W			Po: 0.633 W
Capacitance	Ci: 0.0000 µF	Cc2: 0.115 µF/km => 0.0575 µF	Cc1: 0.085 µF/km => 0.2125 µF	Cct: 0.2700 µF	Co: 0.6400 µF
Inductance	Li: 0.0000 mH	Lc2: 2 x 0.4920 mH/km => 0.4920 mH	Lc1: 2 x 0.4920 mH/km => 2.4600 mH	Lct: 2.9520 mH	Lo: 3.0 mH
L/R		Lc2/Rc2: 0.040 mH/Ω	Lc1/Rc1: 0.040 mH/Ω	Lct/Rct:	
Resistance	Ri: Ω	Rc2: 2 x 12.30 Ω/km => 12.30 Ω	Rc1: 2 x 12.30 Ω/km => 61.500 Ω	Rct: 73.800 Ω	Ro: 0 Ω

Cable Calculations:
Leq = (Cable mH/km x 2 x Cable Length in m /1000) + Field Instrument mH
Ceq = (Cable µF/km x Cable Length in m /1000) + Field Instrument µF

Verification Checks			Verification Calculations					Final calculation result	
Plant Zone Process	≥	Inst. Zone Process	0	>	0			OK	VERIFIED
Plant Zone Elect.	≥	Inst. Zone Elect.	1	>	1			OK	
Plant Gas Group	≤	Inst. Gas Group	IIB	≤	IIC			OK	
Plant Temp Class	≤	Inst. Temp Class	T4	≤	T6			OK	
Uo	≤	Ui	14.6	V	≤	16.7	V	OK	
Io	≤	Ii	97	mA	≤	150	mA	OK	
Po	≤	Pi	0.633	W	≤	1.00	W	OK	
Co	≥	(Ci+Cct) Ceq	0.6400	µF	≥	0.27000	µF	OK	
Lo	≥	(Li+Lct) Leq	3.0	mH	≥	2.95200	mH	OK	
Lo/Ro	≥	Lct/Rct	THIS VERIFICATION IS NOT NECESSARY AS THE OTHER RELATIONSHIPS (CAPACITANCE, INDUCTANCE AND RESISTANCE) ARE VERIFIED					OK	

INTRINSICALLY SAFE CIRCUIT CALCULATION

E & H LIQUIPHANT FTL 51 WITH FEL 57 INSERT AND FTL 325P NIVOTESTER

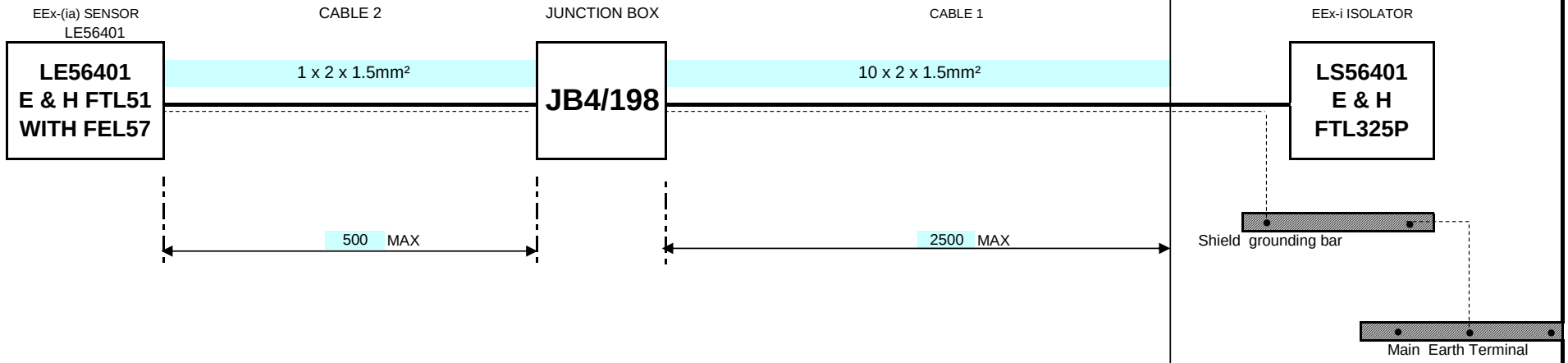
Customer:	Simon Storage					
Plant:	Immingham East	A	DBF	MM	MM	09.04.14
Project :	SI483	Rev	BY	Check	App	Date
Calculation N° :	SI483002_CAL		Sheet : 1	of	1	

Loop Sheet No.

SI483022_DWG

HAZARDOUS AREA | **SAFE AREA**

Zone		Gas Group	Temperature Class
0	1	IIB	T4
Process	Electronics		



	Cable 2	Cable 1	Cable 1 + Cable 2	
Supply by	P&I Design			P&I Design
Specification	SI483002_SPC	BS5308 Part 1 Type 2	BS5308 Part 1 Type 2	SI483002_SPC
Manufacturer	Endress+Hauser			Endress+Hauser
Model	FTL51 with FEL57 Insert			FTL 325P
Description	Vibronics Level Sensor	Single twisted pair - SWA armoured	Multiple twisted pairs - SWA armoured	3 ch Nivotester
Certification	Ex II 1 2 G EEx ia IIC T6			Ex II (1) G D [EEx ia] IIC T6
Certificate No.	KEMA 99 ATEX 0523			DMT 01 ATEX E 052
Voltage	Ui: 16.7 V			Uo: 14.6 V
I current	Ii: 150 mA			Io: 97 mA
Power	Pi: 1.00 W			Po: 0.633 W
Capacitance	Ci: 0.0000 µF	Cc2: 0.115 µF/km => 0.0575 µF	Cc1: 0.085 µF/km => 0.2125 µF	Cct: 0.2700 µF	Co: 0.6400 µF
Inductance	Li: 0.0000 mH	Lc2: 2 x 0.4920 mH/km => 0.4920 mH	Lc1: 2 x 0.4920 mH/km => 2.4600 mH	Lct: 2.9520 mH	Lo: 3.0 mH
L/R		Lc2/Rc2: 0.040 mH/Ω	Lc1/Rc1: 0.040 mH/Ω	Lct/Rct:	
Resistance	Ri: Ω	Rc2: 2 x 12.30 Ω/km => 12.30 Ω	Rc1: 2 x 12.30 Ω/km => 61.500 Ω	Rct: 73.800 Ω	Ro: 0 Ω

Cable Calculations:
Leq = (Cable mH/km x 2 x Cable Length in m /1000) + Field Instrument mH
Ceq = (Cable µF/km x Cable Length in m /1000) + Field Instrument µF

Verification Checks			Verification Calculations					Final calculation result
Plant Zone Process	≥	Inst. Zone Process	0	>	0			OK
Plant Zone Elect.	≥	Inst. Zone Elect.	1	>	1			OK
Plant Gas Group	≤	Inst. Gas Group	IIB	≤	IIC			OK
Plant Temp Class	≤	Inst. Temp Class	T4	≤	T6			OK
Uo	≤	Ui	14.6 V	≤	16.7 V			OK
Io	≤	Ii	97 mA	≤	150 mA			OK
Po	≤	Pi	0.633 W	≤	1.00 W			OK
Co	≥	(Ci+Cct) Ceq	0.6400 µF	≥	0.27000 µF			OK
Lo	≥	(Li+Lct) Leq	3.0 mH	≥	2.95200 mH			OK
Lo/Ro	≥	Lct/Rct	THIS VERIFICATION IS NOT NECESSARY AS THE OTHER RELATIONSHIPS (CAPACITANCE, INDUCTANCE AND RESISTANCE) ARE VERIFIED					OK

VERIFIED

INTRINSICALLY SAFE CIRCUIT CALCULATION

E & H LIQUIPHANT FTL 51 WITH FEL 57 INSERT AND FTL 325P NIVOTESTER

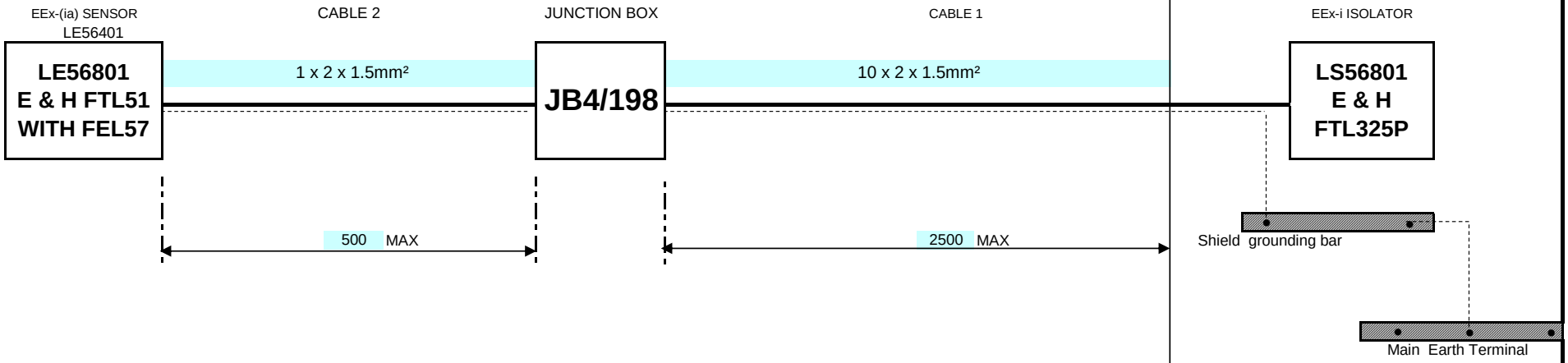
Customer:	Simon Storage					
Plant:	Immingham East	A	DBF	MM	MM	09.04.14
Project :	SI483	Rev	BY	Check	App	Date
Calculation N° :	SI483003_CAL		Sheet : 1	of	1	

Loop Sheet No.

SI483024_DWG

HAZARDOUS AREA | **SAFE AREA**

Zone		Gas Group	Temperature Class
0	1	IIB	T4
Process	Electronics		



	Cable 2	Cable 1	Cable 1 + Cable 2	
Supply by	P&I Design			P&I Design
Specification	SI483003_SPC	BS5308 Part 1 Type 2	BS5308 Part 1 Type 2	SI483003_SPC
Manufacturer	Endress+Hauser			Endress+Hauser
Model	FTL51 with FEL57 Insert			FTL 325P
Description	Vibronics Level Sensor	Single twisted pair - SWA armoured	Multiple twisted pairs - SWA armoured	3 ch Nivotester
Certification	Ex II 1 2 G EEx ia IIC T6			Ex II (1) G D [EEx ia] IIC T6
Certificate No.	KEMA 99 ATEX 0523			DMT 01 ATEX E 052
Voltage	Ui: 16.7 V			Uo: 14.6 V
I current	Ii: 150 mA			Io: 97 mA
Power	Pi: 1.00 W			Po: 0.633 W
Capacitance	Ci: 0.0000 µF	Cc2: 0.115 µF/km => 0.0575 µF	Cc1: 0.085 µF/km => 0.2125 µF	Cct: 0.2700 µF	Co: 0.6400 µF
Inductance	Li: 0.0000 mH	Lc2: 2 x 0.4920 mH/km => 0.4920 mH	Lc1: 2 x 0.4920 mH/km => 2.4600 mH	Lct: 2.9520 mH	Lo: 3.0 mH
L/R		Lc2/Rc2: 0.040 mH/Ω	Lc1/Rc1: 0.040 mH/Ω	Lct/Rct:	
Resistance	Ri: Ω	Rc2: 2 x 12.30 Ω/km => 12.30 Ω	Rc1: 2 x 12.30 Ω/km => 61.500 Ω	Rct: 73.800 Ω	Ro: 0 Ω

Cable Calculations:
Leq = (Cable mH/km x 2 x Cable Length in m /1000) + Field Instrument mH
Ceq = (Cable µF/km x Cable Length in m /1000) + Field Instrument µF

Verification Checks			Verification Calculations					Final calculation result	
Plant Zone Process	≥	Inst. Zone Process	0	>	0			OK	VERIFIED
Plant Zone Elect.	≥	Inst. Zone Elect.	1	>	1			OK	
Plant Gas Group	≤	Inst. Gas Group	IIB	≤	IIC			OK	
Plant Temp Class	≤	Inst. Temp Class	T4	≤	T6			OK	
Uo	≤	Ui	14.6	V	≤	16.7	V	OK	
Io	≤	Ii	97	mA	≤	150	mA	OK	
Po	≤	Pi	0.633	W	≤	1.00	W	OK	
Co	≥	(Ci+Cct) Ceq	0.6400	µF	≥	0.27000	µF	OK	
Lo	≥	(Li+Lct) Leq	3.0	mH	≥	2.95200	mH	OK	
Lo/Ro	≥	Lct/Rct	THIS VERIFICATION IS NOT NECESSARY AS THE OTHER RELATIONSHIPS (CAPACITANCE, INDUCTANCE AND RESISTANCE) ARE VERIFIED					OK	